Lobos CO_2 Pipeline Health Impact Assessment
June 2015

Human Impact Partners in collaboration with
Partnership for a Healthy Torrance Community & New Mexico Department of Health

HUMAN IMPACT PARTNERS

Partnership for a Healthy Torrance Community

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Table of Contents

Executive Summary

Building a carbon dioxide (CO_2) pipeline through Torrance County, New Mexico, has the potential to compromise safety, threaten water supplies and quality, and disrupt the special places, culture and historical connection to the land that unite the county's diverse communities. This Health Impact Assessment (HIA) of Kinder Morgan's proposed Lobos CO_2 Pipeline finds that the project offers few if any benefits to the health, well being and economy of the county.

Although falling oil prices prompted Kinder Morgan in January 2015 to withdraw its application to the US Bureau of Land Management for the proposed Lobos CO_2 Pipeline, the company reserves the right to revive the project if market conditions change. Facing this possibility, the partners who conducted the HIA - Human Impact Partners, New Mexico Department of Health, and Partnership for a Healthy Torrance Community - completed this study to serve as a compendium of information that could be used to evaluate the impacts of a future proposed pipeline or similar projects. The HIA could also be useful to other communities facing such proposals.

Kinder Morgan is the largest energy infrastructure company in North America. It owns an interest in or operates more than 80,000 miles of pipelines that transport natural gas, oil and carbon dioxide, and is the largest transporter of CO_2 in the US.

The proposed $1 billion Lobos Pipeline project includes 213 miles of 16-inch pipeline to carry CO_2 from an underground reservoir in Apache County, Arizona, to the Permian Basin in eastern New Mexico and West Texas for use to enhance the process of extracting crude oil from oil fields. The pipeline would connect in Torrance County to Kinder Morgan's existing Cortez Pipeline, which runs from southwest Colorado to Denver City, Texas. The Lobos Pipeline project is projected to have an initial capacity of 300 million cubic feet of CO_2 a day.

Construction of the pipeline requires the acquisition of a 100-foot right-of-way for the pipeline route, which would cross private, state, and tribal land throughout New Mexico, including areas belonging to Native American tribes and land overseen by the Bureau of Land Management. Landowners can negotiate permission and compensation for allowing right-of-way, however if they refuse, under New Mexico law oil and gas pipelines are "common carriers" serving the public good, and Kinder Morgan has the right to seize the land through eminent domain.

Torrance County is known for its awe inspiring landscape, farms, ranches and warm climate, with a unique history that has tied many families to the area for hundreds or thousands of years. Its diverse population of about 16,000 includes Pueblo and land grant families, descendants of 19th Century homesteaders, retirees and artists. In the 2010 Census, 56 percent of residents identified as white and 39 percent as Hispanic or Latino. Of Hispanics and Latinos, more than half further identify as Spanish or Spanish-American, descendants of families who settled here when Mexico was a Spanish territory.

Torrance County residents struggle with poverty, unemployment and other socioeconomic and health challenges. Of 32 counties ranked in New Mexico, in 2015, Torrance ranked 28th in terms of quality of life, 26th in social and economic factors, and last in health behaviors (smoking, exercise, etc.). However, strong community connections among Torrance County's residents serve as protective health measures.

The Health Impact Assessment focused on how the proposed pipeline would affect health and equity in these key areas:

- Culture and connection to the land
- Land use

- Economic vitality
- Safety
- Water quality and availability

Culture and connection to the land

> *"To take away the connection to the land… to take a part of us… it is like missing a limb."*
> – HIA Focus Group Participant

Cultural and spiritual well being are vital social determinants of health. Yet they are not included in traditional assessments of environmental or health conditions. The culture of Torrance County is tied strongly to preservation of traditions and natural resources. The proposed pipeline would have significant impacts on the unique populations and cultures that have called Torrance County home for centuries.

Numerous culturally significant sites are found in Torrance County. These include all three sites of the Salinas Pueblo Missions National Monument, dating to the 17th century and listed on the National Register of Historic Places, as well as 12 other historic sites or features. Many lesser-known sites are spread throughout Torrance County on both public and private land. In focus groups for this HIA, land grant heirs in particular said sacred sites in Torrance County are crucial to their identity and culture.

Given the strong connection many residents have to culturally and spiritually significant sites in Torrance County, the proposed pipeline's construction, operation and maintenance would likely diminish the community's identity and connection with its culture and history. The project could trigger historical trauma associated with the past traumatic experiences of populations in Torrance County including loss of land and culture and mistreatment by government and private entities. Historical trauma stems from a community's sense of collective loss over past events.

Land use

Land use plays a crucial role in determining health outcomes. In Torrance County, land use is deeply embedded in the history and tradition of the region. Large-scale developments such as the proposed pipeline can impact land use by changes to traditional and current uses such as farming or ranching, degradation of the landscape, and shaping future land use decisions and opportunities.

Focus group participants cited uncertainty about local land use decisions as a cause of anxiety and stress, particularly for those residing on or near the proposed pipeline route. Residents expressed deep concern for how the land has been affected by past developments, such as the addition of a second track to the Burlington Northern-Santa Fe Railroad, and how it might be further damaged by future developments, including the proposed pipeline.

Construction of the proposed pipeline would bring a major industrial development into Torrance County. This is inconsistent with the goals of the County's land use plan which aims to maintain traditional and current land use and protect areas that are historically, culturally, geographically or environmentally unique.

Economic vitality

Kinder Morgan says construction of the pipeline, along its entire length from Arizona to Texas, would employ a peak of 1,200 workers. After construction is complete, operating the pipeline would require 6 to 8 permanent employees. The company says it expects to pay $2.3 million a year in property taxes, to be shared by states, counties and municipalities along the route.

However, there is no guarantee that any Torrance County residents would get either the temporary or permanent jobs, and the county's share of property taxes would be small. In focus groups, residents were concerned that the economic benefits of the pipeline would not outweigh the costs. In Pima County, Arizona, where Kinder Morgan is building a natural gas pipeline, County officials calculated that added costs for public safety, roads, environmental damage and other impacts would exceed the economic benefits to the county.

