COMMENT

OPERATING BLINDLY?: RECALIBRATING *LIGHTNING V. ANADARKO*'S IMPACT ON THE USE OF MWD/LWD IN OFF-LEASE DRILLING*

ABSTRACT

As the old adage goes: "Lightning never strikes the same place twice." However, it remains to be seen whether this will hold true regarding the Texas Supreme Court's decision in *Lightning v. Anadarko*. In its opinion, the Court *expressly* held that off-lease wells that traverse but do not produce from an unpermitting operator's mineral estate do not constitute trespass, and, without addressing existing geophysical trespass case law, *implicitly* held that use of measurement-while-drilling and logging-while-drilling technology during the drilling of off-lease wells does not constitute geophysical trespass. However, a closer look at geophysical trespass case law reveals that this implicit holding may not be accurate and may need modification by Texas courts. Consequently, *Lightning* may strike again if cited favorably by an off-lease mineral lessee seeking to use measurement-while-drilling or logging-while-drilling tools during the drilling of an off-lease well through another mineral lessee's mineral estate.

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TABLE OF CONTENTS

I. INTRODUCTION

Though well logs and seismic data both contribute useful information about the subsurface, it is unclear whether current geophysical trespass case law applies to these methods of exploration under the right to explore usually granted to mineral lessees.[1] A recent Texas Supreme Court case, decided on May 19, 2017, has muddied the geophysical trespass waters.[2] The court's decision considered existing case law regarding off-lease wells drilled through another operator's mineral estate and determined that off-lease wells that traverse but do not produce from the unpermitting operator's mineral estate do not constitute trespass.[3] The decision is problematic because it appears to issue blanket approval

1. *See infra* Section III.B (discussing well logs and seismic data and the impact of *Lightning* on both methods).

2. Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39 (Tex. 2017).

3. *See infra* Section II.B (discussing the Texas Supreme Court's holding in *Lightning*).

for off-lease drilling without considering whether the off-lease driller's effort to log the mineral estate with logging-while-drilling technology (LWD) constitutes geophysical trespass.[4] The court's failure to address the issue of geophysical trespass in its holding may lead off-lease drillers to cite the decision for the implicit proposition that the use of LWD while drilling an off-lease well does not constitute geophysical trespass.[5]

The resulting ambiguity regarding the application of geophysical trespass case law to measurement-while-drilling technology (MWD) and LWD is significant because of the technology's importance to horizontal drilling operations; if a later Texas Supreme Court decision clarifies that geophysical trespass case law does apply, the viability of off-lease drilling may be significantly impacted. In fact, some commentators have remarked that drilling a horizontal well without the aid of MWD/LWD is akin to "drilling blind[ly]."[6] This Comment attempts to determine whether geophysical trespass case law should apply to MWD/LWD, and if so, whether the Texas Supreme Court will update Texas geophysical trespass precedent to comport with horizontal drilling practices by affirming its implicit holding in *Lightning*.[7]

This Comment discusses how the Court's implicit holding in *Lightning*, i.e., that MWD/LWD used in an off-lease wellbore does not constitute geophysical trespass, breaks with existing Texas geophysical trespass case law. Part II of this Comment issues a detailed recitation of *Lightning v. Anadarko*. Part III surveys Texas's current geophysical trespass case law and provides an overview of seismic surveying, LWD, and MWD. Part IV proposes a hypothetical based on the *Lightning v. Anadarko* fact pattern. Part V compares seismic surveys with MWD/LWD and applies current geophysical trespass case law to the facts of *Lightning v. Anadarko* by way of analogy. Part VI concludes this Comment by asserting that geophysical trespass cases should apply to the use of MWD/LWD tools while drilling a nonproducing horizontal wellbore through a neighboring mineral estate, with the caveat that the Texas Supreme Court may rule differently given the strong policy support

4. *See infra* Part III (addressing the Texas Supreme Court's failure to address geophysical trespass case law); Section III.B (explaining MWD/LWD).

5. *See infra* Section III.B (discussing possible implications of the Texas Supreme Court's decision in *Lightning*).

6. JACQUELINE L. WEAVER & BRET WELLS, TEXAS OIL AND GAS LAW at 4-39 (2017).

7. *See* Bret Wells, *The Dominant Mineral Estate in the Horizontal Well Context: Time to Extend* Moser *Horizontally*, 53 HOUS. L. REV. 193, 224 (2015) ("Texas courts have recognized that foundational oil and gas common law may need to be reformulated to accommodate modern notions of horizontal drilling and hydraulic fracturing practices.").

for its holding in *Lightning v. Anadarko*.

II. CASE RECITATION

Anadarko E&P Onshore, LLC (Anadarko) leased minerals underlying the Chaparral Wildlife Management Area (CWMA) from the State of Texas on January 28, 2010 (CWMA Lease).[8] The CWMA Lease restricted Anadarko's use of the surface, stipulating that "[d]rilling locations will be established off the Chaparral [Wildlife Management Area (WMA)] site, when prudent and feasible."[9] Subsequently, Anadarko entered into a surface use agreement with the owner of a neighboring surface estate, the Briscoe Ranch, with a three-year primary term beginning on December 1, 2013.[10] The surface use agreement authorized Anadarko to drill directionally or horizontally from the Ranch's surface through its subsurface to access Anadarko's minerals underneath the adjacent CWMA Lease.[11]

The mineral estate underlying the Briscoe Ranch was severed from the surface and belonged to the Hurd family, which had leased the minerals to Lightning Oil on October 19, 2009 (Cutlass Lease).[12] Anadarko planned to drill through Lightning's mineral estate in order to access its own minerals but did not obtain permission from Lightning Oil.[13] When Lightning discovered Anadarko's plans to drill wells through its mineral estate, Lightning objected to Anadarko's first proposed well location and made it clear that it would not approve any other locations that Anadarko

8. The lease attached to Anadarko's brief on the merits did not indicate when Anadarko took over the lease, only that the lease was originally entered into by Chesapeake Exploration, L.L.C. on January 28, 2010; both parties, however, acknowledged Anadarko as the current lessee under the CWMA lease. Petitioner's Brief on the Merits at 2, Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39 (Tex. 2017) (No. 15-0910); Respondent's Brief on the Merits at 2, Tab 3, *Lightning Oil*, 520 S.W.3d 39 (No. 15-0910).

9. Respondent's Brief on the Merits, *supra* note 8, Tab 3. The CWMA lease did allow the drilling of wells on the surface of the WMA but required approval by the land manager to avoid any disruption of WMA operations. *Id.*

10. *Id.* Tab 2.

11. *Id.* The lease authorized production from the lands underlying Anadarko's CWMA lease only, not production from the lands underlying the Briscoe Ranch. *Id.*

12. Petitioner's Brief on the Merits, *supra* note 8, app. D, at 1. Lightning Oil executed an amended lease on April 1, 2013, which replaced its 2009 lease. *Id*. This amended lease granted Lightning Oil the "right of exploring for, developing, operating, producing, owning, marketing, treating and transporting oil and gas." *Id*.

13. *See* Lightning Oil Co. v. Anadarko E&P Onshore LLC, 480 S.W.3d 628, 630–31 (Tex. App.—San Antonio 2015), *aff'd*, 520 S.W.3d 39 (Tex. 2017) (noting Anadarko only received permission to drill under the Briscoe Ranch from Briscoe Ranch, the surface estate owner).

might propose.[14] Shortly thereafter on January 21, 2014, Lightning filed suit against Anadarko, alleging trespass and tortious interference with contract and seeking injunctive relief to prevent Anadarko from siting any wells on the surface overlying the Cutlass Lease.[15] After Lightning filed suit, Anadarko formalized its agreement with the Briscoe Ranch in its "Surface Use and Subsurface Easement Agreement" (Agreement).[16]

A. Procedural History

Lightning sued Anadarko for trespass to its mineral estate and tortious interference with contract for interfering with its mineral lease.[17] Lightning also sought a temporary restraining order and an injunction preventing Anadarko from drilling on the Briscoe Ranch.[18] Lightning and Anadarko each filed traditional and no-evidence motions seeking partial summary judgment.[19] Lightning moved for traditional summary judgment on its request for injunctive relief and its request "for the court to declare that Briscoe Ranch could not 'grant Anadarko a right to trespass through Lightning's property.'"[20] In its no-evidence motion for summary judgment, Lightning asserted that Anadarko did not have any evidence to support its affirmative defense of justification against Lightning's claims of tortious interference with contract.[21] Anadarko moved for traditional summary judgment, asserting that it had proven justification as an affirmative defense to Lightning's claims of trespass and tortious interference.[22] Anadarko also moved for no-evidence summary judgment, asserting that Lightning did not have evidence of at least one element of each of its claims for trespass and tortious interference.[23] The trial court granted Anadarko's motion for partial summary judgment

14. *Lightning Oil*, 520 S.W.3d at 43.

15. *Lightning Oil*, 480 S.W.3d at 631; Petitioner's Brief on the Merits, *supra* note 8, at 3.

16. *Lightning Oil*, 520 S.W.3d at 43–44 (noting that Anadarko formalized its agreement with the Briscoe Ranch after Lightning filed suit). Though Anadarko had already reached an agreement with the Briscoe Ranch, it executed a formal agreement on February 15, 2014, backdating it so that the three-year primary term began on December 1, 2013. Respondent's Brief on the Merits, *supra* note 8, Tab 2.

17. *Lightning Oil*, 520 S.W.3d at 43.

18. *Id.*

19. *Id.* at 44.

20. *Lightning Oil*, 480 S.W.3d at 632.

21. *Lightning Oil*, 520 S.W.3d at 44. Lightning failed to move expressly for traditional summary judgment on its tortious interference claim. *Lightning Oil*, 480 S.W.3d at 632.

22. *Lightning Oil*, 480 S.W.3d at 631.

23. *Id.*

and denied Lightning's motions without stating the reasons for its rulings.[24] The trial court severed the rulings so that they could be appealed, and Lightning appealed.[25]

The Texas Fourth Court of Appeals subsequently affirmed for Anadarko on both grounds for partial summary judgment.[26] The court affirmed the trial court's grant of partial summary judgment regarding Lightning's trespass claim on the basis of no-evidence, holding that Lightning had no right to exclude the surface owner from use of the subsurface structures beneath its surface estate because such structures, excluding the hydrocarbon molecules within, belong to the surface estate.[27] Accordingly, the court of appeals held that Lightning had not proven any right to exclude Anadarko from its estate and had failed to provide any evidence of an essential element of trespass.[28] Additionally, the court of appeals affirmed the trial court's grant of partial summary judgment against Lightning's tortious interference claim on the basis of traditional summary judgment, holding that Anadarko had proven justification as an affirmative defense to Lightning's tortious interference claims because Briscoe Ranch controlled the subsurface structures underlying its surface estate and granted Anadarko the legal right to drill through the subsurface in its Agreement.[29] Consequently, Lightning petitioned for review.[30] The Texas Supreme Court granted the petition and unanimously affirmed the Fourth Court of Appeals.[31]

B. The Texas Supreme Court's Reasoning

The opinion begins by analyzing Lightning's trespass claim.[32] The Court noted that Lightning's claim, as a mineral lessee, to the right to exclude a surface owner or an adjacent lessee from drilling through its mineral estate—despite their having no intent to produce hydrocarbons from Lightning's estate—was an issue of first impression unresolved by divergent case law.[33] In analyzing the

24. *Lightning Oil*, 520 S.W.3d at 44.

25. *Lightning Oil*, 480 S.W.3d at 632.

26. *Id*. at 638.

27. *Id.* at 635–36.

28. *Id.* at 636.

29. *Id.* at 637–38.

30. Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 44 (Tex. 2017).

31. *Id.* at 43.

32. *Id.* at 46–47. This Comment will only discuss Lightning's trespass claim, not its tortious interference claim.

