STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATIONS OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF SALTWATER DISPOSAL WELLS LEA COUNTY, NEW MEXICO.

CASE NOS. 23614-23617

APPLICATION OF GOODNIGHT MIDSTREAM PERMIAN LLC TO AMEND ORDER NO. R-22026/SWD-2403 TO INCREASE THE APPROVED INJECTION RATE IN ITS ANDRE DAWSON SWD #1, LEA COUNTY, NEW MEXICO.

CASE NO. 23775

APPLICATIONS OF EMPIRE NEW MEXICO LLC TO REVOKE INJECTION AUTHORITY, LEA COUNTY, NEW MEXICO.

CASE NOS. 24018-24020, 24025

APPLICATION OF GOODNIGHT MIDSTREAM PERMIAN, LLC FOR APPROVAL OF A SALTWATER DISPOSAL WELL, LEA COUNTY, NEW MEXICO.

DIVISION CASE NO. 24123
ORDER NO. R-22869-A

GOODNIGHT MIDSTREAM PERMIAN, LLC'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

Goodnight Midstream Permian, LLC ("Goodnight" or "GNM") (OGRID No. 372311) submits the following proposed findings of fact and conclusions of law in the above-captioned matters:

[Page left intentionally blank]

FINDINGS OF FACT

GOODNIGHT MIDSTREAM

1. Goodnight operates a large high-pressure pipeline system in Lea County comprised of 110 miles of pipeline with a projected capacity of 400,000 barrels water per day ("BWPD"), with 6 water recycling and re-use facilities and 11 approved SWDs, serving 13 operators and ~640 dedicated producing wells connected at 29 receipt points. McGuire Direct, Ex. B ¶¶ 7-10; *id.* at Ex. B-2.

2. Goodnight operates four disposal wells in the Llano System within the Eunice Monument South Unit ("EMSU"): Andre Dawson SWD #1, Ernie Banks SWD #1, Ryno SWD #1, and Sosa SA 17 SWD #2. McGuire Direct, Ex. B ¶ 8.

3. The Llano System transports and injects produced water from areas in the Delaware Basin with intense production, high competition for disposal permits, limited deep reservoir capacity, and concerns with shallow disposal. McGuire Direct, Ex. B ¶ 10.

4. It would cost GNM ~$40 million to relocate its four wells inside the EMSU at least two miles outside the EMSU and would cost approximately $120 million to move all wells within two miles of the EMSU at least two miles away. McGuire 5/19/25 Tr., 50:8-24.

5. Goodnight spent ~$300 million on the Llano System, with 4 wells in the EMSU that inject ~60,000 BWPD and support production of ~19,000 barrels of oil per day ("BOPD"). McGuire 5/19/25 Tr., 48:2-11; McGuire 5/20/25 Tr., 175:1-176:4. The Llano System has supported ~$5 billion in oil sales to date, and at a $70 WTI oil price and with constant injection rates going forward, will support another $20 billion over the next ten years. McGuire Direct, Ex. B ¶ 10; McGuire 5/19/25 Tr., 51:8-52:8.

6. Goodnight's EMSU San Andres SWDs are vital to its customers and the oil and gas industry who rely on Goodnight to provide a sustainable, long-term option for produced water disposal—in 2023, Delaware Basin wells connected to the Llano System produced 48.4 million barrels of oil, 110.7 BCF of gas, and 100.6 million barrels of water, ~53.9 million barrels of which were delivered to Goodnight for disposal. McGuire Direct, Ex. B ¶ 10; Davidson 4/21/25 Tr. 254:22-25; 256:10-11 (**GNM's injection is valuable to the producers in New Mexico because "they've got to have somewhere to put the water they're producing or they're going to have to shut wells in."**).

7. There is a substantial and growing demand for produced water disposal in southeastern New Mexico necessary to support increasing oil and gas development. McGuire 5/19/25 Tr., 158:6-163:17; McGuire 5/20/25 Tr., 176:5-177:1; 201:22-203:19.

Goodnight's Applications

8. In Case Nos. 23614-23617 and 24123, Goodnight seeks authorization to inject in the San Andres within the EMSU through its proposed Doc Gooden SWD #1, Hernandez SWD #1, Hodges SWD #1, Seaver SWD #1, and Piazza SWD #1 under [SWD; San Andres (Pool Code 96121)]. Alleman Direct, Ex. A ¶ 8; GNM Exs. A-4 to A-8

9. In Case No. 23775, Goodnight seeks approval to increase the injection rate in Order No. R-22026/SWD-2403 for the Andre Dawson SWD #1 from 25,000 to 40,000 BWPD—maximum surface injection pressure unchanged. Alleman Direct, Ex. A ¶¶ 9, 104; GNM Ex. A-9

10. The applications and Form C-108s in Case Nos. 23614-23617 and 24123 are complete and contain all information necessary for approval. Alleman Direct, Ex. A ¶¶ 4, 8, 10, 12-13, 30-31, 48-49, 66-67, 84-85, and 104 (intervals and locations); 16-17, 34-35, 52-53, 70-72, 88-89 (well bores, packers, casing – closed injection systems); 23, 41, 59, 77, 95 (samples of San Andres water and water chemistry analyses of produced water samples); 24, 42, 60, 78, 96 (surface ownership). GNM Exs. A-4 to A-9, B-47; Alleman 4/24/25 Tr., 30:25-31:4; 38:5-18; 56:24-57:9; 68:19-69:19; 71:7-71:16; 81:12-82:20; 90:15-91:14; 104:6-105:10; 110:1-113:21; 127:11-131:6; 149:1-5; 60:3-63:7 (Form C-108 applications do not state "EMSU" but identify well location, target injection formation, and pool code within the EMSU).

11. Goodnight consulted with OCD about the location of its injection zone in the EMSU unitized interval prior to filing applications for Goodnight's existing SWD wells. McGuire 5/19/25 Tr., 217:16-219:10; 150:19-25.

12. Goodnight furnished notice of each application by certified mail to affected parties and parties entitled to notice based on their addresses of record after undertaking a good-faith effort to identify the correct parties and valid addresses. Alleman Direct, Ex. A ¶¶ 4, 26-28, 44-46, 62-64, 80-82, 98-100, and 105; GNM Exs. A-4 to A-9; Alleman 4/24/25 Tr., 64:15-65:21; 70:8-71:6; 71:20-72:8; 78:9-82:20; 134:1-10 ("shall furnish" NMAC 19.15.2.7); 139:17-140:10.

13. For each application, Goodnight also provided constructive notice by publication in a newspaper of general circulation in Lea County, New Mexico, where the proposed injection wells will be located. Alleman Direct, Ex. A ¶¶ 27, 45, 63, 81, 99, 105 (Andre Dawson C-108 includes a complete administrative notice); GNM Exs. A-4 at 61 (affidavit of publication), A-5 at 42 (same), A-6 at 34 (same), A-7 at 49, A-8 at 40, A-9 (see page following "Public Notice Affidavit").

14. Goodnight has in place access and injection agreements with the private owners of the surface locations for each existing and proposed SWD. Alleman Direct, Ex. A ¶¶ 24, 42, 60, 78, 96; Orders Nos. R-22026/SWD-2403 (Andre Dawson), R-22027 (Ernie Banks), SWD-2307 (Ryno), and R-21190 (Sosa).

15. The proposed SWDs will be for commercial disposal with the following maximum surface injection pressures and injection rates: 820 psi and 42,000 BWPD (Doc Gooden, Hernandez, and Seaver); 840 psi and 42,000 BWPD (Hodges); 825 psi and 40,000 BWPD (Piazza); and 40,000 BWPD (Andre Dawson). Alleman Direct, Ex. A ¶¶ 5, 13, 31, 49, 67, and 85; GNM Exs. A-4 to A-9.

16. The well designs and cement plans for each proposed SWD will protect freshwater and underground sources of drinking water ("USDWs") and will protect correlative rights. Alleman Direct, Ex. A, ¶¶ 20, 38, 56, 74, 92; 18-19, 35, 54-55, 72-73, 90-91 (cement bond logs); 25, 43, 61, 79, 97 (maps and sampling for USDWs); GNM Exs. A-4 to A-9; Alleman 4/24/25 Tr., 142:17-143:20.

17. The San Andres, including Goodnight's injection interval, is not stratigraphically or temporally equivalent to the Capitan Reef Complex establishing that they are not in communication. White Rebuttal, Ex. I; GNM Exs. I-1; White 4/25/25 Tr. at 132:15-149:4; McGuire Rebuttal, Ex. B ¶¶ 58-88; GNM Exs. B-53-61; Tomastik Rebuttal, ¶¶ 31-36; Trentham 2/27/25 Tr. 819:13-14 (Capitan Reef and San Andres are not in communication); Lindsay Direct, Ex. B at 3, Empire Ex. B-3; id. Tr. 2/24/25 173:7-11, 188:1-189:5 (stating no lateral communication).

18. The half-mile AORs for each application confirmed no reviewed wells create potential conduits for migration of injection fluids out of the injection zone. Alleman Direct, Ex. A ¶¶ 21-22, 39-40, 57-58, 75-76, 93-94, 105; GNM Exs. A-4 to A-9 (showing AOR tabulations)

19. The top of the injection intervals for each SWD Goodnight operates within the EMSU do not extend above Goodnight's permeability barrier, nor do any of the proposed SWDs. McGuire

Direct, Ex. B ¶¶ 38-43; Alleman Direct, Ex. A ¶¶ 13, 31, 49, 67, 85, and 104 (listing top of disposal intervals at depth deeper than permeability barrier).

20. The Division previously determined that Goodnight's applications for its existing SWDs were duly filed under Rule 19.15.26.8 NMAC and that Goodnight "presented satisfactory evidence that all requirements prescribed" by that rule had been met. Orders Nos. R-21190 ¶¶ 14-15, R-22026/ SWD-2403 (different phrasing), R-22027 ¶ 10 (different phrasing), SWD-2307 at 1.

PROCEDURAL BACKGROUND

21. Goodnight filed Case Nos. 23614-23617 and 23775 for administrative approval, they were protested by Empire, consolidated, and referred to the Commission to be heard with Commission Case No. 24123, a de novo hearing on the Piazza SWD R-22869-A. *See* GNM Exs. A-2 (Order No. R-23048) and A-3 (Order No. R-22869-A); Alleman Direct, Ex. A ¶¶ 5-7

22. Rice Operating Company ("Rice"), Permian Line Service, LLC ("Permian"), and Pilot Water Solutions SWD, LLC ("Pilot"), intervened to contest Empire's Case Nos. 24018-24020, and 24025, but do not oppose Goodnight's cases; they attended the hearing that lasted approximately five weeks distributed between February 18 and May 21, 2025.

23. The OCD initially appeared in the consolidated cases but then withdrew its case after Goodnight Goodnight agreed to implement a monitoring program within and around the Capitan Reef Aquifer System that "satisfies the requirements imposed upon [OCD] by the" U.S. EPA. OCD 5/15/25 Notice of Dismissal; *id.* at Standalone Agreed-To Administrative Order, § I.A (dismissing its case but noting dismissal "shall not be construed as limiting in any way OCD's ability to pursue separate remedies or actions against Empire or any other operator potentially impacting water quality in the Capitan Reef.").

EMPIRE'S APPLICATIONS TO REVOKE GOODNIGHT'S EXISTING SWDS

24. In Case Nos. 24018-24020, and 24025, Empire seeks to revoke Orders Nos. R-22026/SWD-2403, R-22027, SWD-2307, and R-21190, respectively, which authorize Goodnight to dispose produced water into the San Andres formation within the EMSU through its Andre Dawson SWD #1, Ernie Banks SWD #1, Ryno SWD #1, and Sosa SA 17 SWD No. 2 wells, respectively. Applications in Case Nos. 24018, 24019, 24020, and 24025, filed 11/7/2023 (Empire Applications).

25. Empire's Applications allege, *inter alia*, that: (1) Goodnight is disposing of water within the EMSU's unitized interval; (2) Goodnight misrepresented that the San Andres is a non-productive zone known to be compatible with Goodnight's disposal fluids; (3) residual oil zones ("ROZ") are found within the San Andres; (4) Goodnight's disposal is more saline than the San Andres formation waters; (5) San Andres disposal impairs Empire's ability to recover hydrocarbons from the unitized interval and adversely affects Empire's correlative rights and results in waste; and (6) revocation of disposal authority will prevent waste of recoverable hydrocarbons and protect correlative rights. *See generally*, Empire Applications.

Empire Background & Activities

26. Empire purchased the EMSU, EMSU-B, and AGU with some offsetting wells and leases, from XTO Holdings, LLC for a nominal price of $17.8 million dollars with the intent of pursuing an ROZ development in all three units, but did not conduct on-site due diligence to inspect the properties and stopped due diligence that was being prepared by a

consultant in December 2020 about one month after XTO opened the data room. Wheeler Direct, Ex. A ¶ 10; Wheeler 4/8/25 Tr., 171:7-172:1, 174:1-4, 241:11-19; *Id.* 4/9/25 Tr., 91:21-24; GNM Cross Ex. 13. **At the time Empire purchased the EMSU, it understood the base of the ROZ was at -700 feet subsea depth.** Wheeler 4/8/25 Tr. 181:11-14; GNM Cross Ex. 13

27. Empire did not become aware of the third-party commercial San Andres disposal operations in the EMSU, including Goodnight's operations, until August 2023 when visiting the field. Wheeler 4/9/25 Tr., 9:9-22, 29:22-31:8. **During the August 2023 field visit, Empire realized as part of the purchase it also acquired more than $56 million in plugging liability and outstanding environmental remediation costs.** Wheeler 4/9/25 Tr., 18:21-19:24, 23:5-24:10.