Kinder Morgan's track record raises additional concerns. In other locations, the company has greatly exaggerated the number of jobs and tax revenue from projects, tried to claim unjustified tax deductions, and been fined for environmental violations. Landowners also worry about the effect that the pipeline will have on their property values, mortgages, and insurance.

> *"There ain't no 401(k). There ain't no pension plan. There's not even a fricking savings account. That 80 acres is all I have…I mean, I've got nothing else."* – HIA Focus Group Participant

Safety

The US Department of Transportation classifies CO_2 as a non-flammable hazardous gas. Depending on the concentration and length of exposure, carbon dioxide can have negative health impacts ranging from labored breathing, headaches, visual impairment and loss of consciousness. At very high exposures it can cause brain, lung or heart damage, coma or even death.

The possibility of a pipeline accident concerns residents because Torrance County, with a small population spread over more than 3,000 square miles, has limited emergency services. There is no hospital and no after-hours or emergency health care.

> *"You know one of the problems is an acute problem. The pipeline leaks or breaks. The other problem is chronic. And that's, you know, I mean nothing may happen…with that pipeline if it's built, but people have to live with the thought or the idea, the stress, that it might happen all the time…Fear…That's the chronic condition of living with a thing like that."* – HIA Focus Group Participant

Since Kinder Morgan was formed in 1997, nearly 500 accidents have been recorded on its pipelines (of all kinds). At least 11 leaks have been documented on Kinder Morgan's Cortez CO_2 pipeline, which would connect in Torrance County to the proposed Lobos Pipeline. In 2011 alone, the company was fined more than half a million dollars by federal authorities for pipeline violations, yet it has sharply cut spending for pipeline maintenance. Based on estimates of the annual frequency for CO_2 pipeline accidents, between 12 and 20 accidents can be expected on the proposed pipeline during its operating life of 60 to 100 years.

Water availability and quality

In New Mexico and the entire Southwest, water is a paramount concern, and Torrance County is no exception. According to the US Drought Monitor, most of the county is in a "severe" drought, with some portions in "extreme" drought. In the Estancia Basin, which includes Torrance County, shrinking supplies of groundwater have caused the state to declare it a critical management area.

> *"The first big issue here is our water, because I don't see anybody here that looks like a camel that can survive seven days without water, or that can live without water. To me, that's a priority. Everything else follows: the historical, the cultural, our land, everything."* – HIA Focus Group Participant

Construction and operation activities associated with pipeline projects require a significant amount of water use. Prior to construction of Kinder Morgan's Cortez CO_2 pipeline, Colorado water officials expressed concern that the BLM was not looking closely enough at its impact on water supplies. Environmental impact statements for other CO_2 pipelines have documented that such projects require millions of gallons of water for hydrostatic testing, drilling, dust abatement and other needs.

Once in operation, an accidental release from a pipeline has the potential to affect groundwater quality. CO_2 wells and carbon capture/sequestration projects where accidents have resulted in carbon release have been found to affect water quality by decreasing the pH level, increasing the presence of dissolved metals, or changing water hardness. A study at Duke University found that underground CO_2 leaks could increase contaminants in freshwater aquifers by tenfold or more, in some cases to levels above federal drinking water standards.

Recommendations

The Health Impact Assessment concludes that the Lobos CO_2 Pipeline project offers few benefits for Torrance County; conversely, there are numerous ways it could adversely impact the health and well being of local residents.

Recommendations to the Torrance County Commission to address these impacts include:

- Require Kinder Morgan to establish a mitigation fund to support the development and allocation of resources and services to address adverse impacts of the proposed pipeline to mental and physical health.
- In collaboration with the County Planning and Zoning Board, research and designate north/south and east/west utility corridors for infrastructure development. The process for determining these corridors should take into consideration broad community input, existing land use patterns, historical and cultural impacts, economic impacts, quality and way of life, fragile ecosystems and resources, and health and safety. They should also prioritize the use of existing industrial corridors and align with the County's updated Comprehensive Land Use Plan.
- Require that a comprehensive study of the economic impacts of the proposed pipeline be conducted. The study should include an analysis of loss of use costs, amount and distribution of tax revenues, award compensation and cost benefit analysis, and be made available for public review and comment.

Additional recommendations include:

- With community input, relevant federal agencies should develop guidance for pipeline development in New Mexico, covering impacts to land use, culture and connection to the land, land use, economic vitality, safety and water quality and availability. The guidelines should provide examples of best practices for addressing impacts in these categories, and specifically address the impacts of proposed project activities on health and equity.

These recommendations offer ways for decision makers and project stakeholders to ensure the protection and prioritization of the health and well being of Torrance County residents. The recommendations – and the values and principles deeply held and expressed by many residents as a part of the HIA – can serve as important guiding principles for future decisions that will affect many generations to come in Torrance County and beyond.

I. Introduction

In October 2013, the federal Bureau of Land Management (BLM) announced it would prepare an Environmental Impact Statement (EIS) for a pipeline to transport carbon dioxide from an underground reservoir in Apache County, Ariz., to oil fields in the Permian Basin of eastern New Mexico and West Texas. The Lobos CO_2 Pipeline project was proposed by Kinder Morgan, the largest energy infrastructure company in North America. Several potential routes were under consideration; at least three of them would go through Torrance County, New Mexico.

Upon learning about the proposed pipeline, residents in Torrance County expressed concern about its potential impacts on land use, their way of life, historically and culturally sensitive areas, the economy, safety, and the quality and availability of water. Residents were also concerned that the voices of many in the community were not being addressed adequately in the EIS process.