33. *Id.* at 46; *see* Chevron Oil Co. v. Howell, 407 S.W.2d 525, 526–28 (Tex. App.—Dallas 1966, writ ref'd n.r.e.) (enjoining drilling operation without requiring showing of

Fourth Court of Appeals' reasoning, the Court agreed with the court of appeals' assessment of the "subsurface control cases"[34]— i.e., the Court agreed that the surface estate includes the "geological structures beneath the surface"—but was careful to distinguish these cases because they did not address the situation in which a surface owner was allowed to drill through portions of the mineral estate containing geological structures in which hydrocarbons were "embedded."[35] Because Anadarko's proposed well sites would result in the removal of portions of Lightning's mineral estate that were "embedded" with hydrocarbons, the Court explained that the subsurface control cases were not dispositive in determining whether Anadarko committed a trespass, stating that further analysis of the mineral interests at issue was necessary.[36] In its analysis of Lightning's mineral interests, the Court considered Lightning's right to develop and the extent to which Anadarko's drilling operations could result in extraction of Lightning's hydrocarbons.[37]

1. Lightning's Right to Develop. The Court explained that generally only oil and gas lessees are granted the right to develop under a lease.[38] As the holder of a valuable property right to the mineral estate, Lightning may have a cause of action for trespass when an "unauthorized interference with physical property [occurs] . . . [or when] an unauthorized interference with one of the rights the property owner holds [occurs]."[39] Because Lightning is entitled only to the "rights to explore, obtain, produce, and possess the minerals subject to the lease," and not the right to possess the portion of the earth where the minerals are located, a trespass is

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damages because permission from surface owner, but without permission from the surface lessee or mineral estate, was insufficient); Humble Oil & Ref. Co. v. L. & G. Oil Co., 259 S.W.2d 933, 934, 938 (Tex. App.—Austin 1953, writ ref'd n.r.e.) (allowing surface owners to drill through unpermitting mineral estate because objecting mineral estate's statement that it may want to drill at the surface locations was insufficient to show an unreasonable interference with its ability to develop the minerals).

34. *Lightning Oil*, 520 S.W.3d at 47. In using this term, the Court refers to a trio of cases the Fourth Court of Appeals analyzed and relied upon in reaching its holding: Dunn-McCampbell Royalty Interest, Inc. v. Nat'l Park Serv., 630 F.3d 431 (5th Cir. 2011), Humble Oil & Ref. Co. v. West, 508 S.W.2d 812 (Tex. 1974), and Springer Ranch, Ltd. v. Jones, 421 S.W.3d 273 (Tex. App.—San Antonio 2013, no pet.). *Lightning Oil*, 480 S.W.3d at 635–36.

35. *Lightning Oil*, 520 S.W.3d at 46–47 (emphasis omitted).

36. *Id.* at 47–48.

37. *Id.* at 48–50.

38. *Id.* at 49. The Court rejected Lightning's argument that the language of the mineral deed granted the Hurds an exclusive right to lease and vested in Lightning an absolute right to exclude Anadarko from its mineral estate. *Id.* at 52–53. Accordingly, the Court analyzed Lightning's rights as a leaseholder. *Id.*

39. *Id.* at 49.

committed only when unauthorized interference with the place where the minerals are located interferes with Lightning's right to develop.[40] In addressing Lightning's trespass claim and request for injunctive relief, the Court explained that the accommodation doctrine governs, holding that an unauthorized interference did not occur because Lightning's ability to use the surface as reasonably necessary to develop its oil and gas resources was not unreasonably interfered with by the surface estate or an adjacent lessee.[41] Furthermore, the Court stated that Lightning was not entitled to injunctive relief on the basis of speculation but rather must show "that absent such relief, it will suffer imminent, irreparable harm."[42] The Court held that no trespass to Lightning's right to develop occurred because the right would be adequately protected by the accommodation doctrine and statewide spacing rules.[43]

2. Extraction of Lightning's Hydrocarbons. Though no trespass to the place where the minerals were located occurred because neither Anadarko nor the Briscoe Ranch interfered with Lightning's right to develop, the Court emphasized the possibility of a claim arising from unauthorized physical interference with the minerals themselves.[44] The Court acknowledged that the removal of "minerals embedded in the physical matter that will be drilled out of the ground" may be a trespass, but stated that such a determination should be made only after balancing the interests of Lightning with the collective interests of the oil and gas industry.[45] After comparing the *de minimis* amount of minerals that would potentially be displaced by Anadarko's wellbore to the benefits of a policy promoting off-lease drilling, the Court held that Anadarko's proposed wellbore was not a trespass.[46] In so holding, the Court cited a strong policy rationale supporting the maximization of oil and gas recovery and the prevention of waste.[47]

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40. *Id.*

41. *Id.* at 49–50.

42. *Id.* at 49.

43. *Id.* at 49–50. Lightning argued application of the accommodation doctrine would expand the doctrine because it would require mineral interest owners and lessees to accommodate the actions of an adjacent lessee and competitor. *Id.* at 52. However, the Court rejected this argument, stating that the doctrine was not expanded because the adjacent mineral lessee is not an additional party that must be accommodated and remains subservient to the mineral estate. *Id.*

44. *Id.* at 50.

45. *Id.*

46. *Id.* at 50–51.

47. *Id.* at 51 (discussing the benefits of off-lease drilling in preventing waste of any oil and gas resources and citing the Texas Constitution, statutes, and case law in support of "the longstanding policy of this state to encourage maximum recovery of minerals and to

III. ANALYSIS OF TEXAS SUBSURFACE TRESPASS JURISPRUDENCE UNADDRESSED BY THE COURT: GEOPHYSICAL TRESPASS

Although the Court addressed the issues of physical trespass by Anadarko's wellbore through Lightning's mineral estate and potential interference with Lightning's right to develop, the Court failed to address the issue of geophysical trespass via Anadarko's potential use of MWD/LWD tools while drilling through Lightning's mineral estate.[48] Though the Court acknowledged "a trespass is not just an unauthorized interference with physical property, but also is an unauthorized interference with one of the rights the property owner holds," the Court's analysis focused on potential interference with Lightning's *right to develop* without discussing potential interference with Lightning's *right to explore*.[49] Instead, the Court's discussion of the right to develop emphasized the potential for interference with Lightning's ability to utilize the surface and subsurface to produce its own minerals and actual extraction of a small amount of Lightning's minerals.[50]

Though the Court did not address the right to explore and its corresponding body of geophysical trespass case law, both Lightning Oil and Anadarko briefed the issue on appeal to the Fourth Court of Appeals.[51] Lightning argued that it would suffer the loss of proprietary information because Anadarko would be able to obtain information about the mineral estate through its well logs.[52] Lightning contended that this would enable Anadarko to calculate

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minimize waste").

48. *Compare id.* at 46–53, *with* Lightning Oil Co. v. Anadarko E&P Onshore LLC, 480 S.W.3d 628, 632–34 (Tex. App.—San Antonio 2015), *aff'd*, 520 S.W.3d 39 (Tex. 2017) (discussing application of *Villarreal v. Grant Geophysical, Inc.*, 136 S.W.3d 265 (Tex. App.—San Antonio 2004, pet. denied) and other geophysical trespass cases). This Comment will not discuss the Texas Supreme Court's holdings regarding the accommodation doctrine or ownership of subsurface structures, but instead will focus on issues related to geophysical trespass.

49. *Lightning Oil*, 520 S.W.3d at 49. However, the Court did acknowledge that the right to explore is part of the right to develop typically granted in oil and gas leases. *See id.* ("[T]he rights conveyed by a mineral lease generally encompass the rights to explore, obtain, produce, and possess the minerals subject to the lease; they do not include the right to possess the specific place or space where the minerals are located.").

50. *Id.* at 49–51.

51. *Compare* Appellant's Brief at 10–11, 18, 34–35, Lightning Oil, 480 S.W.3d 628 (NO. 04-14-00903-CV), *aff'd*, 520 S.W.3d 39 (Tex. 2017) (discussing impact of well log data and geophysical trespass cases), *with* Appellee's Brief at 16–17, 41–44, *Lightning Oil*, 480 S.W.3d 628 (NO. 04-14-00903-CV) (countering Lightning's arguments, arguing that geophysical trespass cases do not apply to Anadarko's use of log data).

52. Appellant's Brief, *supra* note 51, at 10–11.

the hydrocarbon content of the formations within Lightning's mineral estate.[53] Additionally, because Anadarko is required by the Texas Railroad Commission to disclose its well log information after drilling, this proprietary information would be made public.[54] Anadarko countered that Lightning would suffer no real loss of valuable information because Anadarko would only run minimal logs while drilling.[55] Anadarko stated it planned to run only a basic gamma ray log and mud gas detection to avoid perforating its well near Lightning's mineral estate and ensure that it could drill its laterals safely.[56] Additionally, Anadarko proposed to limit the amount of information recorded by only running its gamma ray log from a depth of 7000 feet to Total Depth.[57] The Fourth Court of Appeals held for Anadarko, stating that no geophysical trespass had taken place because Anadarko had not conducted any seismic surveys of Lightning's mineral estate.[58]

As argued later in this Comment, the Fourth Court of Appeals inappropriately limited application of the geophysical trespass cases to their facts.[59] However, Lightning's allegation of geophysical trespass was not discussed any further because Lightning did not brief the issue on appeal to the Texas Supreme Court.[60] Though it is unclear why Lightning decided not to brief its allegation of geophysical trespass, its decision not to brief may have caused the Texas Supreme Court to avoid discussing the implications of its opinion for geophysical trespass because the issue was not before the court. However, given the sweeping policy justifications the Court cited in holding that Anadarko's off-lease drilling arrangement were nontrespassory, the court should have at least issued its opinion with the caveat that, while the physical act of drilling a nonproducing horizontal wellbore through a neighboring mineral estate may not constitute a trespass, the use of

53. *Id.*

54. *Id.* at 10. *See* 16 TEX. ADMIN. CODE § 3.16 (requiring oil and gas operators to file an electric well log within ninety days of well completion, with an option to delay filing and maintain confidentiality for a period of three to five years after well completion).

55. Appellee's Brief, *supra* note 51, at 16–17.

56. *Id.*

57. *Id.* at 17*; see* HOWARD R. WILLIAMS & CHARLES J. MEYERS, MANUAL OF OIL AND GAS TERMS 1167 (Patrick H. Martin & Bruce M. Kramer eds., 17th ed. 2018) (defining "Total Depth" as "[t]he greatest depth reached by a well bore").

58. Lightning Oil Co. v. Anadarko E&P Onshore LLC, 480 S.W.3d 628, 634 (Tex. App.—San Antonio 2015), *aff'd*, 520 S.W.3d 39 (Tex. 2017).

59. *See infra* Section V.B. "Geophysical trespass cases" refers to the quartet of cases discussed in Section III.A. *See infra* note 66 and accompanying text.

60. *See* Petitioner's Brief on the Merits, *supra* note 8, at 11–42 (withholding discussion of geophysical trespass).

MWD/LWD while doing so may constitute a trespass.[61]

A. Survey of Geophysical Trespass Jurisprudence

Geophysical trespass is not a separate cause of action from trespass; rather, it is one of several types of claims for wrongful interference based on a theory of trespass and is commonly associated with oil field operations, such as fracking, geophysical testing, and waterflooding.[62] Geophysical trespass claims have typically been associated with seismic exploration in the oil and gas industry.[63] In Texas, the traditional cause of action for trespass consists of three elements: "(1) entry (2) onto the property of another (3) without the property owner's consent or authorization."[64] The Texas geophysical trespass cause of action is distinct from traditional trespass for two reasons: first, the trespass may take the form of an invasion of a mineral estate owner's right to explore and obtain geophysical information; second, claimants in Texas are allowed to waive the trespass and sue in assumpsit to recover the reasonable value of the use and occupation of their land.[65] Four cases have clarified the cause of action for geophysical trespass in Texas.[66] Accordingly, this Comment will focus on these four cases.

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61. *Lightning Oil*, 520 S.W.3d at 50–51 (holding minimal displacement of Lightning's actual minerals by a nonproducing wellbore to be *de minimis* in comparison to the "policy of this state to encourage maximum recovery of minerals and to minimize waste"); *see infra* Section III.B (discussing possible ramifications of Texas Supreme Court's holding in *Lightning*).

62. 1 ERNEST E. SMITH & JACQUELINE LANG WEAVER, TEXAS LAW OF OIL AND GAS § 7.2[C], at 7-11 to -12 (2d ed., 2018).

63. *See id.* at 7-26 (describing seismic exploration as "the most common method used to explore for oil and gas before drilling. Other methods include gravity, magnetic, electrical, and geochemical measurement techniques. These are collectively known as geophysical operations, but to date only seismic testing has been held to involve invasion or disturbance of the mineral estate.").