28. Empire's management issued an order in August 2023 to suspend its planned Grayburg waterflood operations for 2023 and 2024 when it discovered SWDs injecting into the San Andres within the EMSU. Wheeler 4/8/25 Tr. 216:15-24, 220:2-20; *Id.* 4/9/25 Tr. 25:8-27:25. Empire's position is that all SWDs within a 2-mile radius of the EMSU, EMSU-B, and AGU should be shut in. *Id.* Tr., 212:18-22-213:14.

29. During 2023, Empire reported a net income loss of $12.4 million, its working capital decreased from $5.1 million at the end of 2022 to negative $6.3 million due to debt incurred in North Dakota, and was required to report that there was "substantial doubt" about whether Empire could maintain itself as a "going concern." GNM Cross Ex. 15 at 12, 27-28, 44-45. **During 2024, Empire's net income loss increased to $16.2 million, its working capital further dropped to negative $8.9 million due to debt incurred in North Dakota, and was again required to report that there was "substantial doubt" about whether Empire could maintain itself as a "going concern."** GNM Cross Ex. 17 at 27, 32, 47-48.

30. Empire filed lawsuits seeking claims against Goodnight and other commercial San Andres SWD operators within the EMSU, including Pilot, Permian Line Service, and Rice Operating. Wheeler 4/8/2025 Tr. 213:18-22; *id.* 4/9/2025 Tr. 105:13-106:3. Mr. Wheeler acknowledged that, because Empire failed to do its due diligence as provided for in the purchase and sale agreement to acquire the EMSU, EMSU-B, and AGU, it is instead "trying to utilize the Commission . . . to more or less right some wrongs that Empire should have known better" than to incur. Wheeler 4/9/25 Tr. at 33:3-11.

31. Since purchasing the EMSU, EMSU-B, and AGU, Empire has undertaken no effort to identify or further define or delineate an ROZ across of the three units: It has not drilled or cored any new wells and has not collected any mud logs. Wheeler 4/9/25 Tr., 26:4-25, 91:25-93:10.

32. Other than Empire management's order to suspend operations, nothing is preventing Empire from pursuing and evaluating a potential ROZ in the San Andres at the AGU or any of the units it operates. Wheeler 4/9/25 Tr., 95:6-13; Davidson 4/21/25 Tr. 233:19-21; 255:20-256:22 (nothing is preventing Empire from drilling and coring a well to see if an ROZ profile exists).

EMSU UNITIZED INTERVAL AND SPECIAL POOL

33. In 1984, Gulf filed three applications with the OCC. In Case No. 8397, Gulf sought approval of the EMSU as a statutory waterflood unit. In Case No. 8398, Gulf sought approval for waterflood injection for secondary recovery in the Grayburg and Lower Penrose formations within proposed EMSU. In Case No. 8399, Gulf sought to create a special pool within the Unit Area from the top of the Grayburg formation or to a subsea datum of -100 feet, whichever is higher to a lower limit at the base of the San Andres formation. After notice and hearing, the OCC entered Order No. R-7765 approving the EMSU as a statutory waterflood and created a special pool under Order No. R-7767, mirroring the unitized interval. McGuire Direct, Ex. B ¶ 2.

34. The EMSU Unit Area encompasses ~14,189.84 acres located in portions of T20S, R36E, Secs. 25 and 36; T20S, R37E Secs. 30, 31, and 32; T21S R36E Secs. 2-4, 12-14, 21, and 22, N.M.P.M. Empire Ex. A-6, ¶ 3.

35. Ray Hoffman, Gulf's geologist, testified that the oil-water contact in the EMSU was at -325 feet subsea and that this depth determined the lower limit of oil production in the EMSU. McGuire Direct, Ex. B ¶ 30; GNM Ex. B-6. Gulf therefore expressly excluded the San Andres from its proposed waterflood injection operations because the oil column was limited to the Grayburg and Lower Penrose. McGuire Direct, Ex. B ¶ 29.

36. The San Andres was not included in the EMSU based on a finding it was productive of hydrocarbons or had been reasonably defined by primary production but because it was the only water source sufficient for the waterflood. Wheeler 4/8/25 Tr., 167:23-168:2; McGuire Direct, ¶¶ 30-32; GNM Ex. B-7; GNM Exs. B-5, B-6.1, B-7; McGuire 5/20/25 Tr., 156:7-17.

37. Seven active third-party commercial SWDs currently inject produced water into the San Andres within the boundaries of the EMSU, as follows: Permian Line Service's N 11; Rice Operating's EME 21; Pilot/OWL SWD Operating's P 15; and Goodnight's Banks, Ryno, Sosa, and Dawson wells. McGuire Direct, Ex. B ¶ 46; GNM Ex. B-8.

38. Multiple SWD San Andres injection wells ultimately within or just outside the EMSU pre-existed unitization of the EMSU, were continually used for that purpose after unitization, and thus, unitization of the EMSU did not change the purpose of the San Andres disposal zone. GNM Ex. B-47 (showing the EME #33 SWD, EME #21 SWD) McGuire Direct, Ex. B ¶ 26. Other SWD wells were also permitted within the EMSU Unit Area after unitization and prior to Goodnight's applications for its current SWDs. GNM Ex. B-47.

SAN ANDRES IS NON-PRODUCTIVE AND SEPARATE FROM THE GRAYBURG

39. The San Andres has been a water management zone for commercial produced water disposal and water supply since at least the 1960s. McGuire Direct, Ex. B ¶ 25; GNM Ex. B-47.

40. The San Andres was first used as a disposal zone in and around where the EMSU was later created when Rice drilled the EME #33 SWD in April 1960. Rice subsequently drilled the EME #21 SWD in September 1966. McGuire Direct, Ex. B ¶ 26; GNM Ex. B-47. The EME #33M SWD is within 175 feet of the EMSU and has injected about 59.9 MMBBLS into the San Andres on vacuum. McGuire Direct, Ex. B ¶ 70; GNM Ex. B-47; Wheeler 4/8/25 Tr., 15:13-18. The EME #21 SWD is located within the EMSU and has injected about 43 MMBBLS on vacuum. McGuire Direct, Ex. B ¶ 26; GNM Ex. B-47; Wheeler 4/8/25 Tr., 15:13-18. In 1975, the Trucker SWD was converted to commercial disposal in the EMSU and injected 1.08 MMBBLS into the San Andres before being plugged. GNM Ex. B-47.

41. The EMSU was unitized in 1984 around existing commercial produced water disposal wells that had already injected tens of millions of barrels into the San Andres for more than 20 years. McGuire Direct, Ex. B ¶ 32; GNM Ex. B-7; Wheeler 4/9/25 Tr., 17:5-13. In 1987, Chevron, operator of the EMSU, converted the EMSU SWD #1 to San Andres disposal that has been used by Empire for produced water disposal until early February 2025. McGuire Direct, Ex. B ¶ 26. EMSU SWD # 1 has injected 4.4 MMBBLS. McGuire Direct, Ex. B ¶ 46; GNM Ex. B-47; McShane 4/8/25 Tr., 8:6-22:4.

42. EMSU operators used six water supply wells ("WSW") to supply water from the San Andres for waterflood operations in the EMSU. McGuire Direct, Ex. B ¶ 48. **Since 1985, the EMSU WSWs have withdrawn more than 350 MMBBLS of water from the San Andres within the EMSU.** McGuire Direct, Ex. B ¶¶ 51-52; ¶¶ 66-68; GNM Ex. B-18. **Once drilled and producing, WSW could withdraw nearly 90,000 barrels of water per day to supply 122 injection wells as part of the EMSU waterflood.** Tomastik Direct, Ex. C ¶¶ 34-35; id. 4/25/25 Tr. 87:19-88:7.

43. **The WSWs have not reported oil production or skim oil.** McGuire Direct, Ex. B ¶¶ 111,161; McGuire 5/20/25 Tr. at 71:14-15; 73:12-15; 74:7-76:3; Knights Direct, Ex. E at 4; McShane 4/8/25 Tr., 25:14-18; 26:1-5; Tomastik Direct, Ex. C ¶ 65

44. **At the time the EMSU was created, "[n]o wells ha[d] produced from the San Andres at EMSU[.]"** West Direct, Ex. I at 5 ¶ 6; Empire Ex. I-4; West 4/9/25 Tr., 166:2-3; 218:11-12; 219:12-23; West 4/11/25 Tr., 31:6-8; Wheeler 4/8/25, Tr. 100:23-101:13. Division records confirm there has never been reported primary production from the San Andres at the EMSU. McGuire Direct, Ex. B ¶ 25; West, 4/9/25 Tr., 218:11-12; 219:12-23; Lake Direct, Ex. G ¶ 10 ("There is no oil production from the San Andres aquifer in the EMSU."). There are no accumulations of conventional oil within what Empire defines as the San Andres in the EMSU. West 4/9/25 Tr., 218:13-18; Empire Ex. N-12.

45. **Over an 11-year period from 1987 to 1998, the WSWs "averaged a produced water rate of more than 60,000 BWPD" which is "magnitudes more volume than what is described as needed to test a ROZ," according to Dr. Trentham**. McGuire Rebuttal, Ex. B ¶¶ 30-31.

46. **Empire's expert petroleum geologist agreed that the Grayburg and San Andres formations are "different reservoirs from a geologic standpoint[.]"** Bailey 2/25/25 Tr., 328:3-4; *id.* Tr., 311:9-312:1; 329:7-9; 424:8-14; Bailey Direct, Empire Ex. K at 4; Knights 4/22/25 Tr., 64:1-7; 109:12-112:4; 131:7-24; 157:19-24; 218:8-17; Knights 4/23/25 Tr., 18:17-19:1; 109:12-112:4; 115:8-12; Knights Direct, Ex. E, at 6-7, 8-9, Fig. 14; Knights Rebuttal, Ex. E at 5-6 ("Vertical isolation across the Grayburg Reservoir zones is supported by the presence of distinct depletion and water drive mechanisms within the Grayburg Reservoir, as well as the absence of extraneous water influx into the EMSU."); Davidson Direct, Ex. D at 30; Davidson Rebuttal, Ex. D at 3, 41; Davidson Sur-Rebuttal, Ex. D at 9, Fig. 9; Davidson 4/21/25 75:7-76:14; 188:19-20; 237:1-4; 238:8-17; Tomastik Direct, Ex. C ¶ 14; Tomastik 4/25/25 Tr. 110:23-111:6.

47. They act as separate reservoirs due to a geologic seal between them. McGuire Direct, Ex. B ¶¶ 6, 49-50, 54, 56, 24, 107; McGuire Rebuttal, Ex. B at ¶¶ 3-5; GNM Exs. B-8, B-9, B-10 to B-10.5, B-25, B-27; McGuire, 5/20/25 Tr. at 121:2-13. **Dr. Davidson testified that the preponderance of the evidence establishes that what he calls the Upper San Andres and the Lower San Andres—where GNM's disposal zone is located—"are two different systems" that do not communicate with each other, and that there's currently enough data before the Commission, including the lack of interference in Empire's Grayburg waterflood production, and the loss of circulation when operators drill through the permeability barrier, to conclude that the systems are separate**. Davidson 4/21/25 Tr. 237:1-4, 238:11-17.

INJECTION INTO SAN ANDRES DISPOSAL ZONE IS CONFINED

48. The presence of an effective confining layer between the San Andres disposal zone and the overlying Grayburg formation is proven by the presence of a sustained and substantial regional pressure differential. McGuire Direct, Ex. B ¶ 105; Tomastik Direct, Ex. C ¶¶100-101.

49. Numerous vertical permeability barriers extend across the EMSU that, in the aggregate, isolate the San Andres disposal zone from the overlying reservoir and production. Knights Direct, Ex. E at 1, 6-7, Fig. 9; Knights Sur-Rebuttal, Ex. E, Fig. 3; Knights 4/22/25 Tr., 63:16-25; 64:1-7; 201:4-18;215:16-24; 242:15-24; 250:4-7; Knights 4/23/25 Tr., 114:17-21 ("[I]n aggregate, when you have multiple different analysis techniques, they come up with a significant number of perm barriers over a small stratigraphic interval, [] those are just demonstrative of a vertical perm barrier."); Davidson Direct, Ex. D at 29; Davidson Rebuttal, Ex. D at 40; Davidson Sur-Rebuttal, Ex. D at 9, Fig. 9; Lake 4/24/25 Tr., 213:7-11 (intervals of 2-4 feet of less than 0.1 millidarcy can be established as a permeability barrier zone); *id.*, 182:20-183:2 (stating there are a collection of barriers, probably not a single barrier, separating the zones and the "pressure indication is definitely noncommunication."). RFT measurements from 1986 taken in the EMSU 211, 225, 247, 434, 442, and 458 wells showing large differences in pressure over short vertical intervals, show that the formations can support large pressure differences and are therefore not connected at all. McBeath 4/11/25 Tr. 115:9-116:9, 119:22-120:6; McBeath Rebuttal, Ex. F ¶ 26.

50. In the EMSU-679 core, there are 29 different intervals across 179 vertical feet, from approximately -590 feet subsea to -765 feet subsea, that have vertical permeabilities of less than 1 millidarcy "that individually could be permeability barriers but in aggregate are significant permeability barriers to vertical flow[,]" (Knights 4/23/25 Tr., 13:9-21:25) especially in combination with relatively higher permeability intervals interbedded throughout that serve as a lateral pathway for fluid flow, "so it is not just the low perm intervals that are barriers to vertical flow, it's also these high perm intervals." *Id.* 17:11-14; 13:9-21:25; 24:24-25:2; 45:22-46:5; 79:25-80:2 (referring to Empire Tables B-1 through B-9 for core vertical permeability measurements); 114:17-21; Tomastik Direct, Ex. C ¶¶ 108-110; GNM Exs. C-6, C-7.

51. The San Andres WSWs saw no decline in the ability to produce water for the EMSU waterflood despite the Grayburg having been depressurized through primary production. The San Andres WSWs supplied enough water to fill the EMSU gas cap and re-pressure the depleted Penrose-Grayburg oil column in the EMSU, demonstrating pressure separation. McGuire Direct, Ex. ¶¶ 106-107; Knights Direct, Ex. E at 4; Tomastik Direct, Ex. C ¶ 98;Tomastik 4/25/25 Tr. 62:10-63:6; Tomastik 4/25/25 Tr. 58:8-59:2; 102:5-22.

52. In contrast, the history of production from the Grayburg shows behavior typical of a solution gas drive reservoir, having a rapid decline in reservoir pressure without a rapid rise in water production, explaining why a waterflood was enacted in the EMSU to re-pressure the reservoir and sweep remaining oil. McGuire Direct, Ex. B ¶ 105. The Grayburg has now been pressured up under continuous waterflood. McGuire Direct, Ex. B ¶ 109; GNM Exs. B-22, B-23.

53. The pressure differential between the Grayburg and San Andres has been maintained for 35 years without equilibration fluid communication. McGuire Direct, Ex. B ¶¶ 42, 107, 114, 116, 124 (noting Dr. Lindsay states five separate times in his dissertation that there is a reservoir seal); GNM Ex. B-25 at 535 (Dr. Lindsay dissertation: "It has been found that the composite sequence boundary at the top of the Upper San Andres Formation acts as a reservoir seal and does not allow fluids to communicate with Grayburg Formation fluids. **The ultimate test has come from pressure data that shows one pressure system associated with the Upper San Andres Formation and a different pressure system associated with the Grayburg Formation**."); McGuire 5/19/25 Tr., 70:19-73:1; 307:9-13; McGuire 5/20/25 Tr., 153:23-154:20; Knights 4/22/25 Tr., 67:11 (San Andres is "under-pressured"), 67:10-20, 67:25-68:6, 218:8-17; Davidson, 4/21/25 Tr., 207:7-208:24 (San Andres is under-pressured); Lindsay 2/24/25 Tr., 154:7-24. "The Grayburg and San Andres formations show pressure differences between the producing reservoir and the disposal aquifer. **Consistent and significant pressure differences like this are conclusive evidence of lack of communication**." Lake Direct, Ex. G at 3; Lake 4/24/25 Tr., 162:8-11 ("Pressure to me is the most definitive aspect of barriers and so if you can see things in the pressure that's a barrier."), 212:22-25 ("I think, based upon the pressures, yeah, I think it's [impermeable layers in the San Andres] been well established."); *id.*, 164:23-25 **("[P]ressure behavior indicates literally no communication between the disposal unit and the Grayburg**.").

54. Each of Goodnight's 11 SWD wells in and around the EMSU all held a column of drilling fluid in the Grayburg formation but experienced complete loss of circulation when drilling below a confining layer that isolates the San Andres disposal zone, establishing the presence of an effective barrier. McGuire Direct, Ex. B ¶¶ 115-118; GNM Ex. B-20; McGuire Rebuttal, Ex. B ¶ 28; McGuire 5/20/25 Tr., 210:10-24; 41:16-42:8; Knights Direct, Ex. E at 4, 6-7, 8-9, Fig. 14; Davidson Direct, Ex. D at 4, 29-30, Appx. B (loss circulation flags); Davidson Rebuttal, Ex. D at 2, 40-41; Davidson Sur-Rebuttal, Ex. D at 9; Knights 4/22/25 Tr., 131:7-24 ("Loss circulation is where you have a change in the reservoir, the pressure differential, indicating that you have a barrier on top and a barrier on bottom . . . So, I think each one of these loss circulations, the top of those is a distinct permeability barrier from everything above it."); 132:5-8; 157:19-24; 109:12-112:4; Knights 4/23/25 Tr., 18:17-19:1; 38:3-45:8; 46:17-23; 109:12-112:4; 115:8-116:2; Tomastik Direct, Ex. C ¶ 34. Rice also loses circulation when they drill into the San Andres disposal zone, and their well take fluid on vacuum. McGuire Supplemental, Ex. E ¶ 8; McBeath Supplemental, ¶ 5; McBeath 4/11/25 Tr., 155:25-157:14.

55. Shut-in fluid levels in Goodnight's EMSU SWD wells taken on July 20, 2024, establish an average pressure gradient of approximately 0.381 psi/ft, which is much lower than a normal pressure gradient of 0.465 psi/ft. McGuire Direct, Ex. B ¶ 120; GNM Ex. B-21

56. The only pressure data that Empire reported for its EMSU Grayburg waterflood injection wells show the average shut-in tubing pressure to be 471 psi, which calculates to an average pressure gradient of 0.587 psi/ft, above that of a normally pressured reservoir and higher than the pressure gradient in the San Andres disposal zone. McGuire Direct, Ex. B ¶ 121; GNM Exs. B-21, B-22; *see also* McGuire Direct, Ex. B ¶¶ 122-123.

57. Empire's EMSU shut-in well pressures average 524 psi in the Grayburg, whereas all GNM's SWDs in the EMSU shut-in with negative wellhead pressures. McGuire Rebuttal, Ex. B ¶ 28; GNM Exs. B-45, B-11, B-12, B-22, B-23.

58. Goodnight's disposal zone within the San Andres aquifer is characterized by its ability to sustainably accept large volumes of produced water at very low operating pressures. McGuire Direct, Ex. B ¶ 6; GNM Ex. B-64; Knights 4/22/25 Tr., 251:7-252:2 ("[T]the strongest evidence" for no communication "is material balance, which is volumes and pressures," and the limited change in pressures in the San Andres for the volumes of water that were both extracted and injected "is just amazing" and "a unique situation[.]"). Goodnight's SWDs go back on vacuum within about 60 seconds after shutdown indicating any injection pressures are related to friction and not formation pressurization. Tomastik Direct, Ex. C ¶ 89.

59. "Any activity above -500, or above -700, and below -700 are going to be completely isolated" so Empire can potentially develop an ROZ in the shallower EMSU intervals while Goodnight continues to dispose of produced water in the interval below -700 feet subsea. Knights 4/22/25 Tr., 65:10-19; 219:14-18. No evidence supports concluding Goodnight's disposal cannot continue in the San Andres disposal zone, a reservoir separate and isolated from the EMSU operations in the Grayburg above, so the two activities can coexist. McBeath 4/11/25 Tr., 161:6-163:19; 192:17-23; *id.* 4/23/25 Tr., 226:3-23.

No Evidence of Fracture Communication with San Andres Disposal Zone

60. The only direct evidence Empire's geologist Joseph McShane relies on for his opinion that fracturing allows communication between Goodnight's disposal zone and the reservoir above is the EMSU-679 fracture study prepared by Dr. Lindsay. McShane, 4/8/25 Tr., 87:20-90:15; 91:16-20; 99:24-101:2; West 4/11/25 Tr., 11:17-12:10 (admitting that the EMSU-679 fracture study is a single data point, which is not sufficient to make a decision).

61. Dr. Lindsay points to no new data or information establishing the existence of fractures in the EMSU since his 2014 dissertation when he wrote there is a "reservoir seal" establishing different pressure regimes between the Grayburg and San Andres that would justify a different conclusion. Lindsay Direct, Ex. B. 10; McGuire Direct, Ex. B ¶¶ 125-127.

62. Mr. McShane did not correlate the depths of the fractures identified in the EMSU-679 core fracture study with Goodnight's permeability barrier because he does not know the depth of Goodnight's permeability barrier. McShane, 4/8/25 Tr., 82:19-25; 83:16-86; 85:15-86:25; 87:20-90:15; 88:18-22; 91:16-20; 99:24-101:2

63. Dr. Lindsay also testified he had not reviewed GNM's testimony or exhibits and did not even know where GNM's disposal zone interval was or where GNM had identified a permeability barrier, and was not asked by Empire to evaluate that. Lindsay 2/24/25 Tr., 90:24-93:6, 161:14-21.

64. Dr. Lindsay's fracture study on the EMSU-679 core does not extend into or through Goodnight's identified permeability barrier because the deepest rock analyzed for fractures is no deeper than 4,180 feet and the confining layer that isolates the Grayburg from Goodnight's disposal zone starts at 4,268 feet, which is deeper by about 88 feet. McGuire Direct, Ex. B ¶¶ 126-128; GNM Ex. B-27; Knights Rebuttal, Ex. E at 4; Lindsay Rebuttal., Ex. J. at 8 ("The remainder of the EMSU-679 cored interval . . . from 4180' to 4258' (178' total) were not oriented and were not included in the fracture study.); Tomastik Rebuttal, Ex C. ¶ 19; Davidson Direct, Ex. D, Appx. B (679 well showing GNM San Andres top); Lindsay Rebuttal, Ex. J, Appx. 1 (supplemental fracture study that does not identify fracture depths or correlate to GNM's permeability barrier); Lindsay 4/24/25 Tr., 154:20-155:4.

65. The largest fractures observed were only three feet in length, far from Goodnight's identified permeability barrier, and not long enough to connect the Grayburg to Goodnight's disposal zone nearly 90 feet below. McGuire Direct, Ex. B ¶ 127; Knights Rebuttal, Ex. E at 4; Lindsay 4/24/25 Tr., 220:5-7 (doesn't know distribution of fractures or width); Tomastik Direct, Ex. C ¶¶ 111-115; Tomastik Rebuttal, Ex. C ¶¶ 23-24; *id.* 4/25/25 Tr. 68:13-69:7.

66. The fractures identified by Dr. Lindsay have been mineralized, no longer conductive pathways for fluid, and are located within a 100-foot interval of ~0mD permeability rock. McGuire Rebuttal, Ex. B ¶¶ 3-5; GNM Ex. B-34; McGuire, 5/19/25 Tr., 295:2-21; Lindsay Direct, Ex. B. at 5; Empire Exs. B-12, B-15; Lindsay Rebuttal, Ex. J, Appx. 1 at 3 ("EMSU pyritized fractures are common").

67. Contrary to Empire's testimony, there is no documented fracture network extending into the San Andres below the impermeable barrier causing communication with the Grayburg nor any evidence of plumes of water from the San Andres disposal zone vertically encroaching into the Grayburg. Tomastik Direct, Ex. C ¶ 33; id. 4/25/25 Tr. 56:9-14; **The EMSU-679 core shows**

a thick zone of low vertical permeability rock at GNM's confining layer starting at 4,268 feet. GNM Ex. B-27.

68. If there were extensive fracturing in Goodnight's permeability barrier the sustained and extensive pressure differential between the reservoirs could not have been maintained for decades. McGuire 5/20/25 Tr., 205:13-206:3; 92:24-93:1; Lindsay 2/24/25 Tr., 154:14-20 (continuous pressure differences indicate a seal).

Grayburg Water Production Does Not Show Communication

69. Goodnight's four existing SWDs in the EMSU each inject about 15,000 BBLS per day or about 60,000 BBLS per month total into the San Andres, excluding EMSU San Andres disposal by other third-party SWD operators. McGuire Direct, Ex. B ¶ 81; GNM Ex. B-13.

70. As of September 2018, a total of about 131.5 MMBBLS of produced water have been injected into the San Andres aquifer in and around the EMSU by third-party commercial disposal operators at the Goodnight commenced injection into its first San Andres disposal well in the area. McGuire Direct, Ex. B¶ 131

71. Current water production volumes from the Grayburg do not show impact from produced water disposal in the San Andres disposal zone. Davidson Sur-Rebuttal, Ex. D at 9; Knights Rebuttal, Ex. E at 1 (injection-withdrawal ratio balancing do not show communication), 6 (noting "absence of extraneous water influx into the EMSU"); McGuire Rebuttal, Ex. ¶ 7-8 (Empire Ex. I-18 shows Grayburg EMSU water production remaining constant).

72. Empire injects about 70,000 barrels of water per day into the Grayburg waterflood at the EMSU and produces about 70,000 barrels of water per day from its Grayburg producers. West Direct, Ex. I at 2; Empire Ex. I-18; West 4/10/25 Tr., 121:16-20 (Empire Ex.I-18 is the only data Empire has provided on alleged impacts to production); West 4/11/25 Tr., 48:41-49:13; 51:13-52:4 (**unable to identify specific water production data showing impacts and conceding that "it's hard to say what has been coming in . . . . You can't tell where it's coming in."**).

73. Empire has not, and cannot, point to production data from any particular EMSU well that shows evidence of impacts from Goodnight's disposal. McGuire Rebuttal, Ex. B ¶ 9; Lindsay 2/24/25 Tr., 144:5-145:19 (Lindsay is unable to identify a single well in the EMSU that shows communication); Lindsay 2/24/25 Tr., 146:11-16 (Lindsay points to the EMSU-B-887, but that well is in the EMSU-B not the EMSU and is miles away); Lindsay Rebuttal, Ex. J, Appx. 1 (EMSU- B-887 was part of an oriented core fracture study that does not identify fracture depths or correlate to GNM's permeability barrier).

74. There has never been any evidence that San Andres disposal injection has interfered with the Grayburg producing zone since San Andres disposal began at the EMSU more than 60 years ago. McGuire Direct, Ex. B ¶ 36.

75. There were never claims by any previous EMSU operator that San Andres disposal interfered with Grayburg production or EMSU operations. McGuire Direct, Ex. B ¶ 131.

76. Empire's witnesses were unable to identify any literature, data, or study establishing that San Andres water has been "pluming" into the Grayburg before the start of the EMSU waterflood. *Compare* West 4/9/25 Tr., 199:15-19 (stating it is well documented in public literature that San Andres water has "plumed" into the Grayburg in the EMSU) *with* 228:14-22 (unable to cite to a single reference). The three papers Mr. West ultimately cited [(1) the April 1983 Technical Committee Report (GNM Cross Ex. 19); (2) 1998 Tracy Love SPE Paper (GNM Cross Ex. 1); and (3) the 1996 Chevron NACE Paper (GNM Ex. B-5)] do not state that the San Andres water is "pluming" or even migrating into the Grayburg formation. West 4/9/25 Tr., 229:3-20; Knights 4/22/25 Tr., 49:2-7 (unable to identify any literature or discussion of San Andres water pluming through fractures).