In March 2014, Human Impact Partners entered into a collaboration with the Partnership for a Healthy Torrance Community and the New Mexico Department of Health to conduct a Health Impact Assessment (HIA) to comprehensively address the health and equity concerns raised by those the pipeline would impact. The goals of the HIA were to provide information about the health and equity impacts of the pipeline to Torrance County residents and decision makers and to propose recommendations for consideration in decisions about the proposed project. The HIA also aimed to provide data and information that may not be addressed by the EIS or analyses from other sources.

In January 2015, during the time the HIA was being conducted, Kinder Morgan withdrew its application with the BLM for the pipeline, citing "current market conditions" – the sharp drop in the price of oil. Company officials said that although the application would be withdrawn, Kinder Morgan may revisit the project proposal if market conditions change. If Kinder Morgan does decide to renew the proposal, it will be required to initiate a new EIS process.[1] As the HIA was near completion when the proposal was withdrawn, and knowing that the proposal could be revisited in the future, HIA partners decided to proceed with finalizing and releasing the HIA on the Lobos CO_2 Pipeline Project. HIA partners also hoped the data and information gathered would be useful to other decision-making processes, both in Torrance County and in other places where similar projects are proposed.

An abundance of research confirms that good health is a product of social, environmental and economic conditions that create opportunities for individuals, families and communities to lead healthy lives. This definition of health led us to focus on five areas that could be impacted by the proposed CO_2 pipeline or similar project:

- Culture and connection to the land
- Land use
- Economic vitality
- Water availability and quality
- Safety

Other issue areas that could be impacted by the proposed pipeline project but that were not addressed in this report include the effects of CO_2 mining and transport on greenhouse gas emissions, and the impacts of the end use of the proposed project (EOR) on climate change, environmental and human health. The HIA steering committee recognizes that these are important potential impacts of the proposed pipeline project that should be addressed, however, fall outside of the feasible scope of this HIA project.

About The Health Impact Assessment

According to the National Academies of Sciences, HIA is "a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, or project on the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects."

The HIA of the proposed Lobos CO_2 Pipeline was conducted from March 2014 to March 2015, with funding from the W.K. Kellogg Foundation. Guiding the process was a steering committee that included Human Impact Partners (HIP), Partnership for a Healthy Torrance Community, New Mexico Department of Health, and New Mexico Health Equity Partnership.

Although the proposed pipeline route would span from Arizona through New Mexico and into Texas, the steering committee decided to limit the scope of the HIA to Torrance County. This decision reflected resource and time constraints, in addition to the concern that the proposed pipeline could affect a wide range of unique cultural resources and landscapes in Torrance County, and the fact that many county residents who would be impacted by this pipeline expressed concerns about the project. Even though this HIA is limited to Torrance County, the potential impacts of the project are also relevant to surrounding areas that would also be impacted by the pipeline.

The HIA process engaged Torrance County residents through public meetings and community forums to develop the HIA scope, share preliminary research findings and discuss recommendations. Residents were also invited to participate in focus groups and informational interviews to inform the analysis.

HIP conducted the research and drafted the report, convened the steering committee, prepared materials for and helped facilitate the public meetings and community forums and managed the overall HIA process. Local steering committee members organized public meetings, forums and focus groups; provided feedback on the HIA's scope of research and report drafts and tracked the EIS process. The Steering Committee received a subgrant to cover the costs of their participation and activities in the HIA.

HIA findings were derived through literature review on key areas of interest; primary data collection through focus groups with local residents; interviews and conversations with stakeholders in Torrance County and New Mexico with expertise in one of the HIA's focus areas; secondary data collection and analysis; and gathering statistics from a variety of published reports and government websites. We found that relatively few CO_2 pipelines have been constructed in the US, so there is little peer-reviewed research on the impacts CO_2 pipelines to health and other social and economic factors. Therefore, analysis in this HIA often relies on proxy measures, such as documented impacts from projects similar in scope and nature, to inform predictions about the potential impacts of the proposed CO_2 pipeline.

About Human Impact Partners

Human Impact Partners is a nonprofit organization based in Oakland, California. Our mission is to transform the policies and places people need to live healthy lives by increasing the consideration of health and equity in decision-making. We are one of the few organizations in the United States conducting health-based analyses with an explicit focus on uncovering and then addressing the policies and practices that make communities less healthy.

II. About the Proposed Lobos CO_2 Pipeline Project and its Context

Kinder Morgan owns an interest in or operates approximately 80,000 miles of pipelines that transport natural gas, oil and carbon dioxide, primarily in the US and Canada.[2] The company is the largest transporter of CO_2 in the US.[3] In New Mexico, Kinder Morgan operates approximately 3,600 miles of pipeline, including 1,300 miles of CO_2 pipeline.[4] The proposed $1 billion Lobos CO_2 Pipeline project included 213 miles of new 16-inch pipeline that would connect to the existing Cortez CO_2 pipeline and transport carbon dioxide from an underground CO_2 reservoir in Apache County, Arizona, to the oil and gas fields of the Permian Basin in eastern New Mexico and West Texas. The project would also expand the Cortez Pipeline from Torrance County to southeastern New Mexico. The proposed pipeline would be 16 to 20 inches in diameter, require three pump stations along the pipeline route, and support an initial capacity of approximately 200 million standard cubic feet per day of CO_2.[5] The CO_2 transported through the Lobos Pipeline would be used to support extraction of oil from fields where easy-to-produce oil (e.g. through pumping) has been exhausted.

Basics of CO_2 and its use in pipeline transport

Carbon dioxide (CO_2), which is naturally occurring in the atmosphere, exists in gas, liquid and solid states. As a solid, it is usually referred to as dry ice. CO_2 is a gas under atmospheric pressures and standard temperatures, and forms a solid at temperatures below -109.5° F. Pressurized CO_2 can be converted to liquid form, and above a critical temperature and pressure it exists as a supercritical fluid, with characteristics of both liquid and gas. The CO_2 gas is nonflammable, noncombustible and at low concentrations is colorless and odorless. CO_2 plays a crucial role in the earth's carbon cycle. It is absorbed and converted to plant matter during photosynthesis, and is a product of cellular respiration.[7] CO_2 is also a major product of fossil fuel combustion, and is the primary greenhouse gas contributing to climate change – over 80 percent of greenhouse gasses emitted from human activities in 2012 were carbon dioxide.[8]

Carbon dioxide can be transported by pipeline either as a pressurized gas or as a supercritical fluid. This supercritical form is sometimes also referred to as dense phase CO_2.[9] In the oil and gas industry CO_2 is transported by pipeline for use in the process of enhanced oil recovery (EOR), where it is injected deep underground into oil wells. Upon injection, the CO_2 expands to push oil to wellbores, and also reacts with oil to make it flow more easily and loosen it from rock surfaces.[10] CO_2 is used in about 60 percent of enhanced oil recovery operations in the US.[10]

Major construction to put the pipeline into place, including the use of heavy equipment, welding and trenching, was expected to take approximately six to eight months.[6] The operating life of the proposed Lobos CO_2 Pipeline was expected to be 60 to 100 years, and when the pipeline was no longer in use, all above-ground facilities would likely be disconnected and the pipeline retired in place.[6]

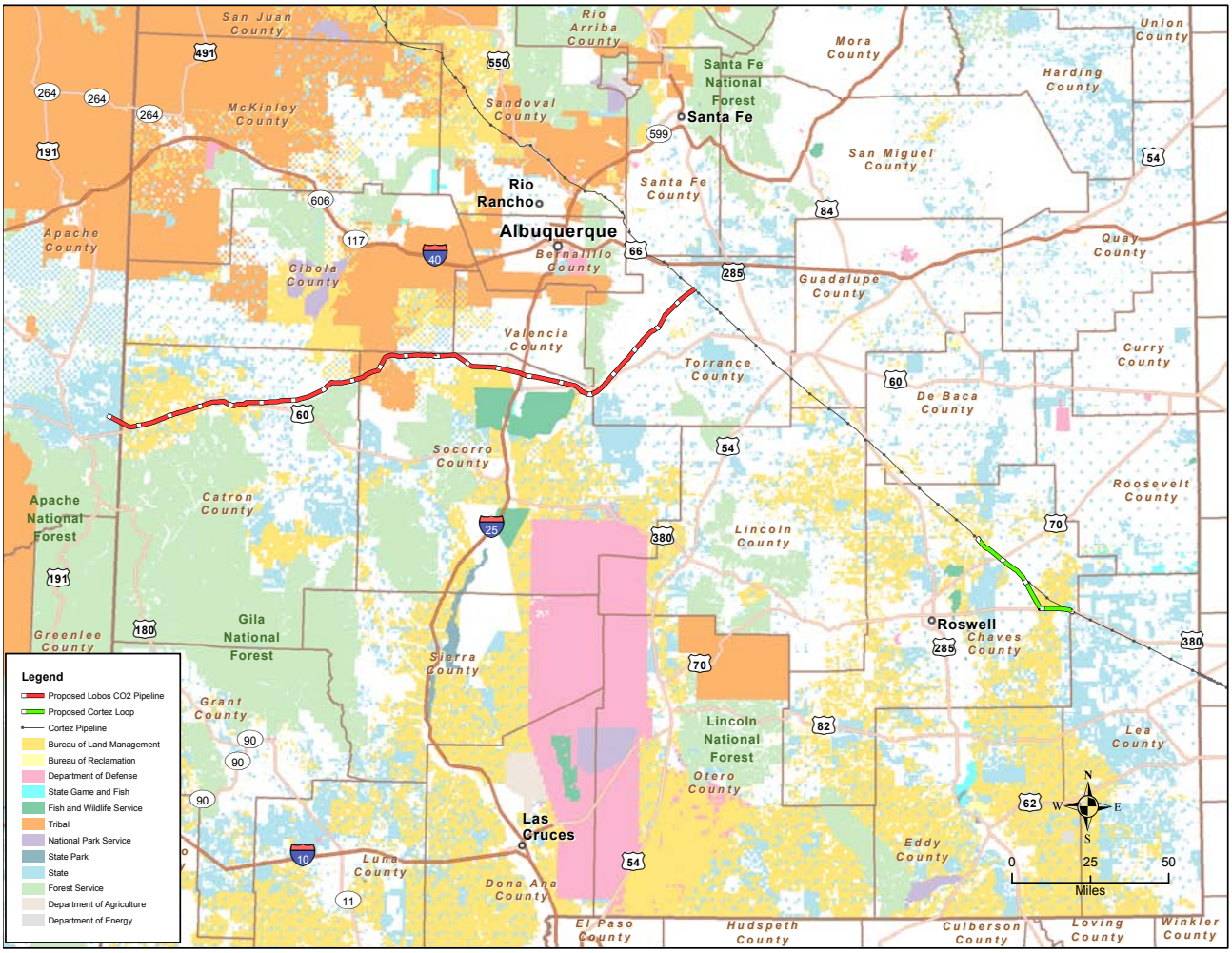
Proposed Pipeline Route

For construction on the project to begin, Kinder Morgan is required to obtain an easement, or right-of-way, along the route that would require the acquisition of 50 feet of land on either side of the pipeline. The final ROW for the constructed pipeline would be 50-feet wide, and would cross private, state, federal and tribal land throughout New Mexico, including areas belonging to Native American tribes and land overseen by the Bureau of Land Management.[6] The map below shows Kinder Morgan's proposed route for the pipeline.