64. Envtl. Processing Sys., L.C. v. FPL Farming Ltd., 457 S.W.3d 414, 419 (Tex. 2015).

65. *See* Phillips Petroleum Co. v. Cowden (*Cowden I*), 241 F.2d 586, 590, 592 (5th Cir. 1957). The Fifth Circuit stated the right to explore was a valuable right that could be legally protected and held that an invasion of a landowner's right to explore and conduct geophysical surveys could be protected through a trespass in assumpsit claim. *Id.* This action differs from the traditional trespass action under which claimants may only recover nominal damages in the absence of proof of actual damages. *Compare id.* (overruling appellant's contention that appellee may recover only nominal damages when there is a lack of proof of actual damage to appellee's property), *with* TEXAS TORTS AND REMEDIES § 22.04[1][a], 22-17 n.1 (2018) (stating that claimants are entitled to only nominal damages in the absence of proof of actual damages).

66. Phillips Petroleum Co. v. Cowden (*Cowden II*), 256 F.2d 408 (5th Cir. 1958); *Cowden I*, 241 F.2d 586; Villarreal v. Grant Geophysical, Inc., 136 S.W.3d 265 (Tex. App.—San Antonio 2004, pet. denied); Kennedy v. Gen. Geophysical Co., 213 S.W.2d 707 (Tex.

1. Kennedy v. General Geophysical Co. In *Kennedy*, the Galveston Court of Civil of Appeals held that the defendant surveying company, General Geophysical Co. (Geophysical), did not commit a trespass by conducting seismic surveys on a public road adjoining plaintiff Kennedy's land.[67] Because Kennedy denied Geophysical permission to conduct seismic surveys on his land, Geophysical instead conducted its seismic survey on the public road adjoining Kennedy's land such that the receiving sets were directly under the neighboring property. On that configuration, the receiving sets would not obtain any geophysical information except for information obtained from the vertical path to and from the receiving sets on the neighboring property.[68] The court found no evidence of physical damage to Kennedy's property, no evidence that information was obtained from Kennedy's property, and no evidence that geophysical information or interpretations were delivered to the defendant's client, Skelly Oil Company.[69] Without more, such as proof of damages to Kennedy's land or proof that Geophysical directly entered Kennedy's land, the court held that vibrations emanating from a seismic survey on a neighboring property and traveling through Kennedy's subsurface were not enough to support a finding of trespass nor an award of actual and nominal damages.[70]

Though the plaintiff's trespass claim failed, the *Kennedy* court established that both direct physical entry without permission and the performance of a seismic survey are required to establish a trespass on a plaintiff's property.[71] Additionally, the *Kennedy* court established that, without direct physical entry on a plaintiff's property, a plaintiff must show actual physical damage to his land to establish a trespass because the mere presence of vibrations is insufficient.[72] The *Kennedy* court also found no liability for trespass by Geophysical due to any extrapolation of geologic information regarding the subsurface of Kennedy's lands, which was based on the assumption that the trends of subsurface information

App.—Galveston 1948, writ ref'd); *see also Villarreal*, 136 S.W. at 268 (acknowledging *Kennedy, Cowden I, and Cowden II* as the controlling cases for geophysical trespass issues); SMITH & WEAVER, *supra* note 62, at 7-27 (recognizing *Villarreal* as the only Texas appellate case to deal with trespass issues related to 3D seismic); Owen L. Anderson & John D. Pigott, *Seismic Technology and Law: Partners or Adversaries?*, 24 ENERGY & MIN. L. INST. 349, 349–54 (2004) (emphasizing the aforementioned cases).

67. *Kennedy*, 213 S.W.2d at 708–09, 711–13.

68. *Id.* at 708–09.

69. *Id.* at 709.

70. *Id.* at 711–13. However, the court did note the possibility of a cause of action grounded in nuisance. *Id.*

71. *Id.* at 709.

72. *Id.* at 709–12.

gathered on neighboring property would continue under Kennedy's property.[73] However, the court left open the important question of whether a plaintiff land owner whose land was not physically entered could successfully establish a trespass claim based on proof that the alleged trespasser "acquired information as to the sub-surface formation and the probable presence or absence of oil, gas, or other minerals in and under appellant's land."[74]

2. Cowden I *and* Cowden II. In *Cowden I*, the Fifth Circuit held defendants Phillips Petroleum Company and Geophysical Services, Inc. liable for trespass because Phillips hired Geophysical to conduct seismic surveys of the underlying mineral estate owned by the Cowden family, Plaintiff in the suit, without permission.[75] Though the defendants obtained permission to enter the surface from the surface estate holder, Paul Moss, the court held that the surface estate does not have the right to grant entry to the mineral estate for exploration purposes.[76] The court recognized that "the right to explore for oil and minerals is a valuable property right that can be legally protected" and that the right typically belongs to the mineral owner rather than the surface estate.[77] On the facts presented, the court stated Moss could have no interest in the right to explore because he had been granted only the right to use the surface by the original owners of the undivided estate.[78] Because the defendants invaded the Cowdens' right to explore, the court held that a trespass had taken place.[79]

Though this case involved a conflict between a surface owner

73. *Id.* at 709.

74. *Id.* at 710. The court emphasized in dicta that plaintiff Kennedy "wholly failed to sustain his burden of proof that the appellees, by the use of seismograph operations, obtained information regarding the sub-surface structure or the presence or absence of oil, gas or other minerals in or under appellant's land," leaving open a question whether a landowner whose land was not physically entered by a defendant surveyor could successfully prove a trespass based on the attainment of such information. *Id.* at 710–11. *See* Anderson & Pigott, *supra* note 66, at 385 ("Thus, the [*Kennedy*] court's dictum suggests that if valuable and useful information had been intentionally gathered from beneath the plaintiff's acreage, the plaintiff might have prevailed."); Harry L. Blomquist III, *Geophysical Trespass? The Guessing Game Created by the Awkward Combination of Outmoded Laws and Soaring Technology*, 48 BAYLOR L. REV. 21, 26 (1996) ("By qualifying its holding, the court inferentially left the door open for an actionable trespass on the mineral estate without physical entry, conditioned upon a showing that the trespasser has obtained valuable subsurface information under the subject property.").

75. *Cowden I*, 241 F.2d 586, 590–92 (5th Cir. 1957).

76. *Id.* at 588, 592.

77. *Id.* at 590.

78. *Id.* at 592. The court notes that even if Cowden had not owned the mineral estate, but was a lessee, Moss still would not hold the right to explore regardless of who holds the exclusive interest. *Id.* at 591–92.

79. *Id.* at 592.

and the original owners of the mineral estate, it is important to take notice of the court's acknowledgement that, on different facts, i.e., a conflict between a mineral lessor and its lessee as to who has the exclusive right to explore, the issue depends on the express language of the lease.[80] Furthermore, the court noted that, whether the lessee holds an exclusive or nonexclusive right to explore, the permission of a surface owner alone will not suffice to allow geophysical surveys of another's mineral estate.[81]

Though the court found a trespass had occurred, some uncertainty remained as to the appropriate measure of damages. The court recognized that the Cowdens could sue for trespass but not for conversion of geophysical information or the right to obtain such information, and thus the defendants argued the Cowdens could recover only nominal damages because the Cowdens were unable to prove a decrease in the market value of their property caused by the defendants' seismic exploration.[82] The court overruled this contention, holding "Texas belongs to the minority of states that permit a landowner to waive the trespass and sue in assumpsit for the reasonable value of the use and occupation."[83] When the issues of damages appeared before the Fifth Circuit again on appeal in *Cowden II*, the court instructed that reasonable value of the use and occupation of the land damaged must be shown by: (1) limiting the number of acres "to the area reasonably regarded as being 'occupied' by the seismograph survey"; (2) including the acres through which seismic vibrations actually traveled; and (3) including any "additional areas for which the trespasser would have had to obtain licenses from a hypothetically 'reasonable' mineral estate owner, if it had conducted the actual operation without trespassing."[84]

The *Cowden I* court established several important precedents for geophysical trespass cases: (1) like *Kennedy,* a physical entry on the surface estate overlying the mineral estate at issue is still required for a geophysical trespass; (2) an invasion of one of the valuable property rights held by the mineral estate, the right to

80. *Id.* at 591.

81. *Id.* at 590*; see* 8 HOWARD R. WILLIAMS & CHARLES J. MEYERS, OIL AND GAS LAW § 218.6, at 228.9 (Patrick H. Martin & Bruce M. Kramer eds., 2017) (observing *Cowden I* holds "that the right to explore . . . is either held by the lessee or mineral owner exclusively or is held jointly by such person and the surface owner, and hence one who conducted a geophysical survey with the consent of the surface owner was liable to the owner of mineral rights in such land for trespass").

82. *See Cowden I*, 241 F.2d at 592.

83. *Id.*

84. Phillips Petroleum Co. v. Cowden (*Cowden II*), 256 F.2d 408, 409 (5th Cir. 1958).

explore, can constitute an actionable trespass; and (3) the owner of the invaded right may waive trespass and sue in assumpsit for the reasonable market value of the exercise of that right.[85] More importantly for this Comment, the *Cowden I* court appears to leave some room for interpretation as to what constitutes an invasion of the right to explore. The court states clearly that the seismic surveys constituted geophysical trespass because they were tests conducted for the purpose of oil and gas exploration and "were reasonably expected to reveal geophysical and geological information" about the land.[86] However, the court also noted in preceding dicta that the rationale supporting a geophysical trespass was to avoid the loss of the speculative value of unexplored mineral rights belonging to the mineral estate by "reduc[ing] . . . the right to reduce to a certainty" and changing the value of the property.[87] As argued below, this emphasis on the loss of speculative value supports the application of geophysical trespass case law to the use of MWD/LWD in the horizontal drilling context.[88]

3. Villarreal v. Grant Geophysical, Inc. In *Villarreal*, the Fourth Court of Appeals held that defendant seismic surveying company, Grant Geophysical, committed no geophysical trespass even though its survey mistakenly obtained seismic information from plaintiff Villarreal's tract without permission.[89] Prior to conducting an extensive 3D seismic survey across three Texas counties, Grant Geophysical sought permission to survey from both surface estate and mineral estate holders in the targeted survey area.[90] Grant Geophysical was unable to obtain permission to survey 125 tracts, so it reconfigured its seismic survey to avoid trespass by ensuring that no receivers were placed on the surface estates of tracts not permitting the survey and deleted any information from unpermitted tracts that may have been incidentally obtained prior to distributing survey information to third party clients.[91]

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85. *Cowden I*, 241 F.2d at 590*; see also* Villarreal v. Grant Geophysical, Inc., 136 S.W.3d 265, 267 (Tex. App.—San Antonio 2004, pet. denied) (discussing physical entry requirement and assumpsit theory established in *Kennedy* and *Cowden I*); Kennedy v. Gen. Geophysical Co., 213 S.W.2d 707, 709, 711 (Tex. App.—Galveston 1948, writ ref'd).

86. *Cowden I*, 241 F.2d at 591.

87. *Id.* at 590.

88. *See infra* Section V.B.2 (discussing implication of *Cowden I* dicta).

89. *Villarreal*, 136 S.W.3d at 267, 268.

90. *Id.* at 267.

91. *Id.* at 267–68. Grant Geophysical admitted that placement of receivers on permitted tracts does not prevent the attainment of all unpermitted seismic data. *Id.* at 267. The company admitted some unpermitted data was obtained from the Villarreals' mineral es-

The court held no trespass occurred because Grant Geophysical never physically entered the surface estate above the Villarreals' mineral estates.[92] The court found the lack of physical entry to be dispositive as a matter of law, refusing to eliminate the physical entry requirement established by both the *Kennedy* and *Cowden I* courts.[93] Though the court recognized no trespass on the Villarreals' mineral estate, the court, in dicta, lamented how "it appears that Texas law regarding geophysical trespass has not kept pace with technology . . . ."[94] In keeping with this sentiment, the court emphasized the fact that Grant Geophysical actually did obtain information from the Villarreals' tracts.[95] However, in its refusal to overturn standing precedent requiring physical entry to demonstrate a valid geophysical trespass claim, the court may have relied on the fact that Grant Geophysical deleted all information obtained from unpermitted tracts and corrected its error after distributing some data from unpermitted tracts to clients.[96]

4. Summary of Geophysical Trespass Case Law. Looking forward, the preceding case law bears significance when considering whether geophysical trespass case law should apply when an operator uses MWD and LWD tools while drilling through an unpermitting mineral estate. As the *Villarreal* court established, geophysical trespass requires direct, physical entry on to the surface estate overlying the mineral estate. Additionally, where no actual damage to the allegedly trespassed property occurs because of seismic waves traveling through the land, the property owner must show the invasion of a valuable property right, i.e. the right to explore, in order to make a valid claim. In determining whether the right to explore has been invaded, it is important to consider whether the information obtained will lead to a loss in speculative value by revealing geophysical or geological information about the property. When the property owner does establish the invasion of

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tate and mistakenly distributed to clients. *Id.* at 268. However, Grant Geophysical requested the return of all unpermitted data from its clients and reissued the surveys. *Id.*

92. *Id.* at 270.

93. *Id.* at 268–70.

94. *Id.* at 270.

95. *Id.* at 267–68.

96. *Id.* at 268; *see* WEAVER & WELLS, *supra* note 6, at 4-8 to -10 (questioning whether the *Villarreal* court would have ruled the same way if Grant Geophysical had not "blacked out" information obtained from beneath the Villarreals' tract). *But see* Rick Strange, *Strange - Prudent Operators Should Be Wary of Gray Areas in Geophysical Trespass Laws*, MIDLAND REP.-TELEGRAM (May 15, 2004, 7:00 PM), http://www.mrt.com/news/article/Strange-Prudent-operators-should-be-wary-of-7831933.php [https://perma.cc/J792-88JQ] (asserting that the *Villarreal* court's decision did not turn on "the use or nonuse of the data").

his right to explore, he may waive the trespass and sue in assumpsit for the lost value of his right to explore. Finally, the attainment of information from unpermitting mineral estates, on which no physical entry of the surface estate has occurred, may not constitute geophysical trespass provided the surveyor deletes the data obtained from the unpermitting tract and does not distribute the information to third parties.

B. Overview and Comparison of Seismic Surveys to MWD/LWD

The Texas Supreme Court's failure to address whether the use of MWD and LWD tools while drilling through another's mineral estate constitutes geophysical trespass is significant because conflicting answers have been provided by various commentators and the issue has not been addressed by Texas courts. One viewpoint is that when there are no concerns of drainage at issue, geophysical surveys conducted on tract *A* for the purpose of developing oil and gas resources on tract *B* require only the permission of the surface owner of tract *A*, not the permission of the owner of the minerals underlying tract *A*.[97] Another viewpoint is that an operator should not obtain any subsurface information from a nonconsenting mineral lessee's estate because doing so would violate the nonconsenting mineral lessee's exclusive right to explore.[98] These

97. *See* WILLIAMS & MEYERS, *supra* note 81, § 218.6, at 230 ("Where drainage of oil and gas from Whiteacre or the prevention of drainage to Whiteacre will not be the consequence of the particular operation involved, consent of the surface owner alone should be sufficient, and joinder by owners of operating or nonoperating interests in minerals should not be required . . . .").

98. *See* James N. Cowden, *Surface-Subsurface Rights and Obligations Incidental to Exploration, Drilling and Production Operations*, *in* 5TH ANNUAL ADVANCED OIL, GAS AND MINERAL LAW COURSE N-1, N-26 (1987) (explaining if an operator runs well logs "from the bottom hole location to the surface and through that portion of the wellbore which penetrates the tract under which he has no mineral rights, he has obtained information which he has no right to obtain and will be liable in damages under the Phillips holding"); WEAVER & WELLS, *supra* note 6, at 4-39 ("Thus, if drilling is performed through the mineral estate of Tract A, Bigg Oil Company should not log the wellbore, take core samples, or otherwise obtain subsurface information underlying Tract A without the permission of Little Oil."); H. Philip Whitworth & D. Davin McGinnis, *Square Pegs, Round Holes: The Application and Evolution of Traditional Legal and Regulatory Concepts for Horizontal Wells*, 7 TEX. J. OIL GAS & ENERGY L. 177, 202 (2011) ("Because Lessee Y has the exclusive right to explore for oil and gas under Tract A, any subsurface information obtained by Lessee X in drilling through Tract A may be a violation of Lessee Y's rights. Lessee X should accordingly not log the wellbore, take core samples, or otherwise obtain subsurface information underlying Tract A without permission of Lessee Y." (citing *Cowden I*, 241 F.2d 586, 592–93 (5th Cir. 1957))); Christy M. Schweikhardt, Note, *Horizontal Perspective: Texas Oil & Gas Law in Light of Horizontal Drilling Technology*, 34 S. TEX. L. REV. 329, 353 (1993) (stating that running well logs through part of a wellbore "to which the operator has no mineral rights is a means of gaining information about the reservoir and will make the operator liable in damages. For this reason, an operator should not log any portion of a horizontal drainhole

conflicting views are the result of a lack of clarification by Texas courts regarding what forms of geological and geophysical operations constitute a violation of the right to explore.[99]

This lack of judicial clarification is illustrated by the Fourth Court of Appeals' decision to limit application of the geophysical trespass cases solely because Anadarko did not plan to conduct any seismic surveys without Lightning's consent.[100] As argued in this Comment, the Fourth Court of Appeals incorrectly limited application of the geophysical trespass cases due to strict interpretation of what constitutes geophysical operations and failed to further consider the effect of MWD/LWD on another's right to explore or the speculative value of another's mineral estate.[101] Furthermore, the Texas Supreme Court's failure to address the issue of geophysical trespass in its subsequent decision may foster more confusion. Specifically, other operators similarly situated to Anadarko may cite the court's decision as standing for the implicit proposition that the use of MWD/LWD does not constitute a geophysical trespass. Consequently, the Court may be required to walk back its decision or affirm its implicit holding with additional explanation. Because Texas courts have not yet clarified which methods of geological and geophysical exploration, other than seismic exploration, merit protection under the right to explore, I propose to do so in this Comment through a comparison of seismic exploration and MWD/LWD.

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to which the operator has no mineral rights").

99. *See* 1 EUGENE KUNTZ, A TREATISE ON THE LAW OF OIL AND GAS § 12.7, at 351 (1987) ("Under Texas law, it is recognized that the right to explore for minerals is a valuable property right which will be protected by law, and it has been assumed that the theory of recovery would be trespass, but the occasion has not arisen nor has a judicial effort been made to distinguish between the various types of geological and geophysical operations." (footnote omitted)). Kuntz notes, "[t]he nature of the method used is significant for substantive law purposes in determining the nature of the right invaded when such operations are carried on without consent of the landowner." *Id.* at 348. "Geological operations" are defined as "the making of surveys and the preparation of maps from information obtained from surface observations, from subsurface data derived from drilling operations, and from core drilling." *Id.* at 347. Kuntz points out that "such operation does not require a penetration of the subsurface strata of a particular tract nor does it involve a physical invasion of the mineral domain" except when data is taken from drilling on the tract. *Id.* "Geophysical operations" are defined as "the detection and measuring of the subsurface characteristics of a particular tract by securing direct information as to the subsurface structures" through a variety of methods including seismic, gravity, and geochemical. *Id.* at 347–48. Kuntz also notes seismic methods are the only geophysical methods requiring actual penetration of the mineral estate. *Id.* at 348.

100. *See* Lightning Oil Co. v. Anadarko E&P Onshore LLC, 480 S.W.3d 628, 634 (Tex. App.—San Antonio 2015), *aff'd*, 520 S.W.3d 39 (Tex. 2017) (refusing to apply *Villarreal* because Anadarko did not plan to conduct any seismic surveys (citing *Villarreal*, 136 S.W.3d at 268.))

101. *See infra* Part VI.

1. Seismic Exploration. As both the most widespread method of geophysical exploration in the oil and gas industry and the subject of the geophysical trespass cases, an overview of seismic exploration is necessary in order to understand what subsurface information MWD/LWD reveal by comparison.[102] Seismic methods of exploration consist of measuring "the rate of transmission of shock waves through the earth" by a seismograph.[103] Using reflection or refraction surveys, participants in the oil and gas industry can map the geological substructure underneath the surface and locate oil and gas reservoirs.[104] Though several different types of seismic surveys have been developed since the technology's conception in the early 1900s,[105] seismic information is still generally gathered by sending acoustic or compressive waves into the earth, either by drilling holes and detonating dynamite charges or by using an airgun or vibrator at the surface and measuring seismic energy reflected back to receivers placed at the surface.[106] The seismic reflections recorded by each receiver are generated by differences in certain physical characteristics, such as density and the speed of sound within a particular rock layer, present at the interface between different layers of rock.[107] The depth of a particular geological boundary is determined by the amount of time it takes the seismic reflection generated by that boundary to return to the receiver at the surface.[108] Seismic sections are then generated by lining up multiple seismic traces[109] side by side to create a "structural picture of the sub-surface" that can be interpreted by geophysicists.[110]

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102. Christopher S. Kulander & R. Jordan Shaw, *Comparing Subsurface Trespass Jurisprudence—Geophysical Surveying and Hydraulic Fracturing*, 46 N.M. L. REV. 67, 81 (2016).

103. WILLIAMS & MEYERS, *supra* note 57, at 442. A seismograph is a "device which records the vibrations of the earth." *Id.* at 955.

104. ENWENODE ONAJITE, SEISMIC DATA ANALYSIS TECHNIQUES IN HYDROCARBON EXPLORATION 17 (2014); Kulander & Shaw, *supra* note 102, at 80. Seismic reflection is the most commonly used method. *See id.* at 81.

105. ONAJITE, *supra* note 104, at 50–54; *see* O. Scott Petty, *Oil Exploration*, TEX. ST. HIST. ASS'N, https://tshaonline.org/handbook/online/articles/doo15 [https://perma.cc/UE4L-LUDH] (last modified Dec. 16, 2010) (stating that first seismic exploration method, seismic refraction, was invented in 1919).

106. ONAJITE, *supra* note 104, at 17, 38–40.

107. *Id.* at 39.

108. *Id.* at 17.

109. *Id.* at 43. A seismic trace consists of "data recorded from one 'shot point' at one receiver position." *Id.* at 41. A shot point is the location "at the surface of the Earth at which a seismic shot is activated." *Id.* at 36.

110. *Id.* at 43.

After acquisition of the data needed to create a seismic section, geophysicists must process the seismic data to "remove all noise and distortions introduced by the seismic acquisition method and produce a seismic section as close as possible to the subsurface image of the earth that can be interpreted . . . ."[111] Once the seismic data has been processed, geophysicists may choose one of two methods to interpret the resulting seismic section: conventional stratigraphy[112] or seismic stratigraphy.[113] Though seismic stratigraphy is more widely utilized, both methods allow for the direct detection of hydrocarbons and quantification of existing hydrocarbon reserves or confirmation that no hydrocarbon reserves exist.[114] Seismic surveys can be utilized to map geologic structures, stratigraphy, reservoir architecture, and subsurface lithology.[115] Additionally, seismic surveys allow direct detection and quantification of hydrocarbon reservoirs.[116]

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111. *Id.* at 72. Processing can include noise suppression, migration of seismic traces to the correct location in time and space, and static and dynamic velocity corrections. *See id.* at 71; Anderson & Pigott, *supra* note 66, at 302–07 (explaining the various methods used in seismic data processing). *See generally* ONAJITE, *supra* note 104, at 71–85 (providing an in-depth explanation of seismic data processing).

112. This interpretation method is also known as "wiggle picking" and relies on the mapping of seismic horizons by tracing patterns present in certain reflectors present in the seismic section. Anderson & Pigott, *supra* note 66, at 320–21. This allows the interpreter to map the substructure of particular geologic layers, fault lines, and calculate hydrocarbon volumes. *See* ONAJITE, *supra* note 104, at 198–207 (discussing use of conventional methods in picking fault lines and geologic boundaries).

113. Anderson & Pigott, *supra* note 66, at 320–21. This method of interpretation consists of correlating well log information from wells surrounding the area included in the seismic survey and tying the geological information from a particular well location, i.e. potential reservoir-bearing layers, to a particular time sequence in a seismic section. *See* ONAJITE, *supra* note 104, 185–89 (discussing use of well log data to compare and correlate with seismic sections to delineate hydrocarbon layers). *See generally* Anderson & Pigott, *supra* note 66, at 321–23 (detailing the seismic stratigraphy interpretation process and noting its use in "extracting the geology from a seismic line").

114. *See* Anderson & Pigott, *supra* note 66, at 321, 323. Seismic data that can be used for the direct detection of hydrocarbons are called "DHIs." *Id.* at 323. When correctly correlated to geological information from well logs, DHIs can be used to determine "reservoir properties [such] as porosity, pressure, fluid type, and fluid volume." *Id.* DHIs include bright spots, dim spots, flat spots, etc. ONAJITE, *supra* note 104, at 220. DHIs are often identified on seismic traces as a result of anomalous contrasts in "acoustic impedance (product of velocity and density) between rock layers" and amplitude between rock layers that are caused by the presence of hydrocarbons. *Id.* at 213, 218–19. *See generally id.* at 213–26 (explaining in greater detail the use of reflection coefficients and seismic amplitude to identify DHIs); Anderson & Pigott, *supra* note 66, at 323–24 (stating that the application of DHIs can be a powerful tool for 3D mapping).

115. *See* ONAJITE, *supra* note 104, at 178 ("The objective of seismic data interpretation is to extract all available subsurface information from the processed seismic data. This includes structure, stratigraphy, subsurface rock properties, velocity, stress and perhaps reservoir fluid changes in time and space.").

116. *See supra* note 114 and accompanying text.

2. MWD/LWD. The "basic gamma ray" log that Anadarko proposed to run while it drilled its horizontal well through Lightning's mineral estate represents one of several types of well logs that are frequently run during MWD/LWD.[117] Accordingly, an understanding of the type of information that MWD/LWD reveals about the subsurface is necessary to determine whether these technologies are comparable to seismic exploration and thus merit application of geophysical trespass case law.

i. MWD.[118] Measurement-while-drilling technology is used to transmit data about drilling conditions downhole and the directional path of the drill bit and allows industry operators to essentially "steer" the drill bit accurately in real time.[119] The tools which record the relevant measurements for both MWD and LWD are stacked within a drill collar above the drill bit according to order of priority of the different measurements.[120] The information recorded by MWD tools is then sent to the surface via mud-pulse telemetry for use by the drilling operator.[121] MWD tools included in the drill collar include: triaxial accelerometers, which measure the inclination of the well bore from vertical by measuring the bottom hole assembly's (BHA)[122] position relative to the Earth's gravitational field; triaxial magnetometers, which measure the BHA's position relative to the Earth's magnetic field to determine its azimuth[123] "with respect to magnetic north"; strain gauges, which measure weight and torque on the bit to determine if there is any

117. Appellee's Brief, *supra* note 51, at 17; *see also infra* Section III.B.2.b.

118. Measurement-while-drilling "is the evaluation of physical properties, usually including pressure, temperature, and wellbore trajectory in 3D space, while extending a wellbore." ROGER GRIFFITHS, WELL PLACEMENT FUNDAMENTALS 139 (2009).

119. *Id.* at 58–61; Katie Mazerov, *Minimizing Uncertainty: Geosteering Advances Keep Wellbores in Sweet Spot*, DRILLING CONTRACTOR (Mar. 21, 2011), http://www.drillingcontractor.org/minimizing-uncertainty-geosteering-advances-keep-wellbores-in-sweet-spot-8777 [https://perma.cc/T27B-D8J3] ("New technologies tell them how to steer the drill bit to stay in the target zone.").

120. *See* R. R. Hansen & J. White, *Features of Logging-While-Drilling (LWD) in Horizontal Wells* 1–2 (SPE/IADCC Drilling Conference, Paper No. 21989, 1991) (explaining how MWD and LWD tools can be rearranged on a drill string to give preference to directional information or to give preference to geological measurements when geological steering is more important).

121. *See* GRIFFITHS, *supra* note 118, at 164 ("Mud-pulse telemetry involves encoding data in pressure pulses that propagate up through the mud inside the drill pipe. These pressure-pulse sequences are detected at the surface and decoded to recreate the numerical value of the data from the downhole tools.").

122. The "BHA" is "[t]he lower end of a drill stem comprising the drill bit, the drill collar and the drill pipe." WILLIAMS & MEYERS, *supra* note 57, at 102.

123. *See* GRIFFITHS, *supra* note 118, at 146 ("Azimuth is the angle between the north reference and a horizontal projection of the current survey position.").

friction between the borehole wall and the drill string; and a temperature gauge.[124] Together with geological information provided by LWD, MWD tools provide necessary information about the direction, inclination, and depth of the drill bit which allow drillers to calculate the real time position of the drill bit when attempting to drill a horizontal well along a targeted well path.[125]

ii. LWD.[126] Traditionally, wireline logging, LWD's precursor, was performed immediately after a well was drilled to measure geological properties helpful in formation evaluation and correlation, such as lithology; permeability; porosity; water, oil, and gas saturation; and the vertical extent of a hydrocarbon-bearing zone.[127] These measurements, along with the volume of the reservoir calculated during seismic interpretation and well-to-well log correlation, can be used to calculate the total volume of hydrocarbons in place.[128] However, the introduction of improved LWD tools in the 1980s allowed similar measurements to be recorded in real time before drilling fluids invaded the wellbore and allowed logging in horizontal well bores where conventional wireline tools could not function.[129] Like MWD tools, these LWD tools are included within the drill collar, record information, and transmit it to the surface in real time.[130] Several different types of measurements can be recorded depending on which logging tools a driller

124. *Id.* at 58–61; OBERTO SERRA, WELL LOGGING HANDBOOK C 114–15 (2008).

125. *See* Hansen & White, *supra* note 120, at 1, 3 (discussing the use of directional measurements provided by MWD tools during well steering); Aimen Amer et al., *Structural Steering—A Path to Productivity*, OILFIELD REV., Spring 2013, at 14, 17–19 (explaining how directional information is incorporated in different well placement methods).

126. LWD is "the measurement of formation properties during the deepening of the borehole or shortly thereafter through the use of measurement tools integrated into the BHA." GRIFFITHS, *supra* note 118, at 190.

127. Mark A. Andersen, *Discovering the Secrets of the Earth*, OILFIELD REV., Spring 2011, at 59–60; *see also A Brief History of Everything MWD,* FRONTIER MWD SYS. (May 19, 2014), https://newtechmwd.squarespace.com/blog/2014/5/19/a-brief-history-of-everything-mwd ("Prior to the introduction of early MWD/LWD technology in the 1970s, wireline logging was the global standard for obtaining survey data."). Wireline logging consists of running a cable with a measuring tool downhole in either an open hole, which has not been cased, or a cased hole. SERRA, *supra* note 124, at C 108–10; *see also* Andersen, *supra*, at 127 ("Drillers typically stabilize formations by cementing casing in the well.").

128. GRIFFITHS, *supra* note 118, at 194; *see also* Andersen, *supra* note 127, at 59 ("Logging tools are calibrated to properly determine these and other quantities from the reservoir so companies can calculate accurate reserve values.").

129. *See* GRIFFITHS, *supra* note 118, at 192; *see also* Jennifer Market et al., *Logging-While-Drilling in Unconventional Shales*, Presented at SPE Annual Technical Conference and Exhibition 2 (Sept. 19–22, 2010) (on file with the Houston Law Review).

130. *See* Hansen & White, *supra* note 120, at 1–2 and accompanying text (discussing MWD/LWD location in BHA).

chooses to include in its logging suite, including (1) resistivity-conductivity logs, (2) nuclear logs, and (3) nuclear magnetic resonance logs (NMR).[131]

a. Resistivity-Conductivity Logs. In their most basic forms, resistivity-conductivity[132] logs use an electrode to send an electrical current into the formation, and a receiver electrode to measure the response of the formations along the wellbore to this current.[133] Geologists can use measurements obtained from resistivity and conductivity logs to: detect reservoirs; determine what types of fluids are present (i.e., water, oil, or gas); and correlate between wells to determine geological structures, lithology, bed thickness, and the dips of beds.[134] One of the most important uses of conductivity-resistivity tools is to determine changes in fluids, such as an oil/water contact, because this information can provide "[k]nowledge of the relative depth from the top of a reservoir to the oil/water contact" necessary to calculate the amount of hydrocarbon reserves in place.[135]

b. Nuclear Logs. An atomic nucleus can be excited to energy levels above its ground state and, if so, re-emits this additional energy as gamma rays.[136] Several different nuclear logs can be used to identify elemental composition according to each element's unique energy of excitation.[137] These include natural radioactivity logs and logs of radiation induced by neutron bombardment.[138]

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131. *See id.* at 2; SERRA, *supra* note 124, at D 145, F 243, I 407. This survey of logging techniques is intended to be illustrative, not exhaustive, and will highlight gamma ray techniques because Anadarko suggested it would only use a basic gamma ray log. *See generally id.* at D 145–M 566 (discussing various well logging techniques in greater depth); GRIFFITHS, *supra* note 118, at 202–313 (discussing the same).

132. "The electrical resistivity of a material is its ability to impede the flow of electrical current through it." SERRA, *supra* note 124, at D 145. Electrical conductivity is the inverse of resistivity and measures a material's ability to conduct electricity. *Id.* at D 145–47.

133. *Id.* at D 152. Oil is generally high in resistivity and low in conductivity; formation water is generally low in resistivity and high in conductivity. *See id.* at D 146 (displaying a chart of the relative resistivities of different fluids).

134. *Id.* at D 182.

135. *Logging While Drilling (LWD)*, PETROWIKI, http://petrowiki.org/Logging_while_drilling_(LWD) [https://perma.cc/4MPB-FCKB] (last modified Oct. 17, 2017); *see* GRIFFITHS, *supra* note 118, at 204 (discussing the importance of resistivity measurements in reservoir evaluation and correlation while drilling in order to avoid penetrating material of a different resistivity). *See generally id.* at 204–52 (providing a detailed explanation of the mechanics of resistivity and conductivity logs).

136. SERRA, *supra* note 124, at F 243–45.

137. *Id.*

138. *See id.* at F 275, H 333–34, H 350 (discussing measurement of natural radioactivity for gamma ray logs and measurement of radiation caused by neutron bombardment generally and for neutron porosity logs).

Gamma Ray Log. "The measurement of the total natural radioactivity of the formations crossed by a well is known as the gamma ray log."[139] This form of logging measures "the number of gamma rays emitted from the disintegration of the three naturally occurring radioactive isotopes commonly found in Earth formations: thorium (Th), uranium (U), and potassium (K)."[140] Gamma ray logs are used to identify minerals and rocks containing radioactive elements, such as clays, shales, and sandstones, and thus are commonly used to determine lithology.[141] Additionally, because gamma ray logs are unaffected by the existence of formation fluids like oil, gas, and water, they are sometimes included in the BHA as the only correlation tool useful for determining the BHA's position relative to a target geological formation.[142]

Neutron Porosity Logs. These logs involve the bombardment of the formations surrounding the wellbore with neutrons and the measurement of the energy lost by each neutron as it collides with atoms of different elements.[143] The presence of hydrogen atoms has the strongest slowing effect on emitted neutrons because hydrogen's mass is almost equal to that of a neutron.[144] Due to hydrogen's importance in slowing down emitted neutrons, neutron porosity logs allow measurement of the hydrogen present in a formation and corresponding calculation of the Hydrogen Index (HI).[145] Because hydrogen is present in both oil and water, geologists can use the HI to estimate the amount of liquid-filled porosity present in a formation.[146]

c. NMR Logs. Nuclear magnetic resonance logs introduce a magnetic field into the formation, causing nuclei and their corre-

139. *Id.* at F 275.

140. GRIFFITHS, *supra* note 118, at 202.

141. *Id.* at 202–03 (explaining how gamma rays determine clay content in a formation); SERRA, *supra* note 124, at F 282–84 (demonstrating how gamma rays measure shale percentage); *Gamma Ray Logs*, PETROWIKI, http://petrowiki.org/Gamma_ray_logs [https://perma.cc/A5TP-UNSD] (last modified June 24, 2015) (noting that sandstones retain radioactive components).

142. GRIFFITHS, *supra* note 118, at 202–03; *see also* Hansen & White, *supra* note 120, at 3 (discussing the use of gamma ray logs as part of an MWD/LWD tool string that "acts as a geological survey tool which can be used to accurately place the horizontal wellbore with reference to nearby formation interfaces or formation fluid contacts").

143. SERRA, *supra* note 124, at H 350–51; *see also* GRIFFITHS, *supra* note 118, at 255 ("Neutrons are emitted from a source at high energies (millions of electron volts, eV) and lose energy as they interact with elements in the formation.").

144. SERRA, *supra* note 124, at H 351.

145. *Id.* at H 350.

146. *Id.*

sponding magnetic moments to interact with the introduced magnetic field in a way that creates a measurable signal.[147] Hydrogen is abundant in oil, gas, and water, and is frequently measured by NMR tools.[148] The hydrogen index calculated using NMR can then be used to determine formation porosity, formation permeability, hydrocarbon characteristics,[149] and well producibility.[150]

iii. Uses of the MWD/LWD System. The measurements provided by the MWD and LWD tools described above serve two main purposes for oil and gas operators: geosteering and formation evaluation.[151] Over the past thirty years, advances in MWD/LWD technology and the measurements available in real time during the drilling process have allowed drillers to use the MWD/LWD system as a "geological steering tool which can be used to accurately place the horizontal section with reference to formation features and/or fluid contacts."[152]

a. Geosteering. Geosteering in the context of horizontal drilling consists of interpreting the information provided from MWD/LWD tools downhole to "model the data in real time and update the geological maps of the subsurface and the well location as it relates to geological events and boundaries."[153] Geosteering a well can often be accomplished using only MWD tools to monitor the drill bit position and a gamma ray tool to "correlate known marker formations," however, the conditions of a particular reser-

147. *See* GRIFFITHS, *supra* note 118, at 262 ("Nuclear Magnetic Resonance (NMR) refers to the way that nuclei respond to a magnetic field. Many nuclei have a magnetic moment—they behave like spinning bar magnets. These spinning magnets can interact with externally applied magnetic fields, producing measurable signals.").

148. SERRA, *supra* note 124, at I 409.

149. For example, using NMR signals, a geologist can distinguish between a heavy crude bearing zone, which produces a small NMR signal, and a water bearing zone, which produces a large NMR signal, based on the contrast in NMR signals. *Id.* at I 429.

150. *Id.* at I 426–32. Geologists can determine the producibility of a well by using NMR measurements to identify fluid contacts and determine the exact dimensions of a hydrocarbon-bearing pay zone. *See* GRIFFITHS, *supra* note 118, at 272 ("For well placement, magnetic resonance data can be used in real time to identify tar zones and reductions in permeability for avoidance. Zones of higher permeability can be identified, and the estimation of permeability along the well enables estimating the productivity of the well during drilling.").

151. *See* Hansen & White, *supra* note 120, at 1 ("Utilization of the combined LWD/MWD system during the drilling of a horizontal well offers to the user real-time geological steering capabilities as well as the primary formation evaluation measurements.").

152. *Id.* Since the introduction of geosteering in the 1990s, operators have shifted from primarily using drill cuttings and gamma ray to using additional "near-bit LWD formation evaluation sensor arrays combined with near-bit inclination control." Mazerov, *supra* note 119.

153. Mazerov, *supra* note 119.

voir may necessitate the use of additional LWD logs such as resistivity or nuclear logs.[154] Depending on the chosen method of well placement, (i.e., reactive or proactive),[155] a drilling engineer will use different LWD tools to ensure placement of the well bore in the reservoir by detecting potential geological obstacles such as faults, fractures, formation dips, or oil/water contacts.[156] Despite its high upfront costs, the use of geosteering is increasing because accurate well placement for maximum reservoir contact can help offset the high costs of horizontal drilling.[157]

b. Formation Evaluation. The same tools that provide geosteering capability in real time also provide formation evaluation[158] capability in real time.[159] The information provided by the

154. *Id.* (citations omitted); *see also id.* ("For example, some shale-gas wells in the US can be geosteered using the more basic gamma ray technology, while wells in the Bakken oil shale play typically require resistivity tools as well in order to be geosteered properly.").

155. Reactive well placement methods consist of creating a geological model of bed boundaries using offset well data and seismic data and using LWD data to react and correct the wellbore trajectory when it leaves the reservoir. *See* Amer et al., *supra* note 125, at 17–18. Proactive well placement methods consist of using LWD data to remotely detect bed boundaries and proactively determine where to steer the wellbore trajectory. *See also id.* at 18–19.

156. *See* Market et al., *supra* note 125, at 1–3 (discussing geosteering applications of various LWD tools such as transmission of "azimuthal laterolog type resistivity for reactive geosteering and real-time dip determination from real-time images; azimuthal propagation resistivity for proactive geosteering and bed boundary mapping . . . azimuthal density for reactive geosteering and dip determination from images; and sonic for real-time rock mechanical properties and real-time fracture zone determination in real time"). For example, a drilling engineer could use a resistivity tool to avoid penetration of a shale layer overlying a hydrocarbon reservoir or to optimally place a well near an oil-water contact in a gas-cap driven reservoir. *See* Hansen & White, *supra* note 120, at 3–4 (discussing application of LWD/MWD in different geosteering contexts).

157. *See* Amer et al., *supra* note 125, at 31 (Geosteering involves additional "tools and requires more data for analysis than conventional drilling; in addition, the costs of structural steering are higher. But the answers provided by the tools and data to engineers and geologists have the potential to reveal better access to more of the reservoir, enhance recovery and produce more hydrocarbons."); Mazerov, *supra* note 119 ("Sophisticated geosteering technology is giving operators and drilling contractors more precise real-time information to help them optimize the placement of a wellbore in the reservoir in order to achieve maximum production."). *But see* Market et al., *supra* note 125, at 1 (stating that the most cost-effective alternative method of "logging in unconventional shale plays has generally been a matter of acquiring open hole logs in the vertical well, selecting the most promising zone from the vertical log, and drilling a horizontal well in that zone. Generally, the horizontal well was landed and drilled using simple LWD gamma ray").

158. "Formation evaluation" involves "[d]escribing a geologic formation and any fluids contained within in terms of their constituent properties [and] [d]etermining the properties of the rock to assess the total and recoverable volume, value, and producibility of the fluids." *Formation Evaluation During Mud Logging*, PETROWIKI, http://petrowiki.org/Formation_evaluation_during_mud_logging [https://perma.cc/Q4E3-PHS6] (last modified Dec. 8, 2015).

159. GRIFFITHS, *supra* note 118, at 202. However, use of MWD/LWD information for

various types of LWD can be used to determine the lithology, permeability, porosity, reservoir thickness, hydrocarbon saturation, and total reserves of the formations surrounding the wellbore.[160] This information can then be used to evaluate "whether hydrocarbons are present and if so what volume of hydrocarbons and thus have a critical role in the decision to develop a reservoir or not."[161]

IV. THE *LIGHTNING V. ANADARKO* HYPOTHETICAL

In determining whether geophysical trespass case law should apply to the use of MWD and LWD tools while drilling horizontally through an unpermitting mineral estate, it is useful to construe the facts of *Lightning v. Anadarko* as a hypothetical.[162] Consider the following: Mineral lessee Able, an oil and gas company, holds the mineral estate underlying Blackacre. Baker is the owner of the surface estate overlying the mineral estate on Blackacre. Mineral lessee Charlie, a competing oil and gas company, holds the mineral estate underlying neighboring Whiteacre. Charlie negotiates a surface use agreement with Baker, allowing Charlie to drill from Baker's surface estate on Blackacre to access his neighboring mineral estate underlying Whiteacre. This arrangement requires Charlie to drill through the subsurface containing Able's mineral estate, but Charlie does not receive permission from Able to drill through his mineral estate. Though current case law holds that no actual trespass has occurred on Able's mineral estate, does Able have a cause of action for geophysical trespass if Charlie uses MWD and LWD tools while drilling horizontally through Able's mineral estate?

V. APPLICATION OF GEOPHYSICAL TRESPASS TO THE *LIGHTNING* HYPOTHETICAL

To determine whether the use of MWD and LWD by an operator in Anadarko's position constitutes geophysical trespass, it is

formation evaluation purposes is usually done after the geosteering decision-making process is complete. *Id.*

160. *See supra* Section III.B.2 (discussing various types of MWD/LWD logs and the information provided by them); *Logging While Drilling (LWD), supra* note 135 and accompanying text (discussing the calculation of relative depth of a hydrocarbon bearing zone using resistivity measurements).

161. GRIFFITHS, *supra* note 118, at 194–95.

162. *See supra* Part II (stating facts of Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39 (Tex. 2017)).

first necessary to clarify whether such operations should be classified as geological operations or geophysical operations.[163] Additionally, in Texas, whether a particular operation should be classified as a geophysical trespass may turn on the type of information gathered by that operation and its impact on the speculative value of the nonconsenting owner's land.[164] Furthermore, the policy rationale in support of encouraging oil and gas development cited by the Texas Supreme Court in its holding that the removal of a minimal amount of minerals from Lightning's estate did not constitute trespass may also determine whether the use of MWD/LWD in off-lease horizontal wells constitutes geophysical trespass.[165]

A. Comparison of the Technologies

As stated by Kuntz, Texas courts have not clearly distinguished between various geological and geophysical operations; however, it appears that the courts have clearly held seismic surveys to be a form of geophysical exploration which constitutes trespass when conducted on an unpermitting mineral estate.[166] On the other hand, MWD and LWD appear to meet Kuntz' definition of geological operations because operators acquire "subsurface data derived from drilling operations" to prepare geological maps and surveys.[167] However, this distinction between MWD/LWD and seismic surveys is superficial because it focuses on each technology's method of acquiring information rather than the type of information acquired and how it is used by oil and gas operators. Several key comparisons are important to consider in determining whether MWD/LWD is similar enough to seismic surveys to warrant application of geophysical trespass case law: (1) when each technology is deployed during the oil and gas exploration process;

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163. *See supra* note 99 and accompanying text (discussing the need for judicial clarification between geophysical and geological operations in Texas).

164. *See supra* notes 86–87 and accompanying text (discussing what type of information is revealed by geophysical trespass and whether that information is required to be of a speculative nature).

165. *See Lightning Oil*, 520 S.W.3d at 51 ("The policy of Texas is to encourage the recovery of minerals, and the Legislature has made waste in the production of oil and gas unlawful." (quoting Key Operating & Equip., Inc. v. Hegar, 435 S.W.3d 794, 798 (Tex. 2014))).

166. *See* SMITH & WEAVER, *supra* note 62, at 7-26 ("These are collectively known as geophysical operations, but to date only seismic testing has been held to involve invasion or disturbance of the mineral estate.").

167. KUNTZ, *supra* note 99, § 12.7, at 347; *see supra* Section III.B.2 (explaining geological measurements obtained by MWD/LWD and their applications).

(2) what information is gathered; and (3) who uses the information.

The first key difference between MWD/LWD and seismic surveys is when each technology is deployed during the oil and gas exploration and development process. Seismic surveys are usually conducted when oil and gas companies are evaluating a tract of land for development potential with the goal of confirming the presence (or absence) of hydrocarbons beneath the tract.[168] MWD/LWD, on the other hand, is conducted during the drilling process, usually after seismic surveys have already been conducted.

The first key similarity between MWD/LWD and seismic surveys is that the information gathered by MWD/LWD and seismic surveys may be used to confirm the presence (or absence) of hydrocarbons and estimate the volume of hydrocarbons present in a reservoir.[169] However, Kuntz distinguishes geophysical operations, including seismic surveys, from geological operations, stating that geophysical methods secure "direct information as to the subsurface structures," while geological methods secure subsurface data that may be used to derive geological maps and observations.[170] Seismic methods do obtain direct information about subsurface structure and hydrocarbon content but the information obtained is *often* cross-referenced with data from offset wells in order to better detect DHI's and calculate the volume of hydrocarbons present in a reservoir.[171] On the other hand, the derivations of hydrocarbon volume and reservoir thickness from MWD/LWD measurements *must* be cross-referenced with seismic data and data from offset wells in order to determine the total volume of hydrocarbons in a reservoir.[172] Though the measure of the volume of hydrocarbons in

168. *See How Does Land Seismic Work?*, RIGZONE, https://www.rigzone.com/training/insight.asp?insight_id=301 [https://perma.cc/53SE-JXNM] (last visited Mar. 19, 2019) (discussing the purpose of seismic surveys in evaluating properties for development prior to drilling); *see supra* Section III.B.1 (discussing use of seismic surveys to detect hydrocarbons).

169. *See supra* Sections III.B.1–2 (discussing uses of seismic and MWD/LWD that allow for detection and calculation of hydrocarbon reserves).

170. KUNTZ, *supra* note 99, § 12.7, at 347.

171. *See supra* notes 113–15 and accompanying text (discussing use of offset well log data during seismic stratigraphy). Furthermore, well log data, whether obtained from wireline logging or MWD/LWD, is considered to "provide the link between geophysics and geology" because the vertical resolution provided by seismic sections is not high enough to describe the reservoir, so seismic data is often supplemented with well logging measurements. OBERTO SERRA & LORENZO SERRA, WELL LOGGING AND GEOLOGY 4–5 (2003).

172. *See* SERRA & SERRA, *supra* note 171, at 1, 4–8 ("In each well is measured the local reservoir thickness, and are evaluated its local effective porosity, saturation, and permea-

place provided by MWD/LWD must be extrapolated in order to determine the total volume of hydrocarbons present in a reservoir, both MWD/LWD and seismic surveys provide direct data regarding the subsurface in some form. Accordingly, Kuntz's distinction is not appropriate for the geophysical trespass context because both seismic surveys and MWD/LWD are capable of directly obtaining information about the subsurface and its hydrocarbon content.

The second key difference between MWD/LWD and seismic surveys is the availability of the information obtained to various parties. Seismic surveyors may license a "speculative survey" to multiple third-party oil and gas operators, or the surveyor may conduct a "proprietary survey" for exclusive use by one such operator.[173] Well log data, on the other hand, may be used by the operator or released to a third-party company to process and provide geosteering models, and that data is required to be published within ninety days of well completion.[174]

Though MWD/LWD and seismic surveys differ in terms of how each technology acquires information and who can use that information, they share an important similarity in that the information collected by each can be used to determine the volume of hydrocarbons in place and the volume of hydrocarbons in the reservoir, respectively. Consequently, classification of each method as a "geological" or "geophysical" operation is insufficient to determine whether geophysical trespass case law applies in each case. Further analysis of geophysical trespass case law is necessary to determine its application to MWD/LWD.

B. Application of Geophysical Trespass Case Law

Considering the simplified facts of the previous hypothetical and the more detailed fact pattern of *Lightning Oil v. Anadarko*, existing geophysical trespass case law arguably applies to Anadarko's situation because a similar operator in Anadarko's position running a full suite of logs could obtain valuable information about the underlying reserves of the unpermitting mineral estate. However, liability may not run to Anadarko's use of a MWD tool string

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bility. These local data must be extended from each well in order to evaluate the final hydrocarbon volume.").

173. Anderson & Pigott, *supra* note 66, at 307–08.

174. *See* 16 TEX. ADMIN. CODE § 3.16 (requiring oil and gas operators to file an electric well log within ninety days of well completion, with an option to delay filing and maintain confidentiality for a period up to three years after well completion); Mazerov, *supra* note 119 ("Sophisticated geosteering technology is giving operators and drilling contractors more precise real-time information to help them optimize the placement of a wellbore in the reservoir in order to achieve maximum production.").

that includes only basic gamma ray logging because this type of log does not provide valuable information about underlying reserves, though it does allow drilling engineers and geologists to correlate targeted marker beds in order to determine when to kick off and land the wellbore. Regardless, given the policy rationale in support of oil and gas development previously cited by the Texas Supreme Court, the court may limit application of geophysical trespass precedent to MWD/LWD by adopting dicta by the Galveston Court of Civil Appeals of Texas in *Kennedy v. General Geophysical Co.*[175] or by the Fifth Circuit in *Philips Petroleum v. Cowden.*[176] A discussion of the following factors is helpful in understanding how geophysical trespass case law applies to the *Lightning* hypothetical: (1) the physical entry requirement; (2) the right to explore; (3) self-protection by operators; and (4) Texas Supreme Court policy rationale.

1. The Physical Entry Requirement. The first factor is perhaps the most easily resolved, but it still merits discussion because Anadarko argued that its proposed use of MWD/LWD tools would not satisfy the physical entry requirement.[177] Anadarko incorrectly cites *Villarreal* for the proposition that the "plaintiff [Lightning] has no claim when data is obtained without a trespass," arguing no trespass occurred because Anadarko was authorized to "conduct all planned activities" by the surface estate.[178] However, Anadarko's argument represents a misconstruction of the physical entry requirement; a legal entry at the surface does not equate to a legal entry at the subsurface.[179] Rather, Anadarko's proposed use of MWD/LWD tools while drilling through Lightning's mineral estate is a physical entry because Anadarko entered the subsurface without Lightning's permission to drill or log its mineral estate and with the intent to gain the "knowledge of the subsurface conditions" necessary to land their drill in the targeted reservoir

175. *See generally* Kennedy v. Gen. Geophysical, 213 S.W.2d 707 (Tex. App.—Galveston 1948, writ ref. n.r.e.).

176. *See generally Cowden I*, 241 F.2d 586, 588 (5th Cir. 1957).

177. *See* Appellee's Brief, *supra* note 51, at 43–44 (arguing that *Villarreal* confirms that Lightning had no claim because Anadarko was authorized to drill from the surface of the Briscoe Ranch).

178. *Id.*

179. *See Cowden I*, 241 F.2d at 592 (holding physical entry requirement to be met when surface estate granted permission to enter surface, but mineral estate did not grant permission to survey minerals); Cowden, *supra* note 98, at N-29 (noting that "although these cases are commonly referred to as cases of 'subsurface trespass', they actually deal with a surface trespass done with the intent to obtain knowledge of the subsurface conditions").

layer.[180]

2. The Right to Explore. As noted by the Fifth Circuit, "in Texas the right to explore for oil and minerals is a valuable property right that can be legally protected."[181] Because Lightning suffered no actual damage to its minerals, the following discussion will focus on damages pursued under an assumpsit theory.[182] In determining whether different methods of exploration—including MWD/LWD—are legally protected, two questions must be asked: First, who possesses the right to explore in the *Lightning* hypothetical? Second, is legal protection of the right to explore limited by dicta in *Kennedy* and *Cowden*?

First, as stated in the *Lightning* hypothetical and the language of its lease, Lightning does not possess the exclusive right to explore.[183] Instead, Lightning possesses a nonexclusive right to explore. This distinction may subject the *Lightning* hypothetical to a split in Texas case law on the question of whether "the surface owner of Whiteacre [may] authorize the owner of an interest in minerals in other premises to conduct geophysical surveys upon Whiteacre[.]"[184] According to the treatise, one Texas court has "held that the easement of a lessee to conduct geophysical operations on the premises (which the court assumed) was not exclusive, and hence the lessor might authorize other persons to enter upon the premises for the purpose of conducting geophysical operations."[185] On the other hand, the same treatise notes that *Cowden I* stands for the proposition that the right to explore "is either held by the lessee or mineral owner exclusively or is held jointly by such person and the surface owner, and hence one who conducted a geophysical survey with the consent of the surface owner was liable

180. Cowden, *supra* note 98, at N-29; *see* Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 43–44 (Tex. 2017) (stating that Anadarko was present on the land above Lightning's mineral estate without permission to drill).

181. *Cowden I*, 241 F.2d at 590.

182. *See id.* at 592 ("Texas belongs to the minority of states that permit a landowner to waive the trespass and sue in assumpsit for the reasonable value of the use and occupation."); *Lightning Oil*, 520 S.W.3d at 51 ("[T]he loss of minerals Lightning will suffer by a well being drilled through its mineral estate is not a sufficient injury to support a claim for trespass.").

183. *See* Petitioner's Brief on the Merits, *supra* note 8, app. D, at 1 (stating that Lightning's amended lease provided for the right to explore without any reference to the exclusivity of that right).

184. WILLIAMS & MEYERS, *supra* note 81, § 218.6, at 228.7.

185. *Id.* at 228.8 (citing Shell Petroleum Corp. v. Puckett, 29 S.W.2d 809 (Tex. App.—Texarkana 1930, no writ)).

to the owner of mineral rights in such land for trespass."[186] Resolution of who holds the exclusive right to explore depends on the language of the lease and is important because it can determine whether a lessor has the right to grant the right to additional third parties besides the lessee.[187]

However, even though Lightning possesses a nonexclusive right to explore, which may be shared with the grantor and any other grantees, the conflict at issue in the *Lightning* hypothetical is not between a lessee and its lessor and/or an additional third party granted the right to explore by the lessor. Instead, the conflict is between a lessee and the holder of an easement granted by the surface estate holder. Therefore, the *Lightning* hypothetical is not subject to the split in the case law discussed above, and Anadarko does not have any right to explore because they were not granted that right by the Briscoe Ranch—rather, they were granted only an "easement and permission to drill through Briscoe's surface estate to access" Anadarko's property.[188] As a threshold matter, Lightning possesses a nonexclusive right to explore, which is legally protected and may not be invaded by Anadarko.[189]

Second, the question of whether geophysical trespass is limited by dicta in *Kennedy* and *Cowden I* is a crucial one because future defendants in a similar position to Anadarko may argue these points to persuade the Texas Supreme Court to rule against application of the geophysical trespass cases to MWD/LWD. Because of dicta in both cases, it is unclear whether an operator with no mineral rights will be liable in damages for physically entering another's property and violating their right to explore by running logs through a portion of the hole as a means of gaining information about the reservoir.[190] Three approaches to this problem bear discussion: (1) the right to explore approach; (2) the *Kennedy*

186. *Id.* at 228.9 (citing *Cowden I*, 241 F.2d at 590).

187. *See* KUNTZ, *supra* note 99, § 12.7, at 352 ("If the lessee has been granted the exclusive right to prospect and explore for oil and gas, the lessor has no right to conduct exploration operations nor can he grant such right to another.").

188. Respondent's Brief on the Merits, *supra* note 16, at 37 (emphasis omitted); *see Cowden I*, 241 F.2d at 592 ("[B]ut the failure to reserve the 'exclusive' exploration right cannot here have the effect of leaving some such right in the surface owner . . . for no such right was granted to him in the deed."); John K. Keller, *Ch. 17: Legal Aspects of Geophysical Exploration*, *in* 13 ENERGY & MIN. L. FOUND. § 17.03[3] (1992) (citations omitted) (noting courts "have generally held that the right is exclusive only if the lease expressly so states. If the lease does not contain an express exclusive exploratory rights provision, the mineral lessee's right to explore is probably concurrent with that of the mineral lessor").

189. *See Cowden I*, 241 F.2d at 590–92 (establishing Cowden's nonexclusive right to explore by proving no right to explore was granted to surface estate owner allegedly granting that power to defendant surveyor).

190. Cowden, *supra* note 98, at N-26.

approach; and (3) the *Cowden I* approach.

The right to explore approach views geophysical trespass in its simplest form: physical entry and a violation of the right to explore.[191] As the trial court in *Cowden I* noted, the right to explore entails "investigation and exploration for oil, gas and other mineral purposes . . . reasonably expected to reveal geophysical and geological information as to [the] land involved . . . ."[192] Because MWD/LWD measurements convey a number of geological characteristics, such as lithology, porosity, and fluid saturation, MWD/LWD satisfies the requirements for geophysical trespass under this approach.[193] Though few articles address the use of MWD/LWD directly, several commentators have adopted this approach, suggesting that operators must secure permission from both the surface and mineral estate before logging a well being drilled through another's mineral estate.[194]

The *Kennedy* approach could possibly modify the right to explore approach through dicta, requiring that information obtained relate to the "sub-surface formation and the probable presence or absence of oil, gas, or other minerals in and under appellant's land."[195] Though the dicta in *Kennedy* was offered in a context contemplating geophysical trespass when the physical entry requirement had not been met, the court's emphasis on the value of the information obtained could be used to limit the types of geological and geophysical information to which geophysical trespass may apply. Under this approach, it may be more difficult to find that Anadarko commits geophysical trespass if allowed to use its proposed MWD tool string equipped with basic gamma ray logging—Anadarko would receive information about the lithology of subsurface formations but would not receive any information about the structure of the sub-surface or the presence or absence of hydrocarbons.[196] However, an operator in Anadarko's position running a more advanced logging suite, including resistivity logs, etc.,

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191. *See Cowden I*, 241 F.2d at 590–92 (discussing physical entry and violation of the right to explore in finding defendant surveyor committed geophysical trespass); Cowden, *supra* note 98, at N-25 to N-29 (establishing requirements of physical entry and permission from party holding the right to explore).

192. *Cowden I*, 241 F.2d at 590–91 (citations omitted).

193. *See supra* Section III.B.2 (discussing geological data recorded by MWD/LWD tools).

194. *See supra* note 98 and accompanying text.

195. Kennedy v. Gen. Geophysical Co., 213 S.W.2d 707, 710 (Tex. App.—Galveston 1948, writ ref'd n.r.e.); *see also supra* Section III.A.1 (discussing dicta established in *Kennedy* that may allow geophysical trespass despite a lack of physical entry if valuable information was obtained about the subsurface).

196. *See supra* Section III.B.2 (discussing measurements obtained by gamma ray and

would likely commit geophysical trespass because the logs would provide information such as porosity, permeability, and fluid saturation, which would enable the determination of the hydrocarbons in place and would likely be of value to the operator.[197]

Finally, the *Cowden I* approach could also modify the right to explore approach through dicta by limiting geophysical trespass to situations where the information obtained might reduce the speculative value of the land.[198] Under this approach, it may be considerably more difficult to reach a finding of geophysical trespass because of vague treatment of the meaning of "speculative value" by Texas courts and federal courts applying Texas law.[199] However, this approach merits discussion because it may limit the application of geophysical trespass precedent to MWD/LWD. When compared to seismic surveying methods, several different factors affect whether MWD/LWD can impact the speculative value of land in a similar manner: (1) the type of information acquired; (2) who can use the information; (3) the timing of each exploration method; and (4) the ability to provide evidence of similar transactions or of the value of the right to explore.[200]

First, seismic surveys can directly obtain information about the sub-surface structure and its contents, allowing calculation of the hydrocarbon reserves. MWD/LWD, on the other hand, can only obtain data from which hydrocarbons in place at that wellsite may be determined.[201] Further correlation with similar data from other

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their applications).

197. *See supra* Section III.B.2 (discussing information obtained from various types of logs).

198. *See Cowden I*, 241 F.2d at 590 ("This conclusion appears reasonable if it is considered that in many instances an unexplored mineral right has only a speculative value which upon investigation may prove to be either far in excess of or considerably less than the real value of the deposits it represents.").

199. The leading case on loss of speculative value is *Humble Oil & Refining Co. v. Kishi*, 276 S.W. 190 (Tex. Comm'n App. 1925, judgm't adopted). *See* Anderson & Pigott, *supra* note 66, at 385. However, the court in that case awarded damages based on a loss of speculative value caused by a lessee wrongfully claiming a valid lease on lessor's land. *Id.* at 385–86. Though no loss of a specific bargain was proved, the court measured speculative value by the value of lease bonuses before a dry hole was drilled and the value of those same bonuses after the dry hole. *Id.* at 386. Unlike *Kishi*, the *Cowden I* court did not reference the loss of a specific bargain or explain how the geophysical surveys reduced the speculative value of the Cowdens' tract, but briefly discussed the possibility of lost speculative value. *See Cowden I*, 241 F.2d at 590. Instead, the Fifth Circuit ruled on an assumpsit theory, which measured the reasonable market value of the exercise of the right to explore without reference to the speculative value of the mineral estate before and after seismic surveys were conducted, without further discussion of the meaning of speculative value and whether it was necessary to its holding. *See id.* at 590–94.

200. *See supra* Section V.A (comparing MWD/LWD with seismic surveys).

201. *See supra* Section V.A (comparing information acquired by seismic and

well logs and/or seismic data is necessary to allow calculation of the total hydrocarbon reserves or determination of sub-surface structures.[202] Second, seismic surveys may be exclusively licensed by third-party oil and gas companies, but well logs are required to be published within ninety days of well completion.[203] Third, seismic surveys occur early in the exploration process, i.e., when an oil and gas company is evaluating a tract of land for development, but MWD/LWD occurs during the development process, i.e., when drilling commences.[204] Finally, it is unclear whether Lightning would be able to provide evidence of similar transactions or the value of the right to explore because oil and gas operators do not usually contract for the right to perform MWD/LWD on tracts they do not own or lease.[205]

Whether the Texas Supreme Court would resolve the previously mentioned factors in favor of finding that MWD/LWD can reduce speculative value will likely depend on the court's policy rationale.[206] One can envision a scenario where the court may view the damage suffered by wrongful use of MWD/LWD to be *de minimis* because a determination of a lack of hydrocarbons at one well may not "condemn" the land, well logs are accessible by other operators once the well is complete, logging takes place towards the end of the field evaluation process when other operators have likely conducted seismic surveys and made leasing decisions, and the court may be reluctant to award damages without evidence of similar transactions.[207] However, one could also envision a scenario where the court would find that a MWD/LWD log confirming

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MWD/LWD).

202. *See supra* Section V.A (discussing need to correlate local well log data with other well log data to determine hydrocarbon reserves).

203. *See supra* Section V.A (discussing which parties may use information acquired by each method).

204. *See supra* Section V.A (discussing when seismic and MWD/LWD are utilized during oil and gas exploration).

205. *See* Blomquist, *supra* note 74, at 44 (discussing *Cowden I*, 241 F.2d 586 (5th Cir. 1957)) ("The pattern indicates that courts are very reluctant to award damages when the plaintiff cannot present evidence of similar transactions and the amount paid for the right to explore.").

206. *See supra* Section II.B.2 (discussing the Texas Supreme Court's policy rationale in favor of encouraging oil and gas development).

207. *See* Owen L. Anderson, *Geophysical "Trespass" Revisited*, 5 TEX. WESLEYAN L. REV. 137, 139 n.3 (1999) ("Accordingly, should 3D seismic become a widely used wildcat exploration tool, unleased mineral owners can be expected to seek greater compensation for 3D seismic operations because of their concern that unfavorable seismic data will eliminate further interest in the property, thereby damaging a tract's speculative mineral value."). Unlike 3D seismic, which can provide a more comprehensive picture of the oil and gas reserves underlying a property, the absence of hydrocarbons in one formation at one well site does not necessarily mean hydrocarbons are not present anywhere on the tract, however,

an absence of hydrocarbons in place on an unpermitting mineral estate may materially reduce the speculative value of the tract because, though the lessee may have already conducted a seismic survey, the well log data confirms that a targeted formation has been drained or is not accessible due to a structural fault.

The *Lightning* hypothetical would likely align more closely with the first scenario because Anadarko held leases on the properties surrounding the Cutlass Lease and Lightning had already drilled several wells on the Cutlass Lease.[208] Because Anadarko held leases on the properties surrounding the Cutlass Lease, it was likely to make a determination of hydrocarbon reserves under Lightning's property using the seismic trends and geologic information from its own seismic surveys and logs on the surrounding lands. In addition, any publication of well log data would likely not condemn or reduce the speculative value of the Hurds' mineral estate by causing Lightning not to lease or develop the property because Lightning had already begun developing the tract. However, as mentioned above, other fact patterns may lead to findings of geophysical trespass under the *Cowden* approach.

3. Self-Protection by Operators. Depending on which approach the court takes regarding the right to explore, geophysical trespass may still not apply to Anadarko's proposed use of an MWD tool string with basic gamma ray logging. Operators may be able to shield themselves from geophysical trespass by "blacking out" information received from unpermitting mineral estates.[209] Because no well log data will be gathered until Anadarko's tool string reaches 7,000 feet, and because that well log data will consist of basic gamma ray data, Anadarko will not obtain information regarding the subsurface structure or the presence of hydrocarbons,

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one could liken a well log confirming an absence of hydrocarbons to the drilling of a dry hole. *See Humble Oil & Refining Co. v. Kishi*, 276 S.W. 190, 190–91 (Tex. Comm'n App. 1925, judgm't adopted) (noting the negative effect of dry hole on the speculative value of a lease).

208. *See* Appellant's Brief, *supra* note 51, at 3–4 (stating that Lightning had three producing wells); *id.* at app. A (showing map of Anadarko properties surrounding Lightning's lease); Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 43 (Tex. 2017) (discussing Lighting's three wells near Anadarko's property).

209. *See* Villarreal v. Grant Geophysical, Inc., 136 S.W.3d 265, 268 (Tex. App.—San Antonio 2004, pet. denied) (noting that defendant surveyor deleted all information obtained from under plaintiff's tract); WEAVER & WELLS, *supra* note 6, at 4-39 ("If any drilling information were to be obtained, then it should be deleted from the drilling records and not provided to Bigg Oil or any other party. These are the same precautions taken by the seismic company in *Villareal v. Grant Geophysical, Inc.*"); *supra* note 96 and accompanying text.

and the lithologic information obtained will not reduce the speculative value of the land.[210] Under the right to explore approach, an attempt to "black out" any log data from 7,000 feet to the surface will likely not succeed because Anadarko will still obtain log data from Lightning's mineral estate without permission.[211] However, under the *Kennedy* and *Cowden* approaches, Anadarko's "black out" will likely aid in preventing a finding of geophysical trespass because no valuable information will be revealed by its gamma ray log.[212]

4. Texas Supreme Court Policy Rationale. Whether the Texas Supreme Court will continue to follow the right to explore approach or adopt dicta in *Kennedy* or *Cowden* depends on which policy rationale the court follows. In *Lightning*, the court followed up its discussion of the benefits of off-lease drilling and its ability to maximize mineral production by avoiding blind spots and landing horizontal wellbores within as much of the target reservoir as possible with a strong policy rationale supporting mineral development despite the removal of a *de minimis* amount of Lightning's minerals.[213] The court's policy rationale in *Lightning* gives reason to believe that it may accept arguments from operators in Anadarko's position and adopt a limiting approach such as the *Kennedy* or *Cowden* approaches in the future because the court will likely want to avoid the impedance of exploration and development by obstructive lessees such as Lightning.[214] According to one commentator, the court has been willing to reform other oil and gas common law doctrines in order to accommodate horizontal drilling, and it may be willing to do so again in this context.[215] Affirmation of its implicit holding in *Lightning* and adoption of either the *Kennedy* or *Cowden* approach would achieve this result by allowing

210. *See supra* Section V.B.2 (discussing the three approaches and their requirements).

211. *See supra* Section V.B.2 (discussing right to explore approach and requirements).

212. *See supra* Section V.B.2 (discussing the *Kennedy* and *Cowden* approaches and requirements of each).

213. *Lightning Oil*, 520 S.W.3d at 50–51.

214. *See* WILLIAMS & MEYERS, *supra* note 81, § 218.6, at 229 (stating why permission from both the mineral estate and surface estate should not both be required: "[t]he first is the difficulty of obtaining the joinder of all such persons. Public interest in exploration and development of mineral resources may to a limited extent at least justify a rule of nonrequirement of joinder because the contrary rule will impede exploration and development."); Owen L. Anderson, *Subsurface "Trespass": A Man's Subsurface is Not His Castle*, 49 WASHBURN L.J. 247, 263–64 (2010) (posing an identical hypothetical to the *Lightning* hypothetical and arguing that unpermitting mineral owners should not be allowed to cause underground waste via "obstruction claims").

215. Wells, *supra* note 7, at 224–25.

the use of MWD with basic gamma ray logging (and possibly additional log types), which would allow off-lease wells to be safely drilled without the threat of suit for geophysical trespass.[216] On the other hand, affirmation of the right to explore approach would achieve the opposite result by allowing mineral estate holders and mineral lessees to impede off-lease drilling under threat of suit for geophysical trespass because drilling operators would not be able to accurately place horizontal wells without a correlation tool like gamma ray logging, even though the physical act of drilling per se is not trespass per the court.[217]

VI. CONCLUSION

By refusing to apply geophysical trespass case law to the use of MWD/LWD, the Fourth Court of Appeals inappropriately limited the application of *Villarreal* on the facts because Anadarko did not plan to conduct any seismic surveys on Lightning's lease. The Texas Supreme Court then affirmed the Fourth Court of Appeals' decision on other grounds, but in doing so stated a broad policy rationale in support of its holding that off-lease drilling does not constitute trespass, which may implicitly support the proposition that the use of MWD/LWD in off-lease wells also does not constitute geophysical trespass. As Kuntz states in his treatise, further judicial development is needed to determine what geological and geophysical operations besides seismic surveys are legally protected under the right to explore. The decision by the Fourth Court of Appeals and the subsequent decision by the Texas Supreme Court fail to further develop geophysical trespass case law by limiting its application to the traditional context of seismic surveys.

Considering the existing body of case law regarding geophysical trespass in Texas and similarities between seismic surveys and MWD/LWD, geophysical case law applies to MWD/LWD under the current right to explore approach. However, given the policy rationale supporting its holding in *Lightning*, the Texas Supreme Court may limit the application of current geophysical trespass case law by adopting a limiting approach based on dicta in *Kennedy* or *Cowden*. As a result, the Texas Supreme Court would affirm its implicit holding in *Lightning* and significantly

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216. *See supra* Sections V.B.2–3 (discussing impact of operator protections and right to explore, as well as the *Kennedy* and *Cowden* approaches).

217. *See Lightning Oil*, 520 S.W.3d at 51 (holding that no trespass will occur when Anadarko drills through Lightning's mineral estate and displaces its minerals without permission); WEAVER & WELLS, *supra* note 6, at 4-39 ("These restrictions may seriously impede the ability to effectively drill horizontally as the drilling engineer will be drilling blind through the formation.").

distinguish existing case law, which requires operators in Anadarko's position to obtain permission from the mineral estate holder in Lightning's position before drilling through the subsurface. Consequently, future operators like Anadarko may only need permission from the surface estate in order to drill and use MWD/LWD off-lease.

D. Duggan Baker V