77. Dr. Lindsay testified it was "common knowledge" there were "water plumes" extending up from the San Andres into the Grayburg but no one mapped them at the EMSU except for Tracy Love who mapped them in an SPE paper "on a well-by-well basis[.]" Lindsay 3/24/25 Tr., 98:12-99:3.

78. When pressed, Dr. Lindsay testified that the 1998 Tracy Love SPE paper (GNM Cross Ex. 1) "had nothing to do with vertical migration" of San Andres water into the Grayburg but instead identifies "conformance problems," does not include or reference vertical pluming from the San Andres, and has no bearing on the issues the Commission is evaluating in the case, contradicting Mr. West. *Compare* West 4/9/25 Tr., 22:5-25:24 *with* Lindsay 3/24/25 Tr., 113:9, 136:1-11, 109:18-110:1, 111:7-16, 242:13-243:8. Other than the 1998 Tracy Love SPE paper (GNM Cross Ex. 1), Dr. Lindsay could not identify published materials identifying movement of injected water from the San Andres into the Grayburg. Lindsay 3/24/25 Tr., 218:8-15.

79. When asked if the vertical plumes he described in testimony exist in the EMSU, Dr. Lindsay testified that "we didn't know of a plume" in the EMSU but knew of one in the EMSU-B, and that he "assume[s]" there are fractures. Lindsay 2/24/25 Tr., 203:9-12, 205:4-13.

80. As of 2000, Chevron had prepared a full-field simulation model showing through an injection and production allocation analysis that all water production was accounted for with no evidence of extraneous water influx into the EMSU other than encroachment of edge water. McGuire Rebuttal, Ex. B ¶¶ 50-51; GNM Ex. 50; Knights Rebuttal, Ex. E at 5.

81. "Water is being sucked from the Goat Seep" from 1.5 to 2 miles away, "through the Grayburg, up-dip into EMSU, and coming in as edge water[.]" Lindsay 2/24/25 Tr., 34:8-10; 32:18-34:10, 189:16-190:1; Lindsay Direct, Ex. B. at 7-8; Empire Exhibit B-27. The Goat Seep extends from the EMSU to the Gaudalupe Mountains to the southwest and to the Glass Mountains to the south, but the true size and thickness is unknown. Lindsay Direct, Ex. B at 4; Lindsay 2/24/25 Tr., 227:3-12, 229:12-19.

82. Chevron measured the encroachment of Goat Seep water on the structure of the EMSU as a pressure wave across and over the top of the crestal structure more than 250 vertical feet up into the EMSU. Lindsay 2/24/25 Tr., 122:20-122:13; Empire Exhibit B-21.

83. Contradicting Lindsay's testimony on Goat Seep edge water encroachment, and responding to whether Empire had eliminated the possibility that higher water volume production in certain wells could be explained by well completion and perforation histories, Mr. West testified he "can't quite get that water contact to the top of the structure where those high waters are[.]" West 4/11/25 Tr., 54:24-55:16.

84. Starting in the 1930s, edge water encroachment into the EMSU field was documented from the west, southwest, southeast, northeast, and east, establishing that even in the central portion of the EMSU field and on the highest portion of the structure there are zones that extend below the oil-water contact inside and along the flanks of the EMSU. Knights 4/22/25 Tr., 42:6-44:9; 252:3-11; Knights 4/22/25 Tr., 51:19-55:5; Knights Rebuttal, Ex. E, Fig. 6; GNM Cross Ex. 18 at 12-15; Tomastik Direct, Ex. C ¶¶ 18, 66-68; Tomastik Rebuttal, Ex. C ¶ 8; *id.* 4/25/25 Tr. 97:13-98:8. Edge water encroachment along permeability barriers and horizontal bedding planes within the Grabyurg structure explain how edge water encroaching into the EMSU could have caused high water production in wells high on structure in the central portion of the EMSU.

Knights 4/22/25 Tr., 45:6-46:2, 44:10-46:2; Knights Sur-Rebuttal, GNM Ex. E, Fig. 5; GNM Cross Ex. 18 at 12-15

85. The completion history of the EMSU-239, one of the high water producing wells on the top of the EMSU structure, supports this analysis. Completed as an oil well in the Grayburg in 1936, it made about 104 barrels of water a day, then in 1959 was down to about 20 barrels a days, indicating that the reservoir was depleting and isolated from anything below it, when in 1973 it was re-completed below the oil-water contact, resulting in high water production reported in 1981. Knights 4/22/25 Tr., 47:16-49:1; 49:8-11. The immediately offsetting wells, EMSU-230 and EMSU-238, were not completed below the oil-water contact and had much lower water production in 1981. McGuire Direct, Ex. B ¶¶ 129-130 (pointing out that Chevron would not have converted the EMSU SWD #1 to San Andres disposal within 1,320 feet if there was communication); GNM Ex. B-28; McGuire 5/19/25 Tr, 66:24-68:22;

86. Empire did not present any testimony, evidence, or data to rebut GNM's evidence that edge water encroachment and well completions explain the high-water production volumes in certain wells within the EMSU identified in Empire Ex. N-23. The alleged presence of localized fracture pathways are not supported by historic Grayburg water production data from before commencement of the waterflood operation in 1986. McGuire Direct, Ex. B ¶ 125; McGuire 5/19/25 Tr., 242:3-14; 304:19-305:14.

Grayburg Oil Production Does Not Show Communication

87. The EMSU currently produces about 800 barrels of oil per day from the Grayburg. West Direct, Ex. I at 2; Empire Ex. I-18 (9-month daily average is 797 BPD).

88. EMSU's oil production does not reflect an anomalous decline in the most recent 9 months of reported oil production nor is there any indication of impairment to oil production over the entire timeframe GNM has been conducting San Andres disposal operations in the EMSU. McGuire Rebuttal, Ex. B ¶¶ 7-8; GNM Ex. B-40. EMSU oil production is currently experiencing the shallowest decline that has been seen in the life of the field with a lower well count, showing that it can be produced more efficiently, not that there are impacts from disposal operations. McGuire Rebuttal, Ex. B ¶ 7; GNM Ex. B-40.

89. Empire also has not identified production data from any particular well within EMSU that shows evidence of impacts from Goodnight's disposal operations in its production or operation. McGuire Rebuttal, Ex. B ¶ 9; McBeath Rebuttal, Ex. F ¶ 33.

Grayburg Water Chemistry Does Not Show Communication

90. There is no chemical or geochemical fingerprint that shows Goodnight's injection fluids altered the chemistry in the San Andres or Grayburg nor that any injection fluids have caused any corrosion or scaling in the EMSU Grayburg waterflood operation. Tomastik Rebuttal, Ex. C ¶¶ 11-12.

91. San Andres water has been introduced into the Grayburg at the EMSU starting in 1986, so the mere presence of San Andres water in the Grayburg is not diagnostic of unwanted water encroachment. McGuire Direct, Ex. B ¶ 110.

92. Historical Grayburg water samples from before GNM commenced disposal injection show concentrations of total dissolved solids (TDS) have ranged from 5,482 mg/L to 59,126 mg/L; chlorides from 2,200 mg/L to 32,804 mg/L; and sulfate from about 18 mg/L to 4,357 mg/L. West Direct, Exs. I-11, I-12

93. Starting in 2024, Empire collected water chemistry samples from Grayburg producing wells that offset GNM's disposal injection wells after Goodnight had been injecting into the San Andres already for several years. West 4/10/25 Tr., 107:18-24; Empire Ex. N-9. Some of the data collected by Empire that did not support their position, including earlier samples showing some chloride concentrations have decreased and that sulfate concentrations have not increased, were not included in Empire's exhibits. West 4/10/25 Tr., 108:2-111:2

94. All water chemistry samples Empire collected are well within historic ranges for all constituents reported by Empire and other sources. McGuire Rebuttal, Ex. B ¶¶ 18-21, 25-26; GNM Exs.B-5, B-44; West 4/10/25 Tr., 113:11-115:8. TDS and chloride values are within the historic ranges before Goodnight commenced injection. McGuire Rebuttal, Ex. B at ¶¶ 18-27; McGuire 5/19/25 Tr., 61: 16-62:3. Sulfate values are also within historic ranges and are flat to decreasing over time, indicating the absence of communication from the San Andres disposal zone into the Grayburg, according to Lindsay. McGuire Rebuttal, Ex. B at ¶¶ 18-27; GNM Ex. B-42; McGuire 5/19/25 Tr., 60:6-61:3.

95. Mr. West acknowledged that chloride concentrations in Empire Exhibit N-9 do not confirm communication and could be show mixing Grayburg waters with different chloride concentrations or preexisting Grayburg connate water that had total dissolved solids concentrations of about 120,000 mg/L. West 4/10/25 Tr., 114:14-8; Empire Ex. B-21. Empire did not prepare an analysis to show that GNM's disposal fluids are not compatible with the San Andres or Grayburg formation fluids. West 4/10/25 Tr., 160:16-17. Mr. West is not an expert in chemistry or geochemistry. West Direct, Exhibit I, Resume Attachment.

Empire's Fatally Flawed Simulation Model Does Not Show Communication

96. Dr. Buchwalter's compositional model based on inputs provided by Empire is intended to represent fluid flow, pressures, and production in the EMSU, and the model parameters were adjusted until the model fit historical production and pressure data provided by Empire. Buchwalter 2/27/25 Tr., 723:23-724:3; Buchwalter 2/28/25 Tr., 911:5-10; Empire Ex. M-5.

97. The model is 17 miles long and 10 miles wide, includes the EMSU, EMSU-B, and AGU, and 638 wells—including 25 SWDs and 8 WSWs (6 EMSU WSWs and 2 AGU WSWs). Buchwalter 2/27/25 Tr., 728:16-18; 731:3-4; 2/28/25 Tr., 908:3-9; 959:1-18; 1024:4-18; Buchwalter Direct, Ex. E at 2. The San Andres was extended 38 miles to the west in the model. Empire Ex. M-1. The model contains 345,000 cells, each about 300 feet square, and is 10 layers thick—2 Penrose, 5 Grayburg, 3 San Andres. Buchwalter 2/27/25 Tr., 731:4-7; 956:2-22

98. The two most important inputs for the model are the starting reservoir pressure and the geologic inputs. Buchwalter 2/28/25 Tr., 1045:12-15. If the starting pressure is wrong, then the entire model will be wrong. *Id.* 2/28/25 Tr., 928:24-930:22; 1028:20-1029:7. Buchwalter did not confirm the validity or accuracy of the data or input ranges provided by Empire. *Id.* 2/28/25 Tr., 919:6-914:15; 1050:10-18. The quality of the data that goes into the model is up to Empire. Buchwalter 2/27/25 Tr., 726:5-8. If the model is based on bad data, it will provide bad answers. Buchwalter 2/27/25 Tr., 767:12-13.

99. It is not a material balance model because the system is too big to do a material balance. Buchwalter 2/27/25 Tr., 925:5-928:20; McGuire 5/20/25 Tr, 165:7-22 (model is too large to meaningfully support material balancing making it unreliable).

100. The model and Dr. Buchwalter's analysis assumes the EMS-211 RFT measured pressure in Goodnight's disposal interval to conclude that the Grayburg and disposal zone are in pressure communication through fractures. Buchwalter Direct, Ex. E at 3; Buchwalter Rebuttal, Ex. M at 2, 4.

101. The model predicts:

- **a.** The current rate of water influx into the Grayburg from the San Andres is about 23,000-24,000 barrels of water per day. Buchwalter Direct, Ex. E at 3, 5, 6; Buchwalter 2/28/25 Tr., 1028:5-14; 1038:4-14; 1038:24-1039:4; Empire Exhibit M-9.
- **b.** For every 1 million BBLS of produced water injected into the San Andres, the San Andres reservoir pressure will increase 4 psi. Empire Exhibit M-5; Buchwalter 2/28/25 Tr., 1040:22-1043:11; 993:1-6; Empire Exhibit M-3.

102. More detail can be put in the model but "for the answer it was designed to -- for what it was designed to answer, I think [the model] is very adequate." *Id.*, 767:14-17. **The main focus was to "figur[e] out the history match and determine what the leak was between the reservoirs[.]"** Buchwalter 2/28/25 Tr., 949:7-12; Buchwalter 2/27/25 Tr., 729:20-24. The model **assumes** that water is coming up into the Grayburg from the San Andres, as well as from the side and bottom in the Grayburg. Buchwalter 2/28/25 Tr., 950:11-18; 938:2-15. "[P]roof that water is entering from the San Andres" is that wells at the top of the Grayburg structure were producing water prior to the waterflood. Buchwalter, Ex. at 4; *but see* Lindsay Direct, Ex. B at 6, 9, Empire Ex. B-21 (describing Goat Seep edge water encroachment).

103. Buchwalter's reservoir model is not reliable because:

- **a.** The model is simple and homogeneous and does not reflect known reservoir complexities necessary to accurately model it. McBeath Rebuttal, Ex. F ¶¶ 8, 34; McBeath 4/11/25 Tr., 135:2-136:8; 144:15-18; Lake Rebuttal, Ex. G at 7; GNM Ex. B-9. Except for small variations in porosity in the Grayburg layers and specific vertical permeability changes in Layer 8, the model is homogenous—e.g., providing for no variation in horizontal permeability within any of the layers, and porosities constant in Layers 1, 2, 8, 9 & 10. McBeath Rebuttal, Ex. F ¶¶ 29-34; Lake Rebuttal, Ex. G at 3-4; GNM Exs. G-9, G-10; McGuire Rebuttal, Ex. B ¶¶ 38, 42-43, 53-55; McGuire 5/20/25 Tr, 165:23-167:10.
- **b.** Well completion histories that include plugging back, deepening, or recompletions on hundreds of wells are excluded, affecting the accuracy of model production history. McBeath Rebuttal, Ex. F ¶ ¶ 9, 31 (citing SPE Paper 17221); McBeath 4/11/25 Tr., 142:2-143:10; McGuire Rebuttal, Ex. B ¶ 38
- **c.** Water movement is curtailed within the Grayburg with an unusually high immobile water saturation, pushes down the oil-water contact in the Grayburg, contrary to documented contacts making less Grayburg water available, which are **adjustments that artificially starve the Grayburg of water in the model**. McBeath 4/11/25 Tr., 141: 1-19; McBeath Rebuttal, F ¶¶ 12, 32. **The model allows only one possible source of water (the San Andres) and thus Dr. Buchwalter's conclusions are presupposed by the model construction.** McBeath Rebuttal, Ex. F ¶¶ 14, 32-33; McBeath 4/23/25 Tr. at 216:22-218:13. Literature values for Grayburg residual water saturations range from 15%-25% but the model uses 35% which suppresses water movement in the Grayburg, "again focusing the source of the produced water to be the San Andres[.]" Lake Rebuttal, Ex. G at 4, 6-8; GNM Exs. G-11, G-12; Lake 4/24/25 Tr., 171:23-173:24; Lake 4/25/25 Tr. 14:16-22; GNM Cross Ex. 8 at 5.

- **d.** Using variable porosity but constant horizontal permeability is unusual and creates drastic modifications in vertical permeability. McBeath 4/11/25 Tr, 136:25-139:2; Lake Rebuttal, Ex. G at 7; GNM Exs. G-10
- **e.** Well-level pressure history matches were not provided and field-wide matches are based on few data points. McBeath Rebuttal, Ex. F ¶ 10; McBeath 4/11/25 Tr., 144:6-14; 145:12-146:8; McBeath 4/23/25 Tr., 219:19-220:13. RFT measurements in the EMSU-211 illustrate the model fails to accurately represent real pressure differences by assuming a constant pressures over multiple intervals shown to have dynamically different pressures within the Grayburg, affecting the reliability of the calculation involving the time steps and equilibrium that is necessary in the larger cell. McBeath Direct, Ex. F ¶¶ 20-21; McBeath 4/11/25 Tr., at 147:10-148:8.
- **f.** The model does not allow a connection to the documented Grayburg edge water aquifer, nor for the complexity of the stratigraphy in the EMSU. McBeath Rebuttal, Ex. F ¶¶ 11, 33; GNM Cross Ex. 5; McBeath 4/11/25 Tr., 136:10-22; 147:10-148:8; 230:5-18; GNM Ex. F-27; McGuire Rebuttal, Ex. B ¶¶ 38, 49-50
- **g.** The model fails to sufficiently account for the size of the San Andres aquifer, making it inconsistent with Dr. Trentham and Mr. Melzer's fairway mapping in the Central Basin Platform. McBeath Rebuttal, Ex. F ¶¶ 13, 32; McBeath 4/11/25 Tr., 148:21-151:11; 159:2-8; 238:22-239:2; McBeath 4/23/25 Tr., 182:8-23; 215:12-216:10
- **h.** **The EMSU-211 RFT measurement at 4,006 feet (shallower than -500 feet subsea) was above Goodnight's identified permeability barrier, not within the disposal zone, not representative of the pressure in Goodnight's injection interval, and not evidence of communication**. McGuire 5/19/25 Tr., at 313:14-315:5; GNM Ex. B-9, GNM Cross Ex. 20; McBeath Direct, Ex. F ¶¶ 20-21; McBeath 4/23/25 Tr., 173:18-23; Davidson Sur-Rebuttal, Ex. D, Fig. 9; West 4/9/25 Tr., 64:2-6 (agreeing the RFT was measured above the top of Goodnight's permeability barrier); West 4/9/25 Tr., 244:12-246:25 (unable to confirm measurement is in Goodnight's disposal zone)
- **i.** **The model's prediction that 23,000-24,000 barrels of water per day are currently moving into the San Andres does not match EMSU water production data showing the EMSU consistently injects about 70,000 BWPD and produces about 70,000 BWPD**. *Compare* Buchwalter Direct, Ex. E at 3, 5, 6 to West Direct, Ex. I at 2; Empire Ex. I-18.
- **j.** **The model's prediction that for every 1 MMBBLS of produced water injected, the San Andres reservoir will increase by 4 psi does not match recent bottomhole shut-in pressure data showing that after 39.3 million barrels were injected through GNM's 10 SWDs between July 2024 and April 2025 the average bottomhole pressure gradient changed from 0.381 psi/ft to 0.383 psi/ft—which is about a 0.25 psi increase per million barrels injected.** McGuire 5/19/25 Tr., 73:10-74:9; Knights 4/22/25 Tr., 213:6-214:5; 214:14-15; McBeath Supplemental, Ex. F ¶¶ 8-9.

104. The model is missing substantial San Andres volumes over the model's time steps:

- **a.** The model does not incorporate all San Andres water supply wells in and around the EMSU, EMSU-B, and the AGU, nor the volumes that these other water supply wells produced, exceeding 850 million barrels. McGuire Rebuttal, Ex. B ¶ 38-42; McGuire 5/19/25 Tr., 56:1-8; GNM Ex. B19

b. The model does not include all San Andres SWDs in and around the three units or the volumes disposed into these SWDs. McGuire Rebuttal, Ex. B ¶ 38; GNM Ex. B-47

c. The model is missing decades of data for volumes injected for some wells that were included in the model that were injecting prior to 1994. McGuire Rebuttal, Ex. B ¶¶ 38, 45-47

105.If all water supply wells and withdrawal volumes were included that had been left out, the model "would never work, not even close." Buchwalter 2/28/25 Tr., 1027:4-7, *id.* 1026:18-1027:7, 1024:19-25, 1025:1-1026:5; 1108:15-19; GNM Ex. B-19

106. Dr. Buchwalter included only about half of the more than 60 SWDs within 5 miles of the EMSU, EMSU-B, and AGU and for the wells he did incorporate he only included volumes injected after 1994. GNM Ex. B-47; Empire Ex. E-5; **"[Y]ou're not going to come up with the pressure in the San Andres in 1986 and currently if you put in all these wells. So that is real data that needs to be matched."** Buchwalter 4/28/25 Tr., 1031:4-21; 1032:2-15; 1034:10-20; 1035:17-1036:14; 1108:15-19

107. Goodnight considered building its own simulation but decided not to because the input data available is not satisfactory to create a reliable and accurate model and there are too many unknown variables based upon available historical data. McGuire 5/19/25 Tr., 315:6-316:16; McGuire 5/20/25 Tr., 167:12-22; McBeath 4/23/25 Tr., 218:19-219:11 (agreeing that there is insufficient data in the San Andres to support a reliable model).

NO EVIDENCE OF IMPAIRMENT

No Evidence of Water Chemistry Impacts to Production

108.*See*, supra FOF 90-95.

109.At the time the EMSU waterflood was initiated, San Andres water was known to be incompatible with the Grayburg prior to unitization, causing known scaling and corrosion issues. McGuire Direct, Ex. B ¶ 19; GNM Ex. B-5; McGuire 5/19/25 Tr. 64:3-12; McGuire 5/20/25 Tr., 189:3-190:15. The 1983 Technical Committee report and Division Order No. R-22869-A, ¶ 10 denying GNM's Piazza SWD#1, stating that San Andres formation waters are compatible for waterflood operations in the Grayburg, are incorrect. McGuire Direct, Ex. B ¶ 19; GNM Ex. B-5.

110. The EMSU water management system has been distributing and circulating known incompatible San Andres water throughout the EMSU system, wells, surface facilities, since the waterflood started in 1986-1987. West 4/10/25 Tr., 87:21-88:2; McGuire Direct, Ex. B ¶ 110

111.The EMSU has historically experienced barium sulfate scale deposits in many producing oil wells prior to unitization and initiation of waterflood operations demonstrating that scaling problems at the EMSU are not associated with existing San Andres SWDs. Tomastik Direct, Ex. C ¶¶ 37, 43, 58-59, 72, 80 (GNM barium injection concentrations are below barium concentrations documented by Chevron in 1996).

112. Compared to other more aggressive types of corrosion, such as H2S, high chloride concentrations are a minor consideration and are commonly encountered across oil and gas activities. Tomastik Direct, Ex. C ¶¶ 47-51, 58); *id.* 4/25/25 Tr. 69:8-18. As of 1966, Grayburg water had H2S concentrations of 180 mg/L. GNM Ex. C-4; Tomastik Direct, Ex. C ¶ 32; *id.* 4/25/25 Tr. 60:7-10.

113. Goodnight uses a combination of chemical treatments and filtering to inhibit potential scaling and corrosion issues typical for produced water prior to injection at its SWD, applied at their inlets and batteries. Tomastik Direct, Ex. C ¶¶ 83-87; *id.* 4/25/25 Tr. 69:19-24.

114. Scale inhibitor treatments were used by previous EMSU operators to control the barium sulfate scale depositions where analysis indicated treatments were needed, but Empire only commenced chemical treatment protocols around February 2022. Tomastik Direct, Ex. C ¶¶ 38, 42, 77.

115. Empire has not shown impacts or impairments, including proof of increased operating costs or necessary remedial actions, resulting from alleged changes in water chemistry at the EMSU from GNM's disposal. McGuire Rebuttal, Ex. B ¶¶ 11-17; McGuire 5/19/25 Tr., 120:12-22; Tomastik Rebuttal, Ex. C ¶ 10; GNM Ex. C-17. Empire also has not presented evidence through any kind of qualified analysis showing that Goodnight's disposal fluids are incompatible with either the San Andres or Grayburg. McGuire 4/20/25 Tr. 141:13-17; *see, supra*, FOF 95.

No Evidence of Impact to San Andres Disposal Zone

116. Empire's engineering witness testified that ROZ is immobile and will only be mobilized through injection of CO_2. West 4/10/25 Tr. 86:3-6. Mr. Melzer testified that withdrawal of water it won't produce oil from an ROZ because it's all residual and stuck to the rock. Melzer 2/28/25 Tr. 1166: 13-20.

117. Even if Empire wants to attempt to produce residual oil that it believes is in the Lower San Andres at some point, Goodnight's operations are not interfering with that potential, because of "the fact that it's an ROZ and the oil is not mobile . . . . [T]he injection is not moving the oil anywhere." Davidson 4/21/25 Tr. 256:3-20.

118. Even if there is an ROZ, as Empire claims, in what Dr. Davidson refers to as the Upper ROZ, Goodnight's "injection operations that are occurring below this yellow band [the anhydrite barrier], are not likely to impact it." Davidson 4/21/25 Tr. 232:23-25. Dr. Davidson's opinion is that Empire can exploit "their potential ROZ development in the Upper San Andres" and Goodnight can "continue on" with its SWD disposal in the Lower San Andres and the operations will "not interfere with one another." Id. Tr. 233:6-14; *see also id.*, Tr. 237:1-4, 238:11-17.

119. Mr. McShane was not able to say whether commercial saltwater injection adversely impacts recovery because Empire "Does not have the type of data that [it] would need to see if it's affected or not," and would need data, such as well logs, from additional offsetting wells. McShane 4/8/25 Tr., at 116:16-117:12.

120. Goodnight's disposal injection is increasing reservoir pressures in the San Andres by only a marginal amount and when injection is paused the reservoir returns to near original pressures, showing there is no impairment to a potential future CO_2 injection project.

121. Data from July 2024 and April 2025 show that after 39.3 million barrels of produced water were injected through GNM's 10 SWDs over the 9-month period the average bottomhole pressure gradient only changed from 0.381 psi/ft to 0.383 psi/ft—which is about a 0.25 psi increase per million barrels injected. McGuire 5/19/25 Tr., 73:10-74:9; Knights 4/22/25 Tr., 213:6-214:5; 214:14-15; McBeath Supplemental, Ex. F ¶¶ 8-9.

122. Goodnight's Piper No. 2 SWD well was shut in for a month or longer prior to fluid levels being tested in April 2025, and the bottom hole pressure calculated to the lowest pressure measurement of all Goodnight's tested wells, near original reservoir conditions. 5/19/25 Tr. 74:13-75:7 and 76:23-77:12; Empire Cross Ex. 10.

123. When the 1959 pre-waterflood pressure in the E-M-E SWD "H" 20 [0.36 psi/ft] is correlated with the group of WSW pressures taken in 1987 with fluid levels and current static levels in the Goodnight SWDS at present [0.383 psi/ft], "the best measurements we have in the San Andres show that there's been very little change in the pressure." McBeath 4/23/25 Tr. 187:17-188:11; GNM Ex. 22; *see generally*, McGuire Supp., Ex. B, Exs. B-62-64. **"This small increase in pressure occurred over more than 60 years of disposal history with hundreds of millions of barrels having been injected. Taken together, this data shows that the San Andres is a world class disposal reservoir which has an enormous capacity to safely accommodate large volumes of water."** McGuire Supp., Ex. B ¶ 14; Buchwalter 4/28/25 Tr. 1015:23-1016:4, 993:21-25 ("[T]echnically, [the San Andres] aquifer can handle a tremendous amount of water. I mean, if you put your saltwater disposal wells through this aquifer, you could inject water to your heart's content.). As a result, Goodnight's injection is not going to increase the cost of CO_2 for a potential ROZ project because the reservoir pressures have not substantially increased. McGuire 4/19/25 Tr. 76:5-18.

SAN ANDRES DISPOSAL ZONE HAS NO ECONOMICALLY RECOVERABLE ROZ

124. Intervals of residual oil in the San Andres disposal zone below GNM's confining layer are too thin, widely spaced, and not areally continuous enough to support enhanced oil recovery operations, and with significant karsting, is not a residual oil zone under any reasonable definition. Davidson Direct, Ex. D at 1-4. Appx. B (well log interpretations); Davidson Sur-Rebuttal, Ex. D, Figs. 3-4. Because average oil saturations are so low and not continuous, the San Andres aquifer does not have sufficient oil in place to warrant economic evaluation. Knights Direct, Ex. E at 1; Knights 4/22/25 Tr. 220:8-21, 223:17-19, 227:16-23.

125. Dr. Davidson testified that the lower portion of the San Andres in Goodnight's disposal zone predominately consists of abandoned paleo migration paths and that if there is a target for CO_2 flooding it will be in the Grayburg, and maybe in the upper part of the San Andres above the gamma ray marker that he identified. Hrg. Tr. April 21, 2025, 65:16-22; Dr. Davidson Direct, Exhibit D, Fig. 15the residual oil does not correspond across the several well logs: "there's not a layer that exists . . . over long intervals or a big aerial extent where they're correlatable. That's part of the reason that I came to the conclusion that I think they're migration paths." Apr. 21, 2025 Tr., at 258:2-11

126. Analysis of core data and historical production tests confirms that the San Andres disposal zone does not meet the criteria for a ROZ because its oil saturations are well below the defined 20% cutoff as defined by Empire's own ROZ experts, confirming that Goodnight's disposal operations will not cause waste or impair correlative rights in the San Andres disposal zone. McGuire Direct, Ex. ¶ 6; GNM Ex. B-32; Birkhead 2/26/25 Tr. 647:10-13 (believes the majority of the ROZ is closer to the top of what Empire defines as the San Andres); *id.* Tr. 647:14-676:11 (Birkhead's impression is that the lower San Andres is assumed to be an aquifer); id. Tr. 676:4-14 (overall the trend in the lower San Andres is that there "tended to be more water in the Lower San Andres than in the Upper San Andres.")

127. Dr. Davidson testified that if there is residual oil still left in any portion of the San Andres aquifer "there's just not going to be enough down there . . . to be economically attractive to go after. And if they're migration paths, they're not going to have any aerial continuity. And if there's major karsting down there, it's going to steal the CO_2 and prevent it from being able to displace any of that [oil] in the first place." Davidson 4/21/25 Tr. at 245:1-9.

Goodnight's NSAI Petrophysical Model is Calibrated to Core and Designed to be Predictive Below the Producing Oil-Water Contact in Low Porosity Carbonate Systems

128. Goodnight's disposal interval in the EMSU is in the San Andres aquifer below GNM's confining layer and below the producing oil-water contact of -350 feet subsea. Knights Direct, Ex. E at 3-4, Fig. 7; GNM Ex. B-9. There is no evidence the producing oil-water contact is below -350 feet subsea in the EMSU, but it is no deeper than -540 feet subsea, which is still above GNM's confining layer and disposal zone. Knights 4/22/25 Tr., 135:2-3; Lindsay Direct, Ex. B at 2 ("Grayburg reservoir at EMSU had initial water-free oil production to a depth of -350 ft (subsea), mixed oil and water production from -350 ft to -540 ft (subsea). Beneath -540 ft only water is produced."); GNM Ex. B-9.

129. The Archies petrophysical model "is not the right type of model to use for this environment," in the San Andres, because it does not work below the producing oil-water contact in low-porosity, oil-wet carbonate systems, where m and n values become non-standard, and will overestimate oil saturations. Davidson 4/21/25 Tr., 77:6-78:24; 86:9-17; 87:16-88:9; 165:14-16; Davidson[1] Direct, Ex. E, Appx. A (explaining non-linear and non-standard petrophysical behavior in oil-wet, low-porosity carbonate systems); Melzer 4/28/25 Tr. 1166:3-5 (agreeing San Andres is oil-wet). In low-porosity intervals there is a "very complicated conductivity environment" that results in a non-linear response when calculating water saturations that is difficult to address with Archies. Davidson 4/21/25 Tr., 227:13-228:18; Davidson Direct, Ex. E, Appx. A; *see also* Lindsay 2/24/25 Tr. 224:1-225:19 (stating that CO2 floods do not work in an "oil wet" zone, because, in an oil wet zone, the water flows through the larger pores removing the oil, and the CO2 will flood back into the vacated moldic pores and not displace the residual oil).

130. Plotting the EMSU-679 core resistivity data against the core-derived water saturations, along with standard saturation exponent values, including n=2 and n=3.4 as recommended by Dr. Trentham, shows the majority of EMSU-679 core data do not fit standard n values and that the San Andres rock types fall grouped together on the plot. Davidson 4/21/25 Tr., 54:2-15; 169:9-16; 178:24-179:11; Davidson Direct, Ex. D, Figs. 7-8.

131. Dr. Davidson testified that he therefore used an alternate petrophysics model developed by Schlumberger for oil-wet reservoirs, such as the EMSU San Andres, that does not use standard Archies parameters, m and n, but a parameter called critical saturation (Sc). Davidson 4/21/25 Tr., 54:16-23; Davidson Direct, Ex. D, Figs. 5, 8, Appx. A. Sc curves fits are made for each core sample and then average Sc values are calculated for each rock type, allowing him the model to incorporate the critical saturation value for each rock type identified to calculate the water saturation. Davidson 4/21/25 Tr., 54:24-55:23; 157:10-158:2; Davidson Direct, Ex. D, Figs. 5, 8, Appx. A.

132. The Sc parameter "describes [a] curve that goes through data points" based on the core, and the Sc "is not a discrete value" because it is a "spectral model" that includes all the rock types and nothing is excluded, except wackestones, which were not included in the model.

[1] Dr. Davidson has more than 40 years' experience conducting petrophysical evaluations and evaluating carbonate systems for potential CO2 recovery, including in the San Andres and Grayburg in and around the Central Basin Platform, and has expertise in formation evaluation, specifically. Davidson 4/21/25 Tr., 22:12-26:23; 135:6-11; 202:1-9; Dr. Davidson Direct, Ex. D-1. While working on his Ph.D., Dr. Davidson worked at the University of Texas, Bureau of Economic Geology with Fred Wang as part of a team, with Jerry Lucia and Charlie Kerans, on the Grayburg and San Andres to correlate well logs to core to develop a petrophysical model for carbonate ramp environments, using outcrop, core and rock typing. Davidson 4/21/25 Tr., 24:4-25:1; 28:20-29:2.

Davidson 4/21/25 Tr., 159:15-3; 160:9-22; 148:10-14; 149:7-25; 158:23-25.This petrophysical model is applicable whether the system is full oil-wet, partially water wet, or mixed because his model is calibrated to the actual core measurements, and that wettability also does not impact the rock type. Davidson 4/21/25 Tr., 230:5-12; 230:21-25. This approach "include[s] all the different rock types" based on the rock types in the core "and [does not] exclude anything," and used the same calibration procedure using the resistivity index for both the Jerry Lucia sonic model and the Schlumberger non-sonic model. Davidson 4/21/25 Tr., 55:14-56:3; 148:10-149:8; 157:10-158:25.

133. In addition to the Schlumberger model, used to interpret log data without sonic logs, Dr. Davidson created a second model created by Jerry Lucia for when sonic measurements are available. Davidson 4/21/25 Tr., 44:25-45:15; Davidson 4/21/25 Tr., 43:14-44:5 (explaining George Asquith model to identify vugs). All the well logs inside the EMSU did not have sonic logs but some wells outside the EMSU did. Davidson 4/21/25 Tr., 44:17-25

134. Dr. Davidson had the highest confidence in the sonic model, so he applied the non-sonic Schlumberger model to the wells with sonic measurements and confirmed it produced the same distribution of rock facies, oil saturations, and porosities, confirming the non-sonic Schlumberger model is predictive. Davidson 4/21/25 Tr., 45:16-46-20. Confirmation is important because in the lower portion of the San Andres there is no core data and increasing vug porosity and karsting and needed to confirm the model would be predictive in that environment. Davidson 4/21/25 Tr. 46:24-47:14.

135. Both the non-sonic Schlumberger and sonic model were tested against the 358 Maljamar well that had both sonic measurements and pressure core, where Dr. Davidson has the highest confidence in the oil saturations and porosities, confirming that both models provided a good match to the pressure core. Davidson 4/21/25 Tr., 46:21-47:10, 61:18-62:4; Davidson Rebuttal, Ex. D ¶ 50, Fig. 7.

136. The non-sonic Schlumberger model (Goodnight's NSAI model) closely matches the EMSU-679 core but over-predicts hydrocarbon pore volume by about 4%. Davidson 4/21/25 Tr., 60:2-13; Davidson, Ex. D, Fig. 10. It matched the R.R. Bell #4 core. Davidson 4/21/25 Tr., 60:21-62:3; Dr. Davidson Sur-Rebuttal, Ex. D, Fig. 3. It matched the SSAU 4113R Well and aligned with the sponge core measurements reported for SSAU core. Davidson 4/21/25 Tr., 63:16-65:8; Davidson Direct, Ex. D ¶¶ 62-65, Figs. 14, 17. And it matched the Tall Cotton Bergen P 02 well. Davidson 4/21/25 Tr., 67:12-68:12; Davidson Sur-Rebuttal, Ex. D, Fig. 10; Knights 4/22/25 Tr., 149:2-10; 98:15-99:6 (confirming Dr. Davidson's model matched five blind tests against each well from offsetting fields).

137. Dr. Davidson performed corrections for the EMSU-679 core for bleeding and shrinkage, but not for stripping/super-flushing after confirming through analysis that the in-situ pressures during coring would not have subjected the core to super-flushing or flushing because residual oil is relatively immobile. He used a rule-of-thumb to determine a core correction factor of 1.22 but also performed rigorous analysis to confirm it was reasonable and calculated a range of core correction factors from 1.1 to 1.25, or 1.3 if the San Andres never experienced a pressure drop. Davidson 4/21/25 Tr., 36:11-42:7: 203:23-204:14; 209:20-210:11 (addressing corrections and sensitivities).

138. Dr. Davidson conducted a rock-typing analysis on the EMSU-679 core to identify rock types using a procedure developed by Jerry Lucia at the University of Texas, Bureau of Economic Geology that included cross-plotting for the lower San Andres and outcrop. Davidson 4/21/25 Tr., 42:9-24; 123:2-6. All rock types were identified. Davidson 4/21/25 Tr., 42:1-5;

156:18-157:3; 158:23-25. In the non-sonic Schlumberger model all rock types are available in every interval except wackestones, which were excluded. Davidson 4/21/25 Tr., 2025, 48:5-49:4; 148:10-14; 149:6-8; 158:23-25.

139. Dr. Davidson used 7% porosity cutoff, similar to the 6% used in Maljamar, and in-line with industry standards, and a 20% oil saturation cutoff, similar to OPS Geologic and Dr. Trentham. Davidson 4/21/25 Tr., 136:18-21, 244:3-9, 252:9-24; Bailey Rebuttal, Ex. K at 9. **The 20% oil saturation cutoff is supported by the fact that oil saturations in the SSAU #4113R well do not drop below 20% in the main pay zone after 40 years of CO2 flooding, which "tells me that CO2 is not going to be effective at oil saturations at 20% or less."** Davidson 4/21/25 Tr., 244:11-21; 246:1-247:18; 248:25-249:20; 245:12-14 (typical residual oil saturation to CO2 injection is about 20%).

140. Dr. Davidson also prepared an uncertainty analysis for his petrophysical model based on core corrections that results in a plus-or-minus 10% uncertainty on each core saturation resulting in a standard deviation of about 0.31. Davidson 4/21/25 Tr., 83:18-84:4; Davidson, Rebuttal, Ex. D ¶¶ 69-70.

141. Offset spectral gamma ray logs confirm high gamma ray readings in the San Andres are due to uranium, rather than thorium or potassium that would tend to indicate the presence of clay. There is a high uranium marker in the San Andres—reflecting about 2-3 times the uranium content—indicating a transition to a cyclical, deep water environment. Davidson Direct, Ex. E ¶¶ 17-20, Fig. 3-4; Davidson 4/21/25 Tr., 35:12-23, 48:21-49:4, 144:1-147:7. Dr. Davidson defines the Lower San Andres as the interval below the high gamma ray marker; everything above he refers to as the Upper San Andres. Davidson 4/21/25 Tr., 74:22-75:1. Shale volume is typically computed based on gamma ray measurements, but can be overstated when there is little or no shale or clay in the system, as in the San Andres, which can contribute to an overestimation of oil saturations. Davidson Direct, Ex. E ¶ 80.

NuTech's Log Analyses Are Not Reliable & Overestimate Oil Saturations

142. NuTech's original log analysis used standard values for m and n at 2 and a modified Archies equation, which resulted in overestimation of the oil saturations all way through the San Andres interval relative to the EMSU-679 core. Davidson 4/21/25 Tr., 75:7-76:14; Birkhead 2/25/25 Tr., 489:12-18 (stating carbonates require variable m and n); Davidson Direct, Ex. D, Fig. 10. **NuTech did not calibrate its initial analysis to the EMSU-679 core data or any core.** Dillewyn 4/7/25 Tr., 159:2-160:25, 187:10-11; 165:6-9 (**admitting it is "highly recommended" to calibrate to core data when available, but Empire did not "based on costs"). The interpretation shows saturations that would be mobile and do not match well file data, mud logs, or production tests, indicating it is invalid and unreliable.** McGuire Direct, Ex. ¶¶ 151-159; McBeath Direct, Ex. F ¶¶ 11-19 ("wildly optimistic"); Dillewyn 4/27/25 Tr. (admitting there is "quite" a bit "of uncertainty associated with [NuTech's] estimates").

143. NuTech prepared a second log analysis at Empire's direction and calibrated its analysis to the EMSU-679 water saturations, not oil saturations, without making any corrections to account for water expulsion, because Mr. Dillewyn does not know how, even though water is lost during the coring process, resulting in a higher interpreted oil saturation. Dillewyn 4/7/25 Tr., 173:10-176:15; 187:10-189:14.

144. Mr. Dillewyn testified that his original analysis and his revised analysis represent a range of potential oil saturations, where the original analysis is the high end of the range and the revised analysis is the low end. Dillewyn 4/7/25 Tr., 138:19-139:6; 157:9-182:15 (admitting his revised testimony did not preserve his original analysis and did not include a range of potential oil saturations). The revised analysis substantially reduced interpreted oil saturations and calculated oil in place, for example from 91.5 MMBBLS per Section for the Ryno SWD #1 to 15.6 MMBBLS per Section, a decrease of more than 82%. Dillewyn 4/7/25 Tr.,180:24-182:5. **If NuTech calibrated its revised analysis to water saturation in the EMSU-679 core, "That would definitely be a high case estimate."** Birkhead 2/25/25 Tr., 486:14.

145. Mr. Dillewyn is "sticking with our initial assessment" over the revised analysis and testimony because (1) the low-end revised analysis is "an unlikely scenario"; (2) more data is needed to determine the actual oil-in-place volumes; and (3) he was unable to determine a basis for the geological and mineralogical models changing with depth. Dillewyn 4/7/25 Tr., 181:13-184:7, 209:1-210:5.

146. NuTech's revised analyses are not representative of what the oil saturations would be and is an overestimate all the way through the San Andres because the model is calibrated to core water saturations. Davidson 4/21/25 Tr., 79:25-14. **NuTech models can't represent a low-end range and high-end range because both models overestimate oil saturations in the EMSU-679 core**. Davidson 4/21/25 Tr., 80:2-24; 86:25-87:3; Davidson Direct, Ex. D, Appx. B; Davidson Rebuttal, Ex. D-9; Birkhead 2/25/25 Tr., 549:14-17 (measured core is lowest possible).

OPS Geologic's Petrophysical Model Excludes Core Data & Overestimates Oil Saturations

147. Mr. Birkhead prepared high-end and low-end analyses for oil saturations and oil-in-place estimates using the Archies equation for purposes of rebutting Goodnight's testimony. Birkhead 2/25/25 Tr., 261:14-262:13; 445:6-484:17; Birkhead Rebuttal, Ex. L ¶ 22. Mr. Birkhead has never prepared a petrophysical analysis for residual oil zone CO2 projects before and does not recall having done petrophysics in a carbonate ramp system like the EMSU. Birkhead 2/25/25 Tr., 466:9-468:24, 470:7-17

148. In a complex carbonate system it is necessary to vary both m and n values. Birkhead 2/25/25 Tr., 489:12-18. Mr. Birkhead acknowledged that n values "can be very high" in a complex pore network like the San Andres EMSU and that there are literature references showing n values that go over 20. Birkhead 2/26/25 Tr., 641:11-17; 659:23-660:1, 664:14-665:2. As porosities decrease and resistivity increases, the Rw value matters less and the m and n values matter more. Birkhead 2/26/25 Tr., 601:14-15. Dr. Birkhead's uncertainty in his interpretation increases with lower porosities and higher resistivities. Birkhead 2/26/25 Tr., 601:14-15 607:13-14.

149. Mr. Birkhead agrees that "calibrations to the core data" are considered to be part of a good petrophysical model, and that in his model n was varied to calibrate to the core data in his low and high cases. Birkhead 2/26/25 Tr., 645:16-18; *id.* at 602:14-603:1, 643:25-5 (explaining that m and n values are "knobs" that can be varied "to calibrate to the real data you have, which in this case is the core saturations.").

150. Rather than limit calibrations and adjustments to only what the core data show, Mr. Birkhead also adjusted m and n to "stay within reasonable values" based on the literature and on mixed-wet/oil-wet systems. Birkhead 2/26/25 Tr., 606:4-25. Mr. Birkhead calculated what the n values are as a function of the core porosity, then used a constant m and variable n value in an Archies equation to calculate saturations. Davidson 4/21/25 Tr., 93:16-22. But in doing so, Mr. Birkhead excluded a substantial portion of the core measurements because the core had intervals that would have calculated much higher n values than what Mr. Birkhead used in his final model. Davidson 4/21/25 Tr., 92:19-94:3; 167:10-168:24; 178:12-15.

151. Based on Empire's Cross Exhibit 7 at 2, Empire represented that Mr. Birkhead disregarded all of the core-calibrated oil saturations with an n value of 11 or above as "very suspicious" and relied instead on literature to determine a range of n values. Empire Cross Exhibit 7 at 2; Birkhead 2/26/25 Tr., 643:18-644:12. **This resulted in removal of about one-third of the corrected, core-calibrated oil saturation values from his petrophysical model, adjusting the average oil saturation values in his model for the Grayburg from 23.94% to 25.7% and for the San Andres from 21.44% to 29.12%. *See* Empire Cross Exhibit 7 at 2. That increased OPS Geologic's average corrected core oil saturations in the Grayburg by 7.4% and in the San Andres by 35%.** *Id.*

152. Mr. Birkhead conducted a similar exercise for the uncorrected core calibrated oil saturations by removing all core data points with n values above 11, adjusting the average oil saturation values in his model for the Grayburg from 16.2% to 17.2% and for the San Andres from 14.34% to 19.5%. Empire Cross Exhibit 7 at 3. That increased the average uncorrected core oil saturations in the Grayburg by 6.17% and in the San Andres by 36%. *Id.*

153. Mr. Bailey testified that "all the wells [in their model] are quality checked based off that core calibration. That is the n points for the petrophysical model." Bailey 2/25/25 Tr., 414:6-13. "[W]e're confident with the -- based on the core measurements. Now where we -- or in the Lower San Andres where we don't have core, obviously there's going to be some uncertainty with that because we don't have physical rock to tie it to. **Our model just carried on down based on the core data all the way through the San Andres. We did not alter it in any way**." Bailey 2/25/25 Tr., 415:3-11.

154. But by "choosing the correlation" they used, OPS Geologic "made every possible porosity return the highest possible oil saturation," which is why their model "leads to overestimation of the oil saturation." Davidson 4/21/25 Tr., 94:12-24; 169:5-8; Knights 4/23/25 Tr., 104:7-105:25 (removing high n values eliminated low oil saturations in the core data). Goodnight's non-sonic Schlumberger model over-estimates the hydrocarbon pore volume in the EMSU-679 by about 4%, but OPS Geologic's low-side analysis is 30% higher than the corrected core measurements as far as the in-place oil volumes and 87% higher than the corrected saturation for the high-side analysis, so OPS Geologic's low-side and high-side cases are still optimistic compared to what the actual core oil saturations are. Davidson 4/21/25 Tr., 81:24-82:14; 83:6-8; 87:16-88:9 (explaining how tight pores become occluded with cement, increasing resistivities, so using Archies in this scenario can calculate oil where there is none); Davidson Sur-Rebuttal, Ex. D at 2-4, 6-9.

155. OPS Geologic's overestimates San Andres oil saturaitons, confirmed by reviewing mud logs, production tests, field reports, and other backup data for the wells interpreted. Davidson 4/21/25 Tr., 88:12-89:8; 91:3-8; Knights 4/22/25 Tr., 34:20-37:2; Knights Sur-Rebuttal, Ex. E, Figs. 7, 9. **The uncorrected core has an average oil saturation of about 14.86%, whereas OPS Geologic's low-case average oil saturation is 30.4%, almost 100% higher indicating a significant overestimation**. Knights 4/22/25 Tr., 37:9-18; Knights Sur-Rebuttal, Ex. E, Fig. 5.

156. OPS Geologic interpreted greater than 60% oil saturation in the EMSU-458 WSW, a saturation that Mr. Bailey believes would be mobile but no oil production was reported. Bailey 2/25/25 Tr., 348:23-354:12; id. Tr. 406:8-25 (stating the San Andres ROZ is not a conventional primary play because it is below the oil-water contact). Frank Marek testified that oil saturations above 45% to 60% "does not strike [him] as a ROZ," and would "expect" there to have been oil produced in the water supply wells from that zone. Marek 4/7/25 Tr., 116:23-118:5.

Disposal Zone Oil Saturations are Uneconomic

157. The San Andres disposal zone, with low oil saturations and low oil-in-place values, is not a reasonable or economic target for any type of hydrocarbon recovery and does not fit the definition or profile of a commercial ROZ. Knights Direct, Ex. E at 7-8; Knights Sur-Rebuttal, Ex. E at 6-7. Goodnight's petrophysical model estimates that there is about 21 million barrels per section in the Grayburg down to -350 feet subsea, and the interval below that down to -500 feet subsea is estimated to have about 9 million barrels per section, and **from -500 feet subsea to -700 feet subsea [GNM's disposal zone] there is about 6 million barrels per section, where "even if you use the most exaggerated recovery factors, that becomes insignificant relative to economics."** Knights 4/22/25 Tr., 61:21-62:10; Knights Sur-Rebuttal, Ex. E, Fig. 13. **In GNM's disposal zone, the volume of oil in place "is just miniscule[,]" and is "[s]ignificantly insignificant to any concept of economic recovery."** Knights 4/22/25 Tr., 62:7-10.

158. Empire's economic calculations are based on unsupported input parameters that make it unreliable. McBeath Rebuttal, Ex. F ¶¶ 7-22. Correcting Empire's economic calculations with reasonable inputs for oil saturation, oil prices and CO2 prices results in both economic models having large negative net present values. McBeath Rebuttal, Ex. F ¶ 3, GNM Exs. F-23 to F-25; McBeath 4/11/25 Tr., 128:17-134:15; McBeath 4/23/25 Tr., 156:10-12 (Empire's "assumptions are not economic"). **"I haven't seen any credible or direct measurement evidence of a viable economic ROZ project. The log analysis that was provided that I looked at and compared with actual tests just doesn't square with the real data. It's wildly optimistic."** McBeath 4/11/25 Tr., 159:15-20.

159. Mr. West's direct testimony constitutes Empire's complete basis supporting its economic evaluation for its proposed ROZ project. West 4/10/25 Tr. 129:8-13. The capital costs were "assumptions" and no testimony was provided on other assumptions in the model. West 4/10/25 Tr. 147:12-24; McBeath Rebuttal, Ex. F ¶ 21. Empire provided no direct testimony in its case in chief on a recovery factor. West Direct, Ex. I, ¶¶ 30-34, Empire Exs. I-26 to I-30.

160. None of Empire's expert petrophysical analyses and oil-in-place calculations were used for Empire's economic models. West 4/10/25 Tr. 134:1-135:4; McBeath 4/11/25 Tr. 243:20-244:5 ("[I]t's a pipe dream."). Empire's economic models assume 400 feet of 30% oil saturation in the San Andres. McBeath Rebuttal at 7, ¶ 9; McBeath 4/11/25 Tr. at 121:18-133:21; West 4/10/25 Tr. 131:8-135:18. Mr. West decided himself 30% average oil saturation "seemed like" it would be "a good representative" for the San Andres and provided no basis for a 400-foot interval. West 4/10/25 Tr., 134:10-12; 134:10; 134:10-136:6; Knights 4/22/25 Tr., 60:8-12 (assumption of constant 30% oil saturation is not supported by OPS Geologic model); Knights Sur-Rebuttal, Ex. E, Fig. 13. None of the wells analyzed by Empire in its case in chief calculated a net oil interval with a continuous 400-foot interval above 30% average oil saturation and none show even a net oil interval of 400 feet with oil saturations above 30%. McShane 4/8/25 Tr., 68:20-71:8; Rev. Empire Ex. G-3(d) - G-3(j).

161. Because dimensionless curves are deterministic, "meaning they generate a set oil recovery for a given volume of CO2 injected and a set volume of CO2 recovered for a given volume of CO2 injected," they must be appropriate for the system being evaluated but **Empire provided no explanation or basis for using the dimensionless curves they selected or the basis for a project 18% recovery factor.** Lake Rebuttal, Ex. G at 2-3, 5 (noting the curves appear to come from a paper addressing water-alternating gas flooding as opposed to continuous CO2 as Empire proposes and in conventional, not ROZ, reservoirs); Lake 4/24/25 Tr., 175:10-177:9;

162. Data on oil recovery from CO_2 floods in about 20 conventional oil fields, mostly in the Permian Basin, shows that after injection of about 4 hydrocarbon pore volumes of CO_2 the mean oil recovery factor is about 11%, one standard deviation above the mean is about 14%, and two standard deviations above the mean is about 18%. Lake 4/24/25 Tr., 175:10-177:9. **Empire relies on a dimensionless oil curve that projects 18% oil recovery after 4 hydrocarbon pore volumes of CO_2, which is two standard deviations above the mean for oil recovery for a CO_2 flood in a conventional reservoir.** Lake 4/24/25 Tr., 175:10-177; GNM Ex. G-6. "It is likely that ROZ floods would perform about a third as well as this." Lake 4/24/25 Tr., 177:4-9; 176:22-180:9; Knights 4/22/25 Tr., 37:9-18, 58:4-59:1; Knights Sur-Rebuttal, Goodnight Exhibit E, Fig. 12 (estimated recovery factor of 1%-6% based on Tall Cotton, which has significantly better quality porosity and higher average core oil saturations—25% compared to 14.86%).

163. None of Empire's ROZ experts or expert witnesses prepared an analysis on a potential recovery factor for ROZ anywhere in the EMSU—let alone in the San Andres disposal zone. McShane 4/8/25 Tr., 109:13-110:2; Birkhead 4/26/25 Tr. 572:25-574:3; 662:7-12; Trentham 4/27/25 Tr. 813: 5-16; Marek 4/7/25 Tr. 98:5-12; Lindsay 4/24/25 Tr., 55:17-21; Melzer 4/27/25 Tr., 867:20-868:11; 868:5-18 (he would not be able to determine a recovery factor for the San Andres ROZ based on the EMSU-679 and R.R. Bell #4 cores); *id.* Tr. 866:23-867:19 (Melzer reviewed the core reports for the EMSU-679 and R.R. Bell #4 but did not review any other data or information specific to the EMSU); West 4/10/25 Tr. 123:15-124:14 (testimony provides no explanation or basis for 18% recovery factor).

164. Empire's CO_2 recovery curve implies nearly 100% CO_2 recovery, which substantially overestimates CO_2 recovery, and conflicts with CO_2 recovery curves generated from actual field data based on 50 years' of experience and data collection. Lake Rebuttal, Ex. G at 5; GNM Ex.G-7. After one hydrocarbon pore volume of CO_2 has been injected the mean CO_2 recovery is about 45%, one standard deviation above the mean is about 60% CO_2 recovery, and two standard deviations above the mean is about 70% recovery, substantially below the nearly 100% recovery Empire assumes. GNM Ex. G-7. In the San Andres EMSU, CO_2 loss would be "very significant" and "on the order of two to three times the CO_2" expected amount because "CO_2 is going to go into any porosity that has permeability, regardless of the oil saturation." McBeath 4/23/25 Tr., 203:12-204:2; Knights 4/22/25 39:20-40:3 (there is an "incredible amount of pore volume in the higher porosity, higher perm," in the San Andres that will need to be filled with CO_2 before it goes to lower porosity intervals); Knights Sur-Rebuttal, Ex. E, Fig. 5. CO_2 purchase is the largest operating expense for a CO_2 flood. McBeath Rebuttal, Ex. F ¶ 14; *id.* 4/23/25 Tr., 160:1-3. Simply using the mean for reported CO_2 recovery of about 55% would nearly double Empire's projected CO_2 costs. GNM Ex. G-7 (mean CO_2 recovery after 1 HCPV is about 55%, as opposed to 95% as Empire projects). **Empire provided no explanation or basis for their CO_2 recovery curve.** West 4/10/25 Tr. 144:19-1458.

165. For what Empire defines as the Lower San Andres, which is a much thicker interval at between 900-1,000 feet thick, OPS Geologic's low-side case interprets a concentration of oil in place near the crestal high of the structure but mostly around the R.R. Bell #4, comprising about 4 Sections that is about 20 million barrels of oil per section, which at 10-acre spacing would be about 313,000 barrels, and at 1% to 6% recovery that would yield between 3,125 barrels to 18,750 barrels per well. Knights 4/22/25, Tr. 59:11-18; Knights Sur-Rebuttal, Ex. E, Fig. 13. Based on Tall Cotton estimated Phase 1 and Phase 2 costs, **the 15-year break even oil price for Empire would need to be between \$200-\$400 per barrel**, assuming a tighter 10-acre spacing for a CO2 flood, and excluding costs to purchase CO2 and to run compression or injection. Knights Sur-Rebuttal, Ex. E, Fig. 13.

166. **Empire's economic model provides insufficient analysis to carry out a CO2 project and Empire has presented no other evidence that could be a quantification of waste other than these unreliable and speculative economic analyses.** McBeath 4/11/25 Tr. 123:18-25; *id.* 4/23/25 Tr. 233:15-234:9.

Proof of a San Andres ROZ is Non-Existent

167. **Dr. Trentham testified that Empire has not "done enough analysis to solidify the argument about the existence of . . . potential recoverable ROZ in the San Andres," and stated that Empire's "money is well spent doing further evaluation."** Trentham 4/27/25 Tr., at 822:6-18.

168. To confirm whether the San Andres has recoverable ROZ at any depth requires "[m]ore work . . . in the form of gathering more data, core analysis and good logs, maybe even FMIs, those kind of things. . . . [W]e have to quantify how good it is, how thick it is." Id. Tr. 823:1-5. 823:1-5. **Dr. Lindsay agreed that Empire does not have that data to confirm a recoverable ROZ in the San Andres: "And that's a real problem."** Lindsay 2/24/25 Tr., 194:22-195:11. Because of that, **there is not enough "direct evidence in the core" of recoverable oil to warrant revoking any of Goodnight's existing SWD permits.** Lindsay 4/24/25 Tr., 195:24-196:4; *id.* Tr., 226:22-227:3.

CONCLUSIONS OF LAW

1. The Commission has jurisdiction over the Parties and the subject matter of this case.

Goodnight's Applications

2. Goodnight's Applications are complete and have been duly filed under Rule 19.15.26.8 NMAC.

3. Proper public notice of Goodnight's Applications and the Commission's hearing were given, including personal notice to all operators, surface owners, and affected persons within a one-half mile radius of the proposed produced water disposal wells, as required by law.

4. To the extent there were any deficiencies in notice, those deficiencies have been cured by Empire's active and substantial participation in these matters.

5. The Commission and the Division have authority under the Oil and Gas Act, NMSA 1978, §§70-2-1 et seq., and its implementing regulations, 19.15.1 et seq. NMAC, and under the federal Safe Drinking Water Act ("SDWA"), 42 U.S.C. 300f et seq., and its implementing regulations, 40 CFR 144 et seq., to issue permits for UIC Class II injection wells. *See* 40 CFR 147.1600.

6. Based on the information and representations provided in Goodnight's Applications, and evidence and testimony presented at the Hearing, the proposed injection, if conducted in accordance with Goodnight's Applications and the terms and conditions of the attached Permits, (a) will not result in waste of oil and gas; (b) will not adversely affect correlative rights; (c) will protect underground sources of drinking water; and (d) will protect the public health and environment and fresh water resources pursuant to NMSA 1978, § 70-2-11(B)(15).

7. Further, granting Goodnight's Applications (a) will not impair correlative rights or cause waste in the Eunice Monument South Unit ("EMSU") pursuant to NMSA 1978, 70-2-11, and (b) will not cause the disposition of produced water in violation of the federal SDWA.

8. Approval of Goodnight's Applications will support existing and future exploration in the Delaware Basin, thereby preventing waste, and would be in the public interest.

9. The Commission has retained jurisdiction over Order Nos. R-7765 and R-7767, as amended, for entry of such further orders as the Commission may deem necessary.

10. The Commission has a continuing obligation to "reclassify wells and pools" and to "redetermine the limits" of any pool from time to time, as may be necessary. NMSA 1978, §§ 70-2-12(B)(11) & (12).

11. Order Nos. R-7765 and R-7767 should be amended to exclude the San Andres from the EMSU's unitized interval and its special pool because the Commission lacked, and continues to lack, authority to include the San Andres in the unitized interval of the EMSU and in the EMSU special Eunice-Monument pool:

a. Because there has been no primary production from the San Andres formation within or around the unitized interval either before or after creation of the EMSU, the San Andres within the EMSU was not, and has not been, reasonably defined by development through primary production. § 70-7-5(B).

b. The Statutory Unitization Act does not apply to exploratory operations and, therefore, requires that productivity of the unitized interval be first demonstrated through primary production. § 70-7-1.

c. Because the San Andres has not been reasonably defined by development through primary production, any type of enhanced oil recovery operation in the San Andres is exploratory and not authorized under Order No. R-7765 or the Statutory Unitization Act. §§ 70-7-1 & 70-7-5(B).

d. The San Andres in the EMSU is not a "pool" and is not "part of a pool" as defined by Section 70-7-33(B) because it does not contain a common accumulation of crude petroleum oil or natural gas or both that has been proven to be capable of producing in paying quantities. *See* Order No. R-13889 at ¶7; § 70-2-11(B)(4).

e. The Grayburg formation within the EMSU is a separate and distinct geologic formation from the San Andres and functions as a separate reservoir and, therefore, the San Andres is not a "pool" or part of a "pool" together with the Grayburg within the EMSU.

f. The San Andres within the EMSU is a non-hydrocarbon-bearing aquifer that has been declared to be a groundwater source within the Captain Ground Water Basin on September 28, 1965. *See* 19.27.26.8 (including all of T21S, R36E). By declaring the Capitan Basin, the New Mexico Office of the State Engineer has expressly identified the San Andres as a water source subject to appropriation and beneficial use, and asserted jurisdiction over all waters within the Basin, including those within the San Andres. *See* NMSA 1978, § 72-12-1.

g. Unitization of the San Andres within the EMSU is contrary to the New Mexico Constitution Art. XVI, § 2.

Empire's Applications

12. Granting Goodnight's Applications (a) will not result in waste of oil and gas; (b) will not adversely affect correlative rights; (c) will protect underground sources of drinking water; and (d) will protect the public health and environment and fresh water resources pursuant to NMSA 1978, § 70-2-11(B)(15)

13. Empire has not satisfied its burden to prove the allegations it set forth in its applications, nor has it demonstrated that there are changed circumstances, necessary for the Commission to revoke Orders Nos. R-22026/SWD-2403, R-22027, SWD-2307, and R-21190.

14. Empire has failed to show that Goodnight's existing or proposed injection will cause or is causing waste.

15. Empire has failed to show that Goodnight's existing or proposed injection will impair or is impairing correlative rights.

16. Empire has failed to show that there is a residual oil zone within Goodnight's disposal interval that is capable of producing oil or gas or both oil and gas in paying quantities.

17. Empire has failed to show that Goodnight's disposal injection is causing the premature and irregular encroachment of water or any other kind of water encroachment into the Grayburg within the EMSU.

18. Empire has failed to show that Goodnight's disposal injection, if it is causing any kind of water encroachment into the Grayburg within the EMSU, is reducing or tending to reduce the total ultimate recovery of crude petroleum oil or gas or both oil and gas from the Grayburg within the EMSU.

19. Empire has failed to show that it would be able to develop a potential San Andres residual oil zone in the EMSU without causing waste.

20. Denying Empire's Applications (a) will not result in waste of oil and gas; (b) will not adversely affect correlative rights; (c) will protect underground sources of drinking water; and (d) will protect the public health and environment and fresh water resources pursuant to NMSA 1978, § 70-2-11(B)(15).

ORDER

1. Goodnight's Applications for the authority for disposal of produced water in the San Andres formation are hereby granted for the Wells

2. Empire's Applications to revoke Goodnight's existing injection authority under Orders Nos. R-22026/SWD-2403, R-22027, SWD-2307, and R-21190 are hereby denied

3. Jurisdiction is retained by the Commission for the entry of such further orders as may be necessary for the prevention of waste and/or protection of correlative rights or upon failure of the operator to conduct operations (1) to protect fresh or protectable waters or (2) be consistent with the requirements in this Order

WHEREFORE, Goodnight respectfully requests that the Commission DENY Empire's applications in Case Nos. 24018-24020, & 24025 and grant Goodnight's applications in Case Nos. 23614-17, 23775 and 24123 and adopt these Proposed Findings of Fact and Conclusions of Law as its own.

Respectfully submitted,

HOLLAND & HART LLP

By: *_/s/ Adam G. Rankin_*

Michael H. Feldewert
Adam G. Rankin
Nathan R. Jurgensen
Paula M. Vance
Post Office Box 2208
Santa Fe, NM 87504
505-988-4421
505-983-6043 Facsimile
mfeldewert@hollandhart.com
agrankin@hollandhart.com
nrjurgensen@hollandhart.com
pmvance@hollandhart.com

ATTORNEYS FOR GOODNIGHT MIDSTREAM PERMIAN, LLC

CERTIFICATE OF SERVICE

I hereby certify that on July 3, 2025, I served a copy of the foregoing document to the following counsel of record via Electronic Mail to:

Ernest L. Padilla
Padilla Law Firm, P.A.
Post Office Box 2523
Santa Fe, New Mexico 87504
(505) 988-7577
padillalawnm@outlook.com

Dana S. Hardy
Jaclyn M. McLean
HINKLE SHANOR LLP
P.O. Box 2068
Santa Fe, NM 87504-2068
(505) 982-4554
dhardy@hinklelawfirm.com
jmclean@hinklelawfirm.com

Sharon T. Shaheen
Spencer Fane LLP
Post Office Box 2307
Santa Fe, New Mexico 87504-2307
(505) 986-2678
sshaheen@spencerfane.com
cc: dortiz@spencerfane.com

Corey F. Wehmeyer
SANTOYO WEHMEYER P.C.
IBC Highway 281 N. Centre Bldg.
12400 San Pedro Avenue, Suite 300
San Antonio, Texas 78216
Corey Wehmeyer
cwehmeyer@swenergylaw.com

Attorneys for Empire New Mexico, LLC

Jesse Tremaine
Chris Moander
Assistant General Counsels
New Mexico Energy, Minerals, and
Natural Resources Department
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
(505) 741-1231
(505) 231-9312
jessek.tremaine@emnrd.nm.gov
chris.moander@emnrd.nm.gov

Attorneys for New Mexico Oil Conservation Division

Matthew M. Beck
PEIFER, HANSON, MULLINS & BAKER, P.A.
P.O. Box 25245
Albuquerque, NM 87125-5245
Tel: (505) 247-4800
mbeck@peiferlaw.com

Attorneys for Rice Operating Company and Permian Line Service, LLC

Miguel A. Suazo
BEATTY & WOZNIAK, P.C.
500 Don Gaspar Ave.
Santa Fe, NM 87505
Tel: (505) 946-2090
msuazo@bwenergylaw.com

Attorneys for Pilot Water Solutions SWD, LLC

Adam G. Rankin
Adam G. Rankin