The segment of the pipeline route proposed to run through Torrance County would have primarily crossed private land, including agricultural and residential land.[5] Kinder Morgan would have been required to secure the right to pass through this land directly with each agency, tribe or private owner. In some cases, the owners

may have willingly negotiated permission and compensation for use of their land. But if an owner did not grant permission, Kinder Morgan would have the option to seize the land through eminent domain.[6]

Figure 1. Proposed Route of the Lobos CO_2 Pipeline



Source: US Department of the Interior, Bureau of Land Management.
http://www.blm.gov/nm/st/en/prog/more/lands_realty/lobos_CO_2_pipeline.html

Key Pipeline Facts

- Kinder Morgan's documentation on the proposed pipeline states that "land within the proposed aboveground facilities (i.e., pump stations, launcher/receiver sites, and mainline block valves) would be permanently converted to industrial use."[11] Other requirements include no permanent building structures or trees to be installed on the pipeline right-of-way.[6] Farming and grazing activities would be allowed to continue, although the right-of-way agreements would ask that no permanent building structures and/or trees be installed on the pipeline right-of-way.[6]
- Major pipeline construction activities are projected to take place over a period of six to eight months, and include digging and building a trench within the 100-foot right-of-way for the 16" pipeline, and welding the pipeline itself. The operational life of the pipeline (including maintenance) is projected to be between 60 and 100 years. Blasting would be required in areas

where mechanical equipment (e.g., excavator or trench machine) cannot break up or loosen the rock.[12] Prior to being operationalized, the pipeline would be hydrostatically pressure-tested to ensure that it is capable of safely operating at its designated pressure.

- Horizontal Directional Drilling (HDD) crossing segments would be tested two times: prior to installation, and as part of the overall hydrostatic test of the pipeline. Kinder Morgan would purchase water from water authorities, water rights holders or individuals, or commercial entities. Anticipated locations for water sources and the volume of water required for testing have not yet been determined.[12]
- The pipeline will be routed to maintain a minimum distance of 200 feet away from existing water wells. If a water well is discovered during installation that is closer than 200 feet, a water well scientist will be hired to evaluate any potential damage to the well or the water supply.[6]
- During operation, the right of way over the pipeline is required to be visible, and covered by no more than native grasses or low-lying shrubs.[6]
- An analysis of the Lobos Pipeline's socio-economic impacts commissioned by Kinder Morgan states that construction of the pipeline would employ 1,200 people at its peak, with an average of 600 workers at a given time.[11] They estimate that 10 to 20 percent of these positions would be filled by local residents.[11] Operation phase employment is expected to add 6 to 8 permanent employees, and local contractors would be hired as needed to maintain the right-of-way.
- Kinder Morgan anticipates property taxes may be due in all counties in which the Project is located. [11] Approximately 40 percent of materials to support the construction of the pipeline (e.g. fuel, food, and construction supplies) may be purchased within the local project area. Material procured locally for project construction and operations would be subject to sales taxes in the counties and municipality in which they are purchased, thus resulting in county and municipal sales tax revenues. However, most major project components (e.g., pipe, valves, and fittings) would be obtained from outside the project area. [11]

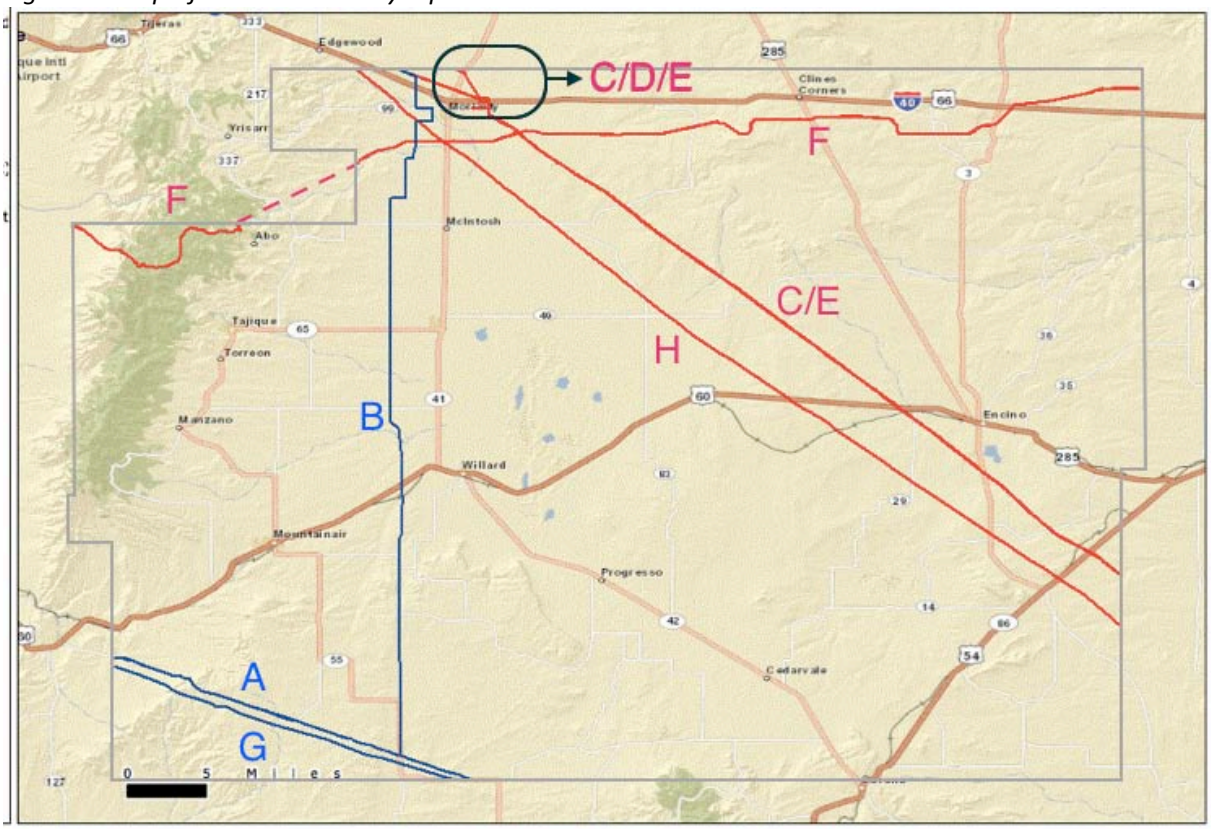
Existing Pipelines in Torrance County

There are already at least eight resource transport pipelines in Torrance County, according to the Department of Transportation's National Pipeline Mapping System. These include three gas pipelines and five liquid pipelines, including the Cortez CO2 pipeline owned by Kinder Morgan. Kinder Morgan's proposal for the Lobos Pipeline includes plans to link the Cortez and Lobos pipelines together in Torrance County.[13]

Decision Making Process for the Proposed Lobos CO_2 Pipeline Project

The Bureau of Land Management (BLM) is the lead regulatory agency responsible for conducting the environmental assessment of the proposed project. The BLM is required to issue a draft environmental impact statement (EIS) delineating its preferred route for the pipeline, on which the public could submit comments.[14] The final EIS would identify the preferred route for the pipeline. Kinder Morgan would also be required to obtain a special use permit from numerous counties the pipeline would pass through. Because Kinder Morgan withdrew its application with the BLM for the pipeline, no draft EIS was released for the proposed project. However, this decision making process would also hold for a future pipeline application.

Figure 2. Map of Torrance County Pipelines



The above map shows existing natural gas pipelines (in blue) and hazardous liquid pipelines (in red) in Torrance County (border outlined in gray). Note that some of the pipelines run adjacent to each other, including the Rocky Mountain, HEP and Cortez pipelines (C, D and E), which join in northern Torrance County. The dotted red line along the Amarillo-Albuquerque pipeline (F) denotes a stretch of the pipeline, which falls outside of Torrance County. Adapted from npms.phmsa.dot.gov.

III. Background

Torrance County is located in the heart of New Mexico. Known for its enchanting rural landscape, agriculture and warm climate, it is home to a diverse population with a unique history that has tied many families to the area for hundreds, and in some cases, thousands of years. Below we provide a brief history of the populations in Torrance County, and in the following section give an overview of the county's demographics and health status.

Figure 3. Map of New Mexico with Torrance County

Source: USGS, The National Map Viewer

History of Torrance County's Inhabitants

Pueblo People

Human settlement in New Mexico dates back to as early as 1500 BCE, with ancestors of the modern-day Pueblo peoples have inhabiting what is now New Mexico since at least 300 BCE.[15] The Pueblo are a cultural and linguistic group of Native Americans who historically and currently populate the Southwest United States and are particularly associated with New Mexico and Arizona.[16,17] Before contact with the Spanish, the Pueblo people were farmers, primarily practicing dry-land farming of corn, squash, beans and cotton in the area's arid landscape.[18]

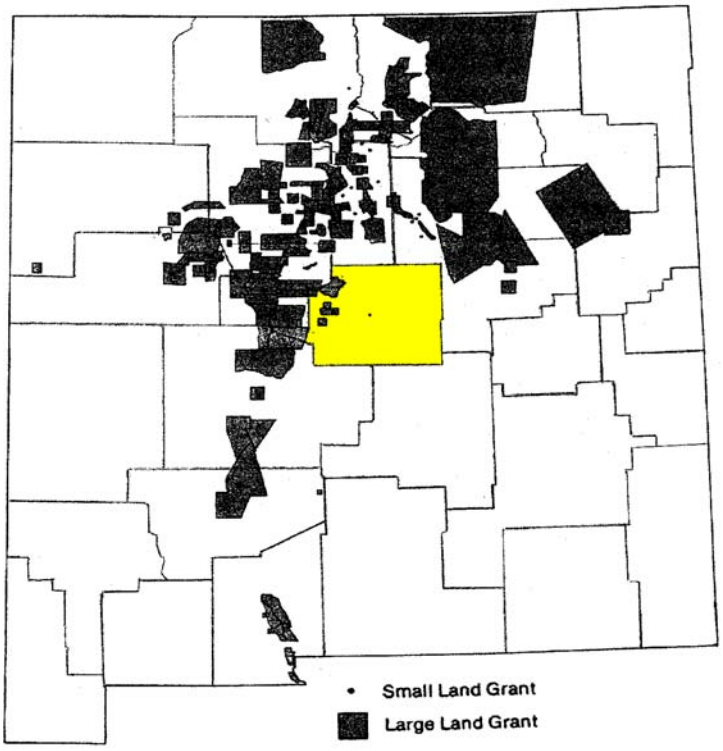
Land Grants

In the early 1500s when colonization by the Spanish began, what is now New Mexico was part of Mexico, which until 1821 was part of the Spanish empire. Under Spanish and later Mexican rule, Spanish, mestizo and some Native American settlers were encouraged to settle in commons, or land grants, awarded by the Spanish government.[19] Land grants were operated by different family units within the

same geographic area who pooled labor cooperatively to cultivate communal croplands.[20,19] Many of the land grants included areas home to ancient Native American settlements.

After the Mexican-American War in 1848 and the signing of the Treaty of Guadalupe Hidalgo, New Mexico became a US territory. About 60,000 Mexicans and 10,000 Pueblos lived there. [19] Similar to how treaties designating land rights to indigenous populations across the US were dismissed over the following centuries, the original land grant boundaries were eroded. It is estimated that over two-thirds of the original land grants that once covered vast stretches of present-day New Mexico have been lost due to acquisitions by the US government and other issues associated with mismanagement of land grant adjudication.[21] Torrance County is home to land grant communities around the villages of Chilili, Manzano, Tajique and Torreon on the eastern foothills of the Manzano Mountains.

Figure 4. Contemporary Land Grant Boundaries in New Mexico



Adapted from Gonzales, 2003, based on US Bureau of Land Management data from 1972.[21]

Homesteading

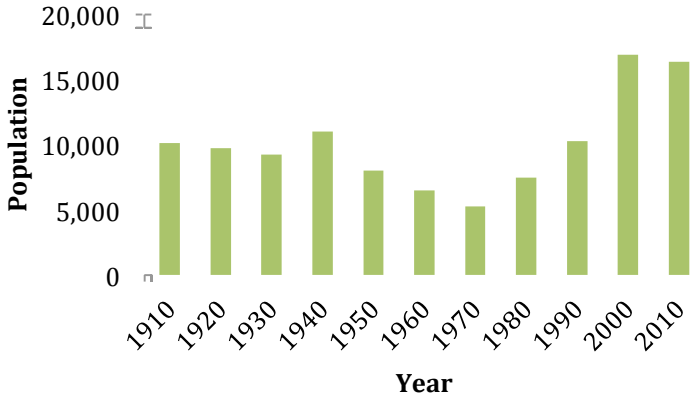
Beginning in the middle of the 19th century, several US government acts promoted "homesteading", or the settlement of land in the western states for farming and ranching.[22] The most important of these acts is the Homestead Act of 1862 which granted 160 acres of land to any head of household that could establish a claim by settling and working the land for a specified period of time. Homesteading brought more migrants from other parts of the US to New Mexico and marked the beginning of a demographic shift.[23]

Historic Demographic Shifts

In the last 100 years, Torrance County's population has fluctuated dramatically. Following a severe drought in the 1940s and 1950s, the county's population dropped by more than half. However, after

1970, the population grew as people moved to the area from other states and Mexico. From 1990 to 2000, Torrance County was the fastest growing county in New Mexico, more than tripling in population.

Figure 5. Population of Torrance County, 1910-2010[24]



IV. Torrance County Today

Torrance County remains a rural, sparsely populated county. It is home to a diverse mix of residents including Pueblo and land grant families, descendants of 19th century homesteaders, as well as relative newcomers including a significant population of retirees and artists. The county's populations struggle with poverty and social, economic and health conditions – of the 32 counties in New Mexico, in 2015 Torrance ranked 25th for overall health outcomes, 26th in social and economic factors (education, income inequality, etc.), and last in health behaviors (physical activity, diet, etc.).[25] However, the presence of strong social and cultural connections within local communities that are described below and through out the HIA help to promote health and well being.

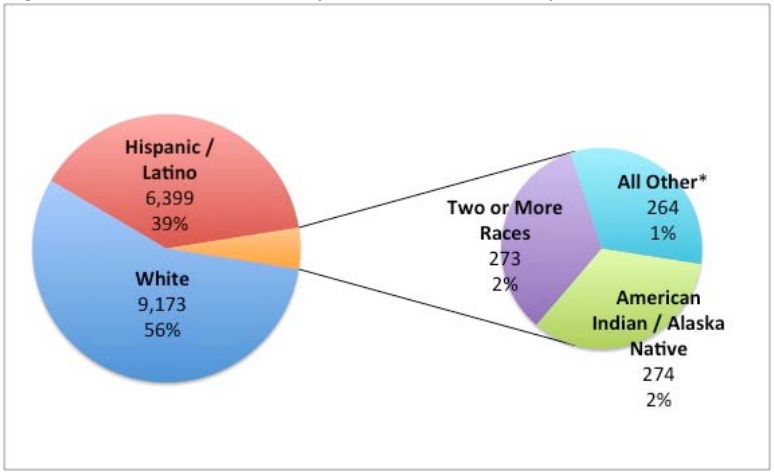
Population

While Torrance County saw steady population growth during the late 20th century, the population has decreased in recent years to 15,717 residents in 2013.[26,27] Population density is less than five people per square mile.[24] Almost three-fourths of residents live in a village or an unincorporated rural area, while the remaining population lives within cities or towns, including Moriarity, Estancia, Mountainair and Willard, all of which are in the western half of Torrance County and adjacent to rural and agricultural areas.[24]

Race and Ethnicity

New Mexico is considered a "majority minority" state and is home to the highest proportion of Latinos/Hispanics in the nation – 42 percent. [28] The majority of the population in Torrance County identifies as white, with Hispanics/Latinos as the next-largest group.[29]

Figure 6. Race and Ethnicity in Torrance County, 2010



Source: 2010 US Census

Although there is only a small section of a Pueblo reservation (the Isleta Pueblo) in Torrance County, and while the Native American population of Torrance County recorded is very low, other groups in Torrance County, such as the land grant communities, identify with Pueblo heritage. We estimate that 21 percent of Torrance County's population (n=3,445) is likely to identify as land grant heirs, descendants of land grant heirs or Hispanic families that have resided in New Mexico for multiple generations. [See also Section V.1. Culture and Connection to the Land]

Age

The median age in Torrance County is 41 as compared to the state median of 37. Fifteen percent of the county's population is age 65 and older which is comparable to the state (13 percent), though lower than in the area around the town of Mountainair (20 percent).[30,31,32] Torrance County's climate, low cost of living and unique natural resources make it an attractive destination for retirees.[18] The growth in the proportion of retirement-age individuals in Torrance County far outpaces the state and nation.

The county has a similar percentage of children and teens as New Mexico overall – 28 percent in the county compared to 28 percent in the state. However, compared to the state, Torrance County has fewer children under age 5, and fewer adults between the ages of 20 and 34.[33]

Income, Poverty and Educational Attainment

One in four people in Torrance County live in poverty compared to about one in five in the state,[34] and rates of poverty in the county have been on the rise over the past decade.

Median household income in Torrance County has fluctuated over the last several decades. The most recent data indicate median household income in 2012 in Torrance County as $31,538, as compared to $44,886 in New Mexico.[a] [34]

The county had an estimated 3,165 jobs in 2013,[35] however, these jobs are not sufficient to meet the population's needs. Respondents to the 2014 Torrance County Community Survey indicated that the top two problems for families are employment and poverty/low income.[33] Since 2004, the County's annual unemployment rate has surpassed that of New Mexico and is currently 8.4 percent, two points higher than the state. [36,37] Additional data show that 47 percent of parents in Torrance County lacked secure employment, compared to 39 percent in the state.[33]

While high school graduation rates are similar to that in New Mexico and the US,[33] only an estimated 12 percent of county residents have a bachelor's degree or higher, which is less than half the rate in the state.[38]

Health Status

Every five years, Partnership for a Healthy Torrance Community – the County's local Health Council that serves as an advisory group to the Torrance County Board of Commissioners regarding actions affecting the health of its residents – develops a community health profile. The health profile is used to prioritize health needs and issues in the county, to identify actions to address the issues, and to identify health indicators that can be used to monitor change and progress in addressing priority health issues. The 2015 Torrance County Health Profile highlights the health and health determinants the county struggles with: low household income and unemployment, high rates of child poverty, and low education attainment levels. The Profile also indicates how strong community connections serve as protective health measures. Below, highlights from the Profile are presented along with data from recent studies of health conditions in Torrance County.[33]

General Health

- Nearly a quarter of Torrance County is without health insurance.

[a] From the 2008-2012 American Community Survey

- Approximately one quarter of Torrance County adults self-report having poor or fair health, a rate higher than the state and the US[b]
- Approximately half of adults in Torrance County are overweight or obese.
- County residents report having had an average of 5 mentally unhealthy days in the past 30 days, compared to an average of 3.6 in the state.[c]
- The county's domestic violence rate is much lower than in the state. Of 2013 cases, more than one quarter involved alcohol/drug use, and close to half were cases with injury.

Mortality

- Between 2010 and 2012, the death rate in Torrance County (811/100,000 population) was greater than the state (742) and the US (747).
- Between 2008 and 2010, the leading causes of death in the county and the state included heart disease, cancer, unintentional injuries, chronic lower respiratory diseases, and stroke. Rates of these deaths were notably higher in Torrance County than in New Mexico.
- Compared to other counties in New Mexico, in 2008-2010 Torrance County ranked 10th highest for alcohol-related deaths
- Between 2008 and 2012, suicide death rates among youth were significantly higher in Torrance County (29.9/100,000 population) compared to the state (22), and more than three times that in the US overall (9.7).

Substance Abuse

- Torrance County has the second highest rate of adult drinking and driving in the state, and is seventh highest for adult binge drinking.
- For youth in both the county and the state, rates for several important risk behaviors including abuse of painkillers, binge drinking, cigarette smoking and physical fighting have fallen dramatically in recent years.

Maternal and Child Health

- The rate of teen births in Torrance County (52 percent) is significantly higher than in the US (31 percent), and slightly higher than the state (48 percent).
- Fewer women in Torrance County receive prenatal care in their first trimester of pregnancy (55 percent) compared to the state (64 percent).
- Between 2007 and 2011, Torrance County's average infant death rate (12.4/1,000 live births) was more than twice that in the state and the nation. The Healthy People 2020 target is 6 infant deaths per 1,000 live births.
- Between 2010 and 2012, Torrance County rated third highest in the state for the percentage of infants born low birth weight; this rate (12 percent) is higher than in the state, the nation, and far exceeds the Healthy People 2020 target rate of 7.8 percent.

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[b] Source: New Mexico Indicator-Based Information System (NM-IBIS). https://ibis.health.state.nm.us/community/highlight/profile/GenHlth.Cnty/GeoCnty/57.html.

[c] Source: 2015 County Health Rankings and Roadmaps. http://www.countyhealthrankings.org/app/new-mexico/2015/rankings/torrance/county/outcomes/overall/snapshot

Youth Risk Behaviors and Protective Factors

- Youth risk for behaviors that contribute to unintentional injury such as wearing a bicycle helmet, texting while driving and having a gun in the home are higher in Torrance County than the state.
- A higher percentage of youth from Torrance County report carrying a weapon such as a gun, knife or club than did youth in the state. County youth also reported a higher rate of bullying on school property than in the state.
- Torrance County youth fare better than youth in the state for risk behaviors associated with alcohol and drug abuse.
- Measures of family health in Torrance County show higher rates of parental interest in children's school performance and the presence of caring adults in the lives of children as compared to the state.
- Torrance County youth demonstrate a greater presence of protective factors with peers such as planning for future educational opportunities, having friends who care about their well being and having fewer friends who get into trouble.

V. Findings

In this section we describe existing conditions, how they relate to health and equity, and ways in which the proposed Lobos CO_2 Pipeline project could impact measures of health and well being for each of the prioritized issue areas in the HIA: culture and connection to the land, land use, economic vitality, safety and water quality and supply.

V.1. CULTURE AND CONNECTION TO THE LAND

"A sense of place must include, at the very least, knowledge of what is inviolate about the relationship between a people and the place they occupy, and certainly, too, how the destruction of this relationship, or the failure to attend to it, wounds people." - Barry Lopez, The Rediscovery of North America

New Mexico and Torrance County are diverse areas rich with cultural resources and unique traditions. At the heart of the Southwest, New Mexico's iconic landscape and Western identity plays a significant role in the spiritual and social lives of its residents. Cultural and spiritual well being, manifested in Torrance County as a deep connection to the land, are vital social determinants of health, yet are not included in traditional assessments of environmental or health conditions [39] Many indigenous cultures extend the concept of health to include physical, mental, emotion, and spiritual dimensions, and define healthy living as being in harmony with the spirit world, with their community and with the land.[39]

Torrance County residents have emphasized the way in which their culture is largely based on preservation — both preserving traditions and preserving natural resources. Given this emphasis, major developments, such as the proposed pipeline, would have significant impacts on the unique populations and cultures that have called Torrance County home for centuries. Others, who have come to Torrance County in recent decades, also stand to have their way of life and connection to the land altered as a result of the proposed pipeline.

Background

History of Settlement, Conflict and Exploitation

The conflict and exploitation arising from multiple waves of colonization have shaped the history of Torrance County and the surrounding region. Under Spanish rule, for example, Pueblo communities such as the Jumanos, Tompiros, Piros and Tiwas were missionized under Spanish Franciscan priests and became embroiled in the internal political struggles of New Spain between the Franciscans and civil authorities. Historic records observe numerