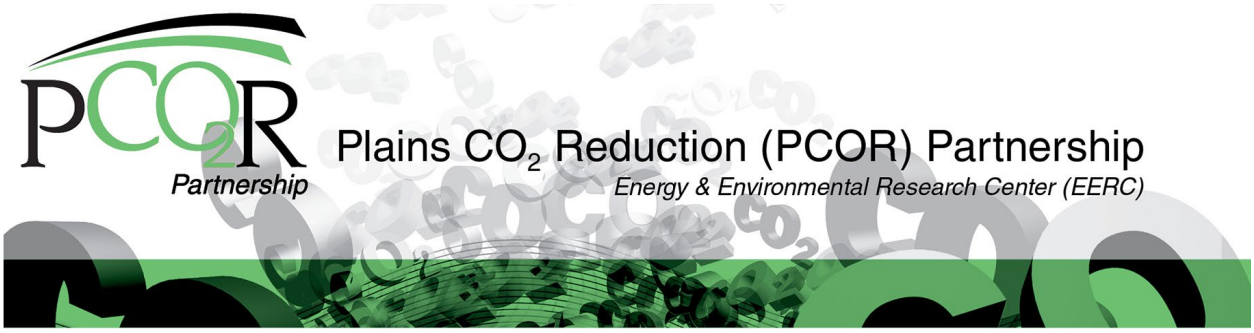

PORE SPACE: TECHNICAL AND LEGAL CONSIDERATIONS FOR CO_2 STORAGE IN NORTH DAKOTA

Plains CO_2 Reduction (PCOR) Partnership Initiative
White Paper

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EXECUTIVE SUMMARY

Access to and use of pore space has been identified as a long-standing regulatory and legal challenge to commercial deployment of carbon capture, utilization, and storage (CCUS). This report focuses on the technical and legal considerations associated with the use of pore space in geologic storage of carbon dioxide (CO_2) from a North Dakota perspective.

Acquiring the legal right to access and use the pore space of a geologic formation for permanent CO_2 storage is critical to the commercial deployment of CCUS projects. The owner of the overlying surface estate owns the pore space in North Dakota, but state law explicitly recognizes the mineral estate as the dominant estate in instances of competing subsurface interests. In North Dakota, securing the access and use of the pore space is achieved through the process of obtaining a storage facility permit (SFP), which is issued by the Department of Mineral Resources (DMR) of the North Dakota Industrial Commission (NDIC). The SFP, which must be approved prior to the initiation of CO_2 injection and storage, requires the applicant to obtain pore space access within the SFP boundary, which includes a buffer area beyond the predicted outer boundary of the areal extent of the CO_2 plume. North Dakota has established statutory law for compulsory unitization, similar to those used in oilfield development, known as pore space amalgamation. The storage operator is required by law to make a good-faith effort to acquire the legal right to use one hundred percent of the pore space with a minimum threshold of at least 60% before the forced pooling law can be applied. An alternative to amalgamation statutes are eminent domain statutes.

Another challenge that an operator will face when working with the pore space owner is establishing a basis for compensation. An operator could compensate a pore space owner based on area or based on volume. Under an area-based approach, an operator would compensate a pore space owner based on the amount of the owner's surface estate that overlies the storage facility area. To date, operators have exclusively used this approach. In a volume-based approach, compensation is based on the volume of the owner's pore space that the CO_2 occupies. This approach is like that used for allocating royalties from oil production from a unitized field.

North Dakota has experienced a rapid increase in project developers that are interested in advancing commercial CO_2 storage projects in the state. The first two projects in the state have received permit approval to geologically store CO_2 in North Dakota and represent first-of-a-kind efforts to amalgamate pore space for CO_2 storage, marking a critical development for the emerging CCUS industry in North Dakota.

PORE SPACE: TECHNICAL AND LEGAL CONSIDERATIONS FOR CO_2 STORAGE IN NORTH DAKOTA

1.0 INTRODUCTION

Carbon capture, utilization, and storage (CCUS) comprises a suite of technologies that capture carbon dioxide (CO_2) emissions from industrial sources, transports the captured CO_2 via pipeline to an injection well location, and injects the CO_2 deep underground into the pore space of suitable geologic formations for permanent storage. Utilization refers to using the captured CO_2 for a commercial purpose, primarily in CO_2 enhanced oil recovery (EOR), where CO_2 is injected into hydrocarbon-bearing rock formations and stored in conjunction with the recovery of oil, otherwise known as "associated storage." Storage refers to the permanent storage of CO_2 that occurs in deep geologic formations during associated storage as well as in non-hydrocarbon-bearing rock formations that are saturated with low-quality saline water, otherwise known as "dedicated storage." This report focuses on the technical and legal considerations for the dedicated storage of CO_2 in non-hydrocarbon-bearing rock formations (i.e., storage reservoirs). Implementing CCUS is vital for mitigating anthropogenic CO_2 emissions while allowing the full range of economic and societal benefits derived from the industries that generate the CO_2.

Acquiring the legal right to access and use the pore space of a geologic formation for permanent CO_2 storage is critical to the commercial deployment of CCUS projects. In North Dakota, securing the access and use of the pore space is achieved through the process of obtaining a storage facility permit (SFP), which is issued by the Department of Mineral Resources (DMR) of the North Dakota Industrial Commission (NDIC). The SFP, which must be approved prior to the initiation of CO_2 injection and storage, requires that several technical and legal considerations associated with the use of pore space within the storage formation be addressed. The purpose of this paper is to identify and discuss these considerations specific to North Dakota.

2.0 PLAINS CO_2 REDUCTION (PCOR) PARTNERSHIP

The Plains CO_2 Reduction (PCOR) Partnership, funded by the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL), the North Dakota Industrial Commission's Oil and Gas Research Program and Lignite Research Program, along with more than 230 public and private partners, is accelerating the deployment of CCUS technology. The PCOR Partnership is focused on a region comprising ten U.S. states and four Canadian provinces in the upper Great Plains and northwestern regions of North America (Figure 1). It is led by the University of North Dakota Energy & Environmental Research Center (EERC), with support from the University of Wyoming and the University of Alaska Fairbanks.

Figure 1. Geographic extent of the PCOR Partnership region consisting of ten states (Alaska, Montana, Wyoming, North Dakota, South Dakota, Nebraska, Missouri, Iowa, Minnesota, and Wisconsin) and four Canadian provinces (British Columbia, Alberta, Saskatchewan, and Manitoba).

Of the ten PCOR Partnership states, four have passed legislation regarding pore space ownership. North Dakota, Montana, Nebraska, and Wyoming have all granted pore space ownership to the surface estate owner. Alaska is the only state in the PCOR Partnership region—and the nation—to find that pore space belongs to the mineral estate owner. This legal precedent comes from a 2016 Supreme Court of Alaska case that found pore space ownership to be included under mineral rights, specifically as it pertains to geologic storage of natural gas (Justia US Law, 2016). In the four Canadian provinces within the PCOR Partnership region, pore space defaults as property of the Crown, or federal government, and can be leased according to provincial regulations. Legislation in Alberta and British Columbia has established the process for leasing pore space of storage reservoirs from the government; Manitoba and Saskatchewan have not enacted any laws further specifying pore space ownership or leasing.

3.0 GEOLOGIC STORAGE OF CO_2

Captured CO_2 is injected into and stored under pressure in the pore space of suitable geologic formations. The definition of a suitable geologic formation is one that 1) has the capacity (enough pore space) to store the targeted volume of CO_2, 2) has pore space with sufficient permeability to allow for injected CO_2 to migrate into and throughout the rock formation (injection zone), 3) is deep enough to maintain sufficiently high pressures and temperatures to keep the CO_2 in a dense phase (i.e., supercritical CO_2), 4) has low-permeability confining zones above (cap rock) and below to keep the CO_2 from migrating out of the injection zone, and 5) is not classified as an underground source of drinking water (USDW) by the Code of Federal Regulations (CFR) (i.e., contains naturally occurring formation water containing more than 10,000 mg/L total dissolved solids [TDS]).[1]

4.0 PORE SPACE

4.1 What Is Pore Space

Pore space is the free (or "open") space between the mineral grains of a geologic formation and is quantified as the porosity of a rock or formation. Porosity is defined as the ratio of the volume of pores to the volume of bulk rock. For example, a block of rock 1 meter on a side has a bulk volume of 1 cubic meter, or 1,000,000 cubic centimeters. If this block of rock has 20% porosity, then 200,000 cubic centimeters of this block is represented by pore space. It is important to keep in mind that in the deep subsurface, the pore space is always occupied by some type of fluid or gas (e.g., water, oil, nitrogen, natural gas). Important rock properties for the storage of CO_2 are the porosity and the connectivity of the pore spaces, i.e., the permeability (Figure 2). Porosity and permeability values in a target CO_2 storage formation can be highly variable and are often related to the type of rock (e.g., sandstone, limestone).

[1] See 40 CFR §144.3, Definitions.

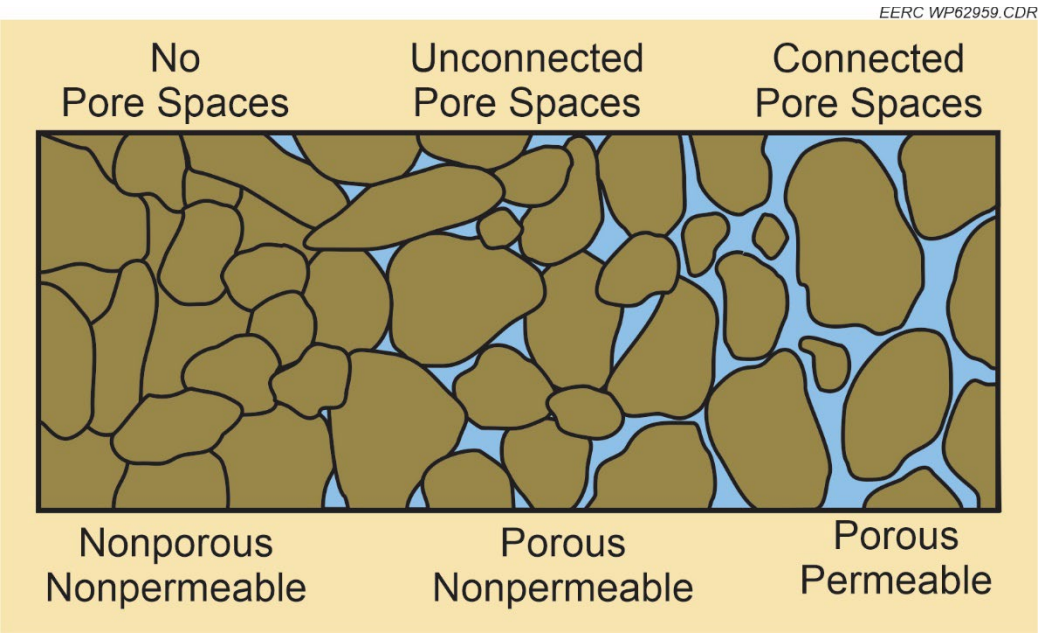

Figure 2. Depiction of porosity and permeability of a rock or formation.

The amount of pore space that is required for a CO_2 storage project is dictated by the quantity of CO_2 targeted for storage and the pressure and temperature conditions at which this storage will occur. Pressures and temperatures increase as the depth into the subsurface increases. At depths greater than about 2600 feet (800 meters), the temperature and pressure are high enough to keep CO_2 in a high-density (i.e., supercritical) phase (Figure 3). This high-density CO_2 is in nearly a liquid form, which requires less pore space for the storage of a given mass of CO_2 than if the CO_2 exists as a low-density gas (i.e., higher density means more mass in a given volume).

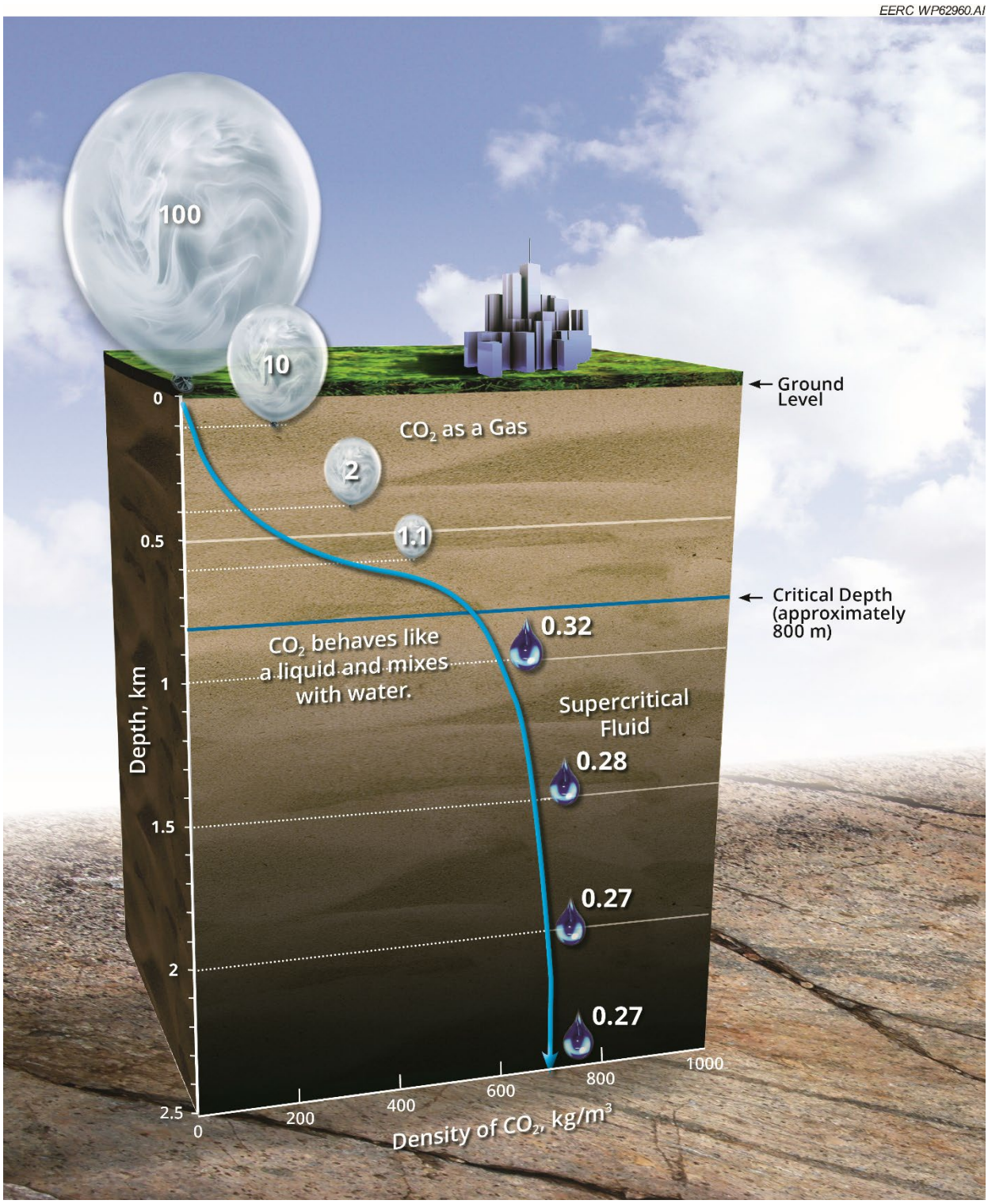

Figure 3. Density profile of CO_2 in the subsurface. Image from PCOR Partnership Atlas (2021).

4.2 Pore Space Ownership

4.2.1 Regional Perspectives

Four states within the PCOR Partnership region—Montana, North Dakota, Nebraska, and Wyoming—have addressed pore space ownership for CO_2 storage through statutory language and have established that pore space is tied to the surface estate.[2] However, both North Dakota and Wyoming prohibit the severance of pore space from the surface estate, while Montana and Nebraska allow for severance if it is specified in the deed or severance agreements. On the other hand, Alaska has established that depending on the particular land parcel, pore space belongs to one of the following government entities: state, federal, or native regional corporations and villages.

4.2.2 North Dakota Framework

In 2009, the North Dakota Legislature enacted two foundational legislative bills[3] that establish the legal and regulatory framework for geologic storage of CO_2 in the state. The origin of this legislation was the North Dakota CO_2 storage work group, which was formed in 2007 at the request of then North Dakota Governor, John Hoeven. This work group included representatives from key energy sectors in the state, government agencies, and energy research organizations. The work group was responsible for drafting comprehensive legislation that would establish the foundation for regulatory certainty, with a focus on identifying the state agency best suited to regulate CO_2 storage, addressing long-term liability, and identifying who owns the pore space. Introductory language in NDCC Chapter 38-22 sets the stage for the geologic storage of carbon dioxide as follows:

> *"It is in the public interest to promote the geologic storage of carbon dioxide. Doing so will benefit the state and the global environment by reducing greenhouse gas emissions. Doing so will help ensure the viability of the state's coal and power industries, to the economic benefit of North Dakota and its citizens. Further, geologic storage of carbon dioxide, a potentially valuable commodity, may allow for its ready availability if needed for commercial, industrial, or other uses, including enhanced recovery of oil, gas, and other minerals. Geologic storage, however, to be practical and effective requires cooperative use of surface and subsurface property interests and the collaboration of property owners. Obtaining consent from all owners may not be feasible, requiring procedures that promote, in a manner fair to all interests, cooperative management, thereby ensuring the maximum use of natural resources."[NDCC Chapter 38-22, Carbon Dioxide Underground Storage]*

These 2009 legislative amendments to the NDCC (Appendixes A and B) established the foundation of North Dakota's approach to concurrently regulate the pore space as a resource and CO_2 as a commodity and laid the legal groundwork for pore space amalgamation. These laws define "pore space" as "a cavity or void, whether natural or artificially created, in a subsurface

[2] Montana SB498, Nebraska LB650, North Dakota SB2139, and Wyoming HB89.

[3] North Dakota Century Code (NDCC) Chapter 38-22, Carbon Dioxide Underground Storage (SB2095), became effective July 2009 and NDCC Chapter 47-31, Subsurface Pore Space Policy (SB2139), became effective April 2009.

sedimentary stratum." The title to the pore space is identified as the owner of the overlying surface estate (i.e., the surface owner owns the pore space) and prohibits the severing of the pore space from the surface estate. There are additional provisions within the law that allow for the leasing of pore space and that address mineral dominance in the relationship between a severed mineral owner and the pore space estate.

The law mandates that operators make a good faith effort to obtain 100% of the rights to access the pore space, obtain at least 60% of those rights, and ensure that all nonconsenting pore space owners are equitably compensated.[4] The law also establishes the legal authority for NDIC to force the amalgamation of all nonconsenting pore space owners after the 60% minimum has been achieved.

In addition, the laws grant regulatory authority to the Oil and Gas Division of NDIC, create a CO_2 storage facility trust fund and administrative fund, and establish a postinjection and postclosure process for operators to be released from long-term liability by transferring title of the stored CO_2 to the state of North Dakota. There is a per-ton fee paid by the storage operator and deposited into the administrative and trust funds, with the fee amount defined by administrative rule. The amount of the fee is determined based on the contribution of the storage facility and the source of the CO_2 to the energy and agriculture production economy of North Dakota. In addition, the fee associated with the administrative fund is based on the anticipated expenses of NDIC that it will incur in regulating storage facilities during their construction, operational, and preclosure phases. The fee associated with the trust fund is based on the anticipated NDIC expenses associated with the long-term monitoring and management of a closed storage facility. North Dakota law establishes a process for operators to transfer title of the stored CO_2 to the state no sooner than 10 years postinjection, after public notice and hearing, and the transfer is consummated based on the operator meeting all statutory and regulatory criteria, including a demonstration that the CO_2 plume has stabilized.

These laws provide regulatory certainty for the geologic storage of CO_2 by providing the foundation for specifying, in a timely manner, quantifiable limits for measurable operating parameters as well as timelines for when these limits must be met. Having these variables explicitly defined by a regulatory body lets businesses know what is expected of them so that they can efficiently plan and allocate resources. In the absence of regulatory certainty, inaction is the usual response as businesses are unable to adequately analyze the operational, financial, social, and legal impacts of their business decisions.

Amalgamation (North Dakota Definition)
Amalgamation is the formal (legal) process that combines the pore space resources of multiple neighboring landowners that make up the SFP area. The amalgamated management and operation of a common reservoir (body of pore space) is necessary to effectively carry out a CO_2 storage project. Such amalgamation is for the common good and will result in the general advantage of the owners of the pore space within the SFP area of the project.

[4] NDCC § 38-22-08.

4.3 Technical Pore Space Challenges

As previously mentioned, the ultimate areal and vertical extent of CO_2 injected in the subsurface depends upon injection conditions and the properties of the storage reservoir, e.g., porosity and permeability. The predicted extent to which the injected CO_2 has been distributed in the subsurface is delineated by simulating the injection process using site-specific geologic models. The simulation efforts use the proposed project injection rate (tons per year) and duration (number of years).

It is important to note that pore space is not used 100% efficiently for CO_2 storage as CO_2 tends to expand outward near the top of the storage reservoir (beneath the cap rock) and results in a shape that is typically wider at the top than at the bottom (Figure 4). This irregular shape is a result of the buoyancy of the CO_2 and variation in rock properties throughout a targeted storage reservoir. The heterogeneity of the storage reservoir is estimated using data from characterization wells drilled into the storage reservoir along with laboratory data that are generated using cores from these drilling operations. It is a technical challenge to predict the pore space distribution within a reservoir using these data, recognizing that the pore space is not uniformly distributed in the subsurface, even within one rock type or formation.

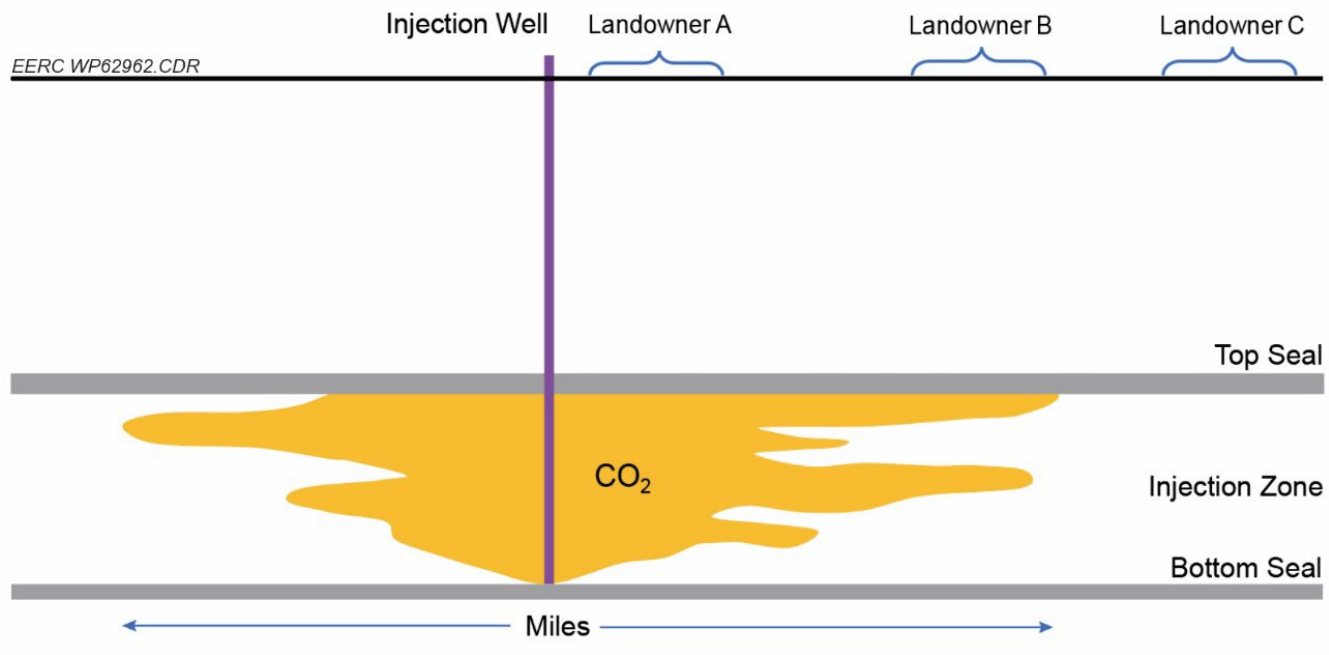

Figure 4. Cross-sectional view depicting a CO_2 plume in the subsurface.

Regardless of where the CO_2 is present in the subsurface, all pore space in and around the storage facility area is affected by the injection of CO_2 since the subsurface is subject to increases in pressure that may impact its use for other purposes, e.g., water disposal, gas storage projects. However, not all of these pore space owners will be compensated for pore space use since the CO_2 plume will likely not extend as far as the pressure impacts (see Landowner C in Figure 4).

4.4 Regulatory Pore Space Challenges/Considerations

Statutes and regulations governing CO_2 storage can present many challenges for potential storage facility operators. The following subsection discusses in detail the most significant of these challenges, pore space acquisition and equitable compensation for both consenting and nonconsenting pore space owners. Other important regulatory considerations that may need to be addressed, i.e., competing mineral interests, future restrictions (surface and subsurface), ownership of the CO_2 following storage, long-term liability, buffer approaches (technical or legal), and notification of interested parties are also briefly described here but will be the focus of further investigation and discussion in a sequel to this white paper.

4.4.1 Consenting and Nonconsenting Pore Space Agreements and Compensation

4.4.1.1 Consenting Pore Space Owners

Pore Space Agreements

For a CO_2 storage project to move forward, consenting pore space owners and the project operator will enter into some type of agreement; the two parties will have to decide what specific type of legal agreement is appropriate.

There are different types of legal agreements whereby a pore space owner would allow an operator to use their pore space. One potential agreement is a storage deed. Under a storage deed, the pore space owner would convey title of their pore space to the operator for a one-time payment. However, this type of agreement is not an option in North Dakota. This is because a storage deed would necessarily sever title to the pore space from title to the surface estate, and an "instrument or arrangement that seeks to sever title to pore space from title to the surface is void"[5] in North Dakota.

A second type of agreement would be a storage lease. Under a storage lease, the pore space owner would keep title to their pore space but would give the operator an exclusive right to possess the pore space in exchange for periodic payments.

One final type of agreement would be a storage easement. Like a storage lease, a storage easement would give the operator a right to use the owner's pore space in exchange for periodic payments. However, unlike a storage lease, a storage easement would only give the operator a nonexclusive right to use the pore space. Thus, the pore space owner and anyone else that obtains the pore space owner's consent could still use the pore space alongside the operator.

[5] NDCC Section 47-31-05.

Pore Space Compensation

In addition to putting an agreement in place, another challenge that an operator will face when working with the pore space owner is getting the owner to agree on the basis for compensation. An operator could compensate a pore space owner based on area or based on volume. Under an area-based approach, an operator would compensate a pore space owner based on the amount of the owner's surface estate that overlies any injected CO_2 (i.e., the CO_2 plume) plus a required buffer (see Figure 4). To date, operators have exclusively used this approach.

In contrast, under a volume-based approach, an operator would compensate a pore space owner based on the volume of the owner's pore space that the CO_2 occupies. This approach is like that used for allocating royalties from oil production from a unitized field.

A good example of the differences between these two approaches can be seen by revisiting Figure 4. As shown, there is a greater volume of CO_2 occupying Landowner A's portion of the injection zone than is occupying Landowner B's portion. Landowner A could therefore receive more compensation than Landowner B under a volume-based compensation approach. In contrast, the amount of Landowner B's surface estate that overlies a portion of the CO_2 plume is equal to the amount of Landowner A's surface estate that overlies a portion of the CO_2 plume. Thus, under a surface area-based compensation approach, Landowner A and Landowner B would be compensated equally, as shown in Figure 5. It should be noted that under both scenarios, Landowner C would receive no compensation.

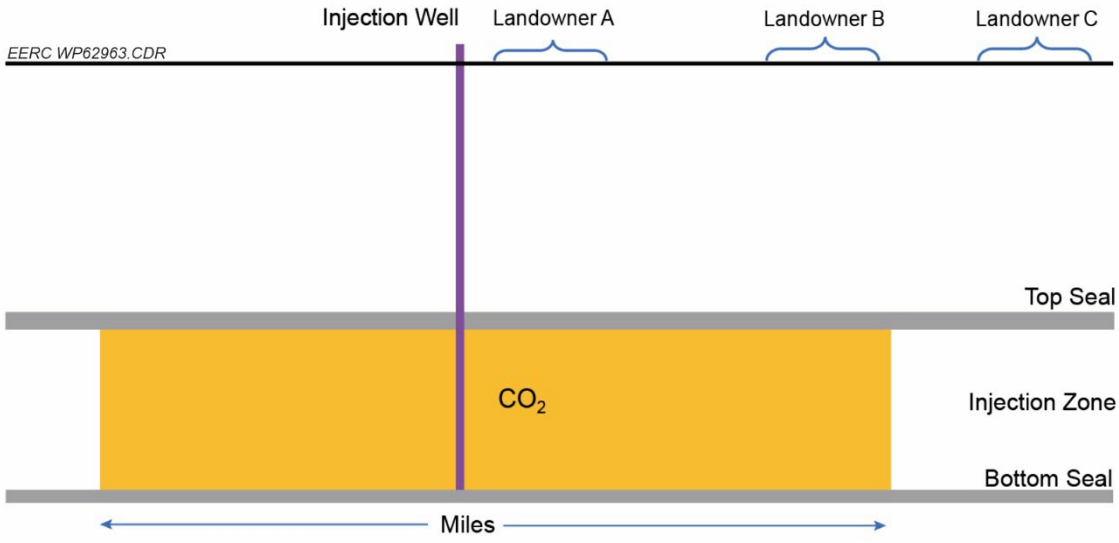

Figure 5. Cross-sectional view of how CO_2 is envisioned in a surface area-based compensation approach.

Regardless of whether an operator and a pore space owner ultimately agree on an area-based or volume-based compensation approach, the two parties will also have to decide at what point in time the area/volume should be measured. In the early years of a CO_2 storage project, any injected CO_2 remains close to the injection well. However, as the project continues and more CO_2 is injected, the plume of CO_2 expands away from the injection well.

In short, with a consenting pore space owner, the operator and pore space owner will need to consider whether a storage deed, a storage lease, or a storage easement will be best suited for their particular situation. In addition, the two parties will need to consider whether the pore space owner will be compensated based on the amount of surface area that overlies the CO_2 plume or volume of pore space occupied by the CO_2 and at what time the area or volume occupied by the CO_2 will be measured.

4.4.1.2 Nonconsenting Pore Space Owners

Obtaining the consent of all pore space owners within a potential storage facility can be difficult, if not impossible. That is why some states have enacted amalgamation statutes to address the pore space of nonconsenting pore space owners. Pursuant to these statutes, a government agency can require that the pore space of nonconsenting owners be included in a potential storage facility. An alternative to amalgamation statutes are eminent domain statutes. Although the challenges presented by these two types of statutes are quite similar, there are differences, as discussed below.

Amalgamation

Compulsory unitization (referred to in North Dakota and hereinafter as "amalgamation") statutes—like those used in oilfield development—have been adopted by several states including North Dakota, Wyoming, Montana, and Nebraska. Under these statutes, an operator of a proposed CO_2 storage project would first need to obtain the voluntary consent of a percentage of pore space owners (60% in Montana, Nebraska, and North Dakota and 80% in Wyoming) within the storage facility area. Once an operator obtains this percentage requirement, nonconsenting owners can be forced to transfer the right to use their pore space in exchange for equitable compensation through a regulatory proceeding. North Dakota's amalgamation statute states that "If a storage operator does not obtain the consent of all persons who own the storage reservoir's pore space, the NDIC may require that the pore space owned by nonconsenting owners be included in a storage facility and subject to geologic storage."[6] However, if owners of 41% of the pore space in a potential storage facility are opposed to an operator using their pore space, then the operator would not be able to leverage North Dakota's amalgamation statute.

Although amalgamation statutes, like the one above, make it possible for an operator to establish a storage facility without the unanimous consent of pore space owners, these statutes present specific challenges. One of these challenges is that an operator cannot use the amalgamation statute until the operator has made a good faith effort to get the voluntary consent of every pore space owner. For example, in North Dakota, an operator must make "a good-faith

[6] NDCC Section 38-22-10.

effort to get the consent of all persons who own the storage reservoir's pore space"[7] before the operator can ask NDIC to amalgamate the pore space of nonconsenting owners. Given that a potential storage facility could have scores of pore space owners, making a good faith effort to obtain the consent of each of these owners can be quite time-consuming and expensive.

Equitable Compensation

Even if an operator can obtain the consent of 60% of the pore space owners of a storage reservoir in North Dakota, an operator still faces the additional challenge of having to compensate all nonconsenting owners. Although North Dakota's amalgamation statute allows NDIC to require the pore space of nonconsenting owners be included in a potential storage facility, that does not mean that an operator can use the nonconsenting owner's pore space without providing compensation. North Dakota law requires NDIC to ensure that each nonconsenting owner is "equitably compensated"[8] for the use of their pore space.

What it means to equitably compensate an owner is open to interpretation. As the agency tasked with enforcing this statute, NDIC is also tasked with being the first government body to interpret it. And although any interpretation by NDIC is subject to judicial review, North Dakota courts will defer to NDIC's interpretation as long as its interpretation is reasonable.

There are at least three ways that NDIC could reasonably interpret the term "equitably compensated." First, it could reasonably interpret it to mean that a nonconsenting pore space owner must receive compensation equal to the fair market value of their pore space, i.e., what a willing buyer would pay in cash to a willing seller.

Second, NDIC could also reasonably interpret it to mean that a nonconsenting pore space owner must receive compensation equal to the amount of damage that an operator causes to the owner's pore space. Under this approach, if an owner's pore space would not be damaged by an operator, then the operator would not need to give the owner any compensation whatsoever.

Finally, NDIC could also reasonably interpret it to mean that a nonconsenting pore space owner must receive compensation equal to the amount that the operator interferes with the owner's use of their pore space. Under this approach, if an operator's use of an owner's pore space does not interfere with the owner's current or future use of their pore space, then equitable compensation would be equal to zero.

Ultimately, what it means to equitably compensate a pore space owner is not clear. The meaning of this term will eventually have to be determined by NDIC and North Dakota courts in the future. According to Gresham and Anderson (2011), the proposition of having to voluntarily acquire property rights in pore space from the required percentage of landowners—perhaps hundreds of landowners—to develop a CO_2 storage unit could make these statutes administratively unwieldy and economically unattractive. Consequently, these statutes will likely result in higher costs associated with acquiring the pore space rights necessary for CO_2 storage.

[7] NDCC Section 38-22-08 Subsection 4.
[8] NDCC Section 38-22-08 Subsection 14.

Eminent Domain

An alternative to amalgamation is the use of eminent domain, which is "the power of the local, state, or federal government agencies to take property for public use without the consent of the owner." There are a few reasons why companies may want to consider eminent domain as opposed to amalgamation. First, whereas amalgamation requires a company to regularly pay a landowner during the time when the company is injecting CO_2 in the landowner's pore space, eminent domain only requires a company to make a onetime payment for the right to use the landowner's pore space.

Second, if a company proceeds through amalgamation, a landowner would have the right to complain to the state agency tasked with regulating CO_2 storage about how a company is operating a CO_2 storage unit. This would not be the case if the company proceeds through eminent domain.

Lastly, amalgamation would require a company to voluntarily obtain the consent of at least 60% of landowners before the company can acquire the right to use nonconsenting landowners' pore space. In contrast, with eminent domain, a company could acquire the right to use nonconsenting landowners' pore space without obtaining the consent of any landowners whatsoever. Eminent domain, therefore, might be more cost-effective than amalgamation.

Statutes Required for Eminent Domain

Before a private company could use eminent domain to acquire the right to use a landowner's pore space for CO_2 storage, the government would need to pass two types of statutes. First, private entities cannot exercise eminent domain without being authorized by the government to do so. Thus, a government agency will need to pass a statute authorizing private companies to use eminent domain for the purposes of CO_2 storage.

Second, the government—or a private entity authorized by the government—may only take private property for "public use," the definition of which must be declared by a statute passed by the government.

North Dakota is an example of a state that has already passed a statute declaring CO_2 storage as a public use (see NDCC § 38-22-01). However, the state has yet to pass a statute authorizing private companies to use eminent domain for the purposes of CO_2 storage. This is most likely because of a unique provision in the state's constitution that defines what can be public use and under what circumstances the government can authorize a private entity to use eminent domain: "[A] public use or a public purpose does not include public benefits of economic development, including an increase in tax base, tax revenues, employment, or general economic health. Private property shall not be taken for the use of, or ownership by, any private individual or entity, unless that property is necessary for conducting a common carrier or utility business." N.D. Const. art. I, § 16.

This provision was adopted by referendum in 2006. It was in direct response to the U.S. Supreme Court's decision in *Kelo v. New London*, 545 U.S. 469 (2005), which held that under the

Federal Constitution, furthering economic development was a valid public use. Over two-thirds of voters voted for this provision.

If North Dakota were to enact a statute that allowed private companies to use eminent domain to acquire the right to use landowners' pore space for purposes of CO_2 storage, landowners would likely attempt to have a court strike down the statute as unconstitutional. They would no doubt argue that only "common carriers and public utilities," such as companies that provide natural gas or electricity, may exercise eminent domain and companies that only store CO_2 do not fall within this category.

However, it surely could be argued that CO_2 storage companies are public utilities and, therefore, are not prohibited by the North Dakota Constitution from using eminent domain. Black's Law Dictionary defines a public utility as a "business enterprise that performs an essential public service and that is subject to governmental regulation." North Dakota has already declared that the public has an interest in promoting "the geologic storage of carbon dioxide" because doing so "will benefit the state and global environment by reducing greenhouse gas emissions."[9] Thus a court could easily find that CO_2 storage is an essential public service.

In addition, CO_2 storage companies would certainly be subject to governmental regulation. Accordingly, there is a persuasive argument to be made that a statute authorizing private companies to use eminent domain to acquire the right to use landowners' pore space for purposes of CO_2 storage would not violate the state constitution.

CO_2 storage likely does not qualify as a "common carrier or utility business." Thus, any statute passed by the North Dakota Legislature that authorizes private companies to use eminent domain for purposes of CO_2 storage would likely violate the state constitution and be struck down by a court. Accordingly, the government is likely the only entity that would be able to use eminent domain for purposes of CO_2 storage in North Dakota.

In contrast to North Dakota, most other states have constitutions that do not prohibit the government from authorizing private companies to exercise domain. As a result, private companies would be able to use eminent domain in these states for purposes of CO_2 storage just as soon as the two types of statutes mentioned above are passed.

Takings Clause and Compensation

After these two types of statutes are passed, how much compensation landowners are entitled to for the use of their pore space—if any—will need to be considered. This is because the ability to use eminent domain is limited by the Takings Clause of the Fifth Amendment of the U.S. Constitution as well as the takings clauses in each state constitution. Under this clause, eminent domain cannot be used to take private property unless the property owner receives "just compensation."

Any action by the government to allow private parties to inject and store CO_2 in a landowner's pore space could be considered a taking. In *Loretto v. Manhattan CATV Corp.*, the

[9] NDCC Section 38-22-01.

court held that a law requiring landlords to allow television cable companies to place cable facilities in their apartment buildings constituted a taking, even though the facilities occupied only 1.5 cubic feet of the landlord's property. The court reasoned that any regulation that results in a permanent physical invasion or occupation of an individual's property, no matter how small, constitutes a taking that warrants compensation.

Many legal scholars (Gresham and Anderson, 2011; Klass and Wilson, 2010), however, have argued landowners would not be entitled to any compensation because the government authorizing private parties to store CO_2 in a landowner's pore space would not amount to the government taking the landowner's pore space. These scholars believe that such an authorization is distinguishable from *Loretto*. They acknowledge that the occupation of the subsurface with CO_2 appears to be "permanent" in that the CO_2 will remain in the subsurface for thousands of years. On the other hand, they argue that placing an odorless, colorless gas nearly a mile below the surface is less like the tangible, physical invasion of a cable wire, and is therefore less likely to so completely "frustrate" the owner's interest in either the surface or mineral estate in the absence of actual harm (Klass and Wilson, 2010).

Ultimately, these scholars believe that the question may come down to the property owner's reasonable expectations regarding their subsurface holdings. They explain that the U.S. Supreme Court has already held that the government authorizing private airplanes to fly over someone's property is not a taking—even though landowners unquestionably own the airspace above their property—because the landowners do not have any reasonable expectation that they can control the airspace far above their property.

These legal scholars believe the same is true when it comes to pore space. According to them, most property owners have never expected to use their pore space in the same way as the surface of their property. Thus, the government authorizing private companies to store CO_2 in their pore space would not constitute a taking that warrants compensation under the Takings Clause.

The preceding arguments, however, are all hypothetical. To date, no court has decided the issue. And assuming that their arguments are incorrect, and courts would find that the government authorizing private companies to inject and store CO_2 in a landowner's pore space is a taking, then private companies would not be able to use a landowner's pore space to store CO_2 without giving the landowner just compensation.

The U.S. Supreme Court has held that just compensation is "measured by the property owner's loss rather than the government's gain." When assessing the value of property, the Supreme Court has generally used a more practical measure in the form of the concept of "fair market value," or "what a willing buyer would pay in cash to a willing seller." However, the court has also recognized that in some cases, it simply may be impossible to determine a market value, particularly in cases where there have been too few sales to credibly predict a future price. In such cases, lower courts have determined that any "fair and nondiscriminatory" method of determining a "fair and realistic value" is sufficient.

These principles would guide any valuation of pore space that is taken through eminent domain. Courts would likely first look to any comparable sale of other pore space in the area. If

evidence of comparable sales is not available, parties will look to other factors. For instance, parties may show a loss in the whole property value due to the taking at issue. The parties would do this by showing the difference between the value of their entire property—this would include the surface and the subsurface—before the alleged taking and the value of their entire property after the taking. So, if a landowner's entire property was worth $1,000,000 before the government authorized companies to inject CO_2 into the landowner's pore space, and the value of that property was then determined to be worth $950,000 after the government authorized companies to inject CO_2 into the property, the landowner would be entitled to $50,000.

In conclusion, eminent domain represents an alternative to amalgamation as a means of dealing with nonconsenting owners. Although the challenges presented by these two types of statutes are quite similar, there are at least two major differences.

The first major difference relates to the effort that an operator must give before it can utilize either type of statute. Both types of statutes require an operator to make a good faith attempt at acquiring each owner's consent voluntarily. However, whereas amalgamation statutes require an operator to acquire the consent of a certain percentage of owners, eminent domain statutes do not require an operator to acquire the consent of any owners at all. So, if an operator makes a good faith attempt to obtain the consent of each pore space owner, the operator can use eminent domain even if every single owner does not give consent.

The second major difference relates to compensation. Both types of statutes require an operator to compensate nonconsenting owners for using their pore space. However, whereas NDIC would determine how much an operator utilizing amalgamation will have to compensate a nonconsenting owner, a jury would determine how much an operator utilizing eminent domain would have to compensate a nonconsenting owner.

In sum, although amalgamation and eminent domain statutes are useful tools for operators dealing with nonconsenting pore space owners, such statutes are not without their challenges. Both types of statutes require an operator to make a good faith attempt to obtain the consent of each pore space owner, which could require considerable time and effort. Likewise, both statutes require an operator to compensate all nonconsenting owners for using their pore space.

4.4.2 Other Considerations

There are additional legal and technical considerations related to pore space amalgamation in North Dakota. These considerations are identified and discussed in this section, some of which will continue to be investigated in more detail as commercial deployment continues in North Dakota and the PCOR Partnership region.

4.4.2.1 Competition with Mineral Interests

Before issuing a CO_2 storage permit in North Dakota, the state must determine whether the storage facility contains commercially valuable minerals; if it does, a permit may be issued only if NDIC is satisfied that the interests of the mineral owners or mineral lessees will not be adversely affected or an arrangement has been made between the mineral owners/lessees and the storage

operator. Nothing in a CO_2 SFP prevents a mineral owner or mineral lessee from drilling through or near a storage reservoir to explore for and develop minerals, provided the drilling, production, and related activities comply with NDIC requirements that preserve the storage facility's integrity.

4.4.2.3 Who Owns the CO_2 in the Pore Space

According to North Dakota law, the storage operator has title to the CO_2 injected into and stored in a storage reservoir and holds title until the state issues a certificate of project completion. While the storage operator holds title, the operator is liable for any damage the CO_2 may cause, including damage caused by CO_2 that escapes from the storage facility.

4.4.2.4 Long-Term Liability

In North Dakota, the storage operator can apply for a certificate of project completion at the end of a CO_2 injection project. This certificate may not be issued until at least 10 years after CO_2 injections ends and the storage operator has met certain requirements. Specifically, the storge operator must:

- Be in full compliance with all laws governing the storage facility and have addressed all pending claims regarding the storage facility's operation.
- Show that the storage reservoir is reasonably expected to retain the stored CO_2 and that the CO_2 in the storage reservoir has become stable (i.e., is essentially not moving).
- Show that all wells, equipment, and facilities to be used in the postclosure period are in good condition and retain their mechanical integrity.
- Show that it has plugged wells, removed equipment and facilities, and completed reclamation work as required by NDIC.

After a certificate is issued, title to the storage facility and to the stored CO_2 transfers, without payment of any compensation, to the state. Title acquired by the state includes all rights and interests in, and all responsibilities associated with, the stored CO_2. At the same time, the storage operator and all persons who generated any injected CO_2 are released from all regulatory requirements associated with the storage facility.

Monitoring and managing the storage facility is the state's responsibility to be overseen by NDIC until such time as the federal government assumes responsibility for the long-term monitoring and management of storage facilities.

4.4.2.5 Buffers and Other Areas

North Dakota regulations also require a buffer area to be defined beyond the predicted outer boundary of the areal extent of the CO_2 plume. This buffer area provides additional assurance that the CO_2 will not migrate beyond the boundaries of the permitted facility. The buffer extent is

squared off to approximately the nearest ¼–¼ section to facilitate legal description of the storage facility area (Figure 6).

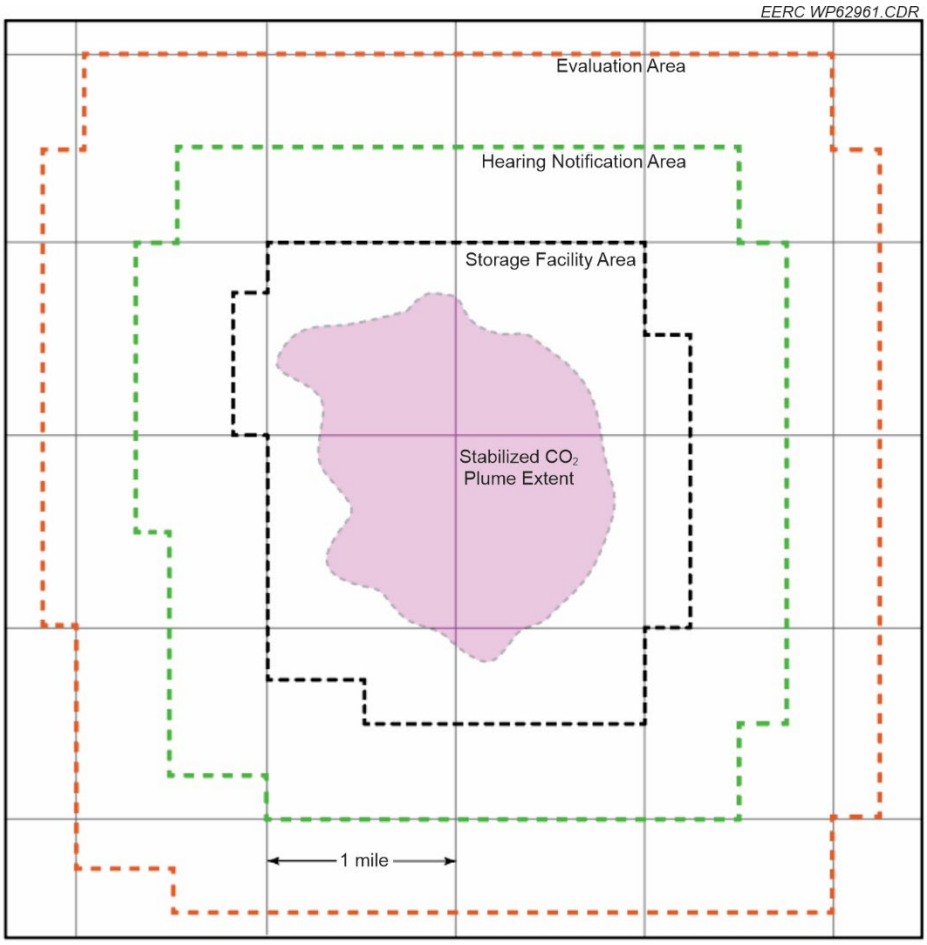

Figure 6. Example areas of note for a CO_2 storage project: storage facility, hearing notification, and technical evaluation areas. Areal extent of the CO_2 plume in this example is based on a relatively small CO_2 storage project (~200,000 tonnes per year).

NDIC is required to hold a public hearing before issuing a SFP. At least 45 days prior to the hearing, the applicant shall give notice of the hearing to each of the following groups of individuals within the facility area and within ½ mile of its outside boundary (Figure 6):

- Owner of record of minerals
- Mineral lessee of record
- Operator of mineral extraction activities
- Owner of record of the surface
- Owner and each lessee of record of the pore space

NDIC is required to give at least a 30-day public notice and comment period leading up to the public hearing. The state follows public notification requirements such as advertising in a newspaper of general circulation in the county where the project is proposed.

North Dakota regulations require a technical evaluation of the proposed storage facility and within 1 mile of its outside boundary. This evaluation includes items such as an evaluation of all existing information on all geologic strata overlying the storage reservoir, including the immediate cap rock containment characteristics and all subsurface zones to be used for monitoring. The evaluation must also identify any productive existing or potential mineral zones occurring within the facility area and any USDWs. NDCC § 43-05-01-05 contains a full list of requirements for the technical evaluation.

5.0 FIRST MOVER COMMERCIAL PROJECTS IN NORTH DAKOTA

As of the writing of this document, North Dakota has experienced a rapid increase in project developers that are interested in advancing commercial CO_2 storage projects in the state. As the first projects matured beyond the initial stages of site screening and feasibility into the project design and permit development stages, they have acquired the necessary rights to pore space access to move forward with pore space amalgamation for the projects.

To date, NDIC has approved the construction of three CO_2 storage facilities. In October 2021, NDIC issued an order approving the creation of Red Trail Richardton Ethanol Broom Creek Storage Facility #1 in Stark County, North Dakota. Pursuant to the order, Red Trail Energy, LLC (RTE) is authorized to store CO_2 in the Broom Creek Formation. NDIC also approved amalgamation of pore space within the boundaries of the storage facility and required RTE to maintain financial responsibility with qualifying instruments covering the storage facility.

Likewise, in January 2022, NDIC authorized Minnkota Power Cooperative (Minnkota) to store CO_2 in the Broom Creek Formation in Minnkota Center MRYS (Milton R. Young Station) Broom Creek Storage Facility #1 and in the Black Island and Deadwood Formations in Minnkota Center MRYS Deadwood Storage Facility #1. These stacked storage facilities are in Oliver County, North Dakota, and are centered on MRYS. NDIC also issued separate approvals for the amalgamation of pore space within the boundaries of both storage facilities and required Minnkota to maintain financial responsibility with qualifying instruments covering both storage facilities.

These two projects represent first-of-a-kind efforts to amalgamate pore space for CO_2 storage, marking a critical development for the emerging CCUS industry in North Dakota.

6.0 REFERENCES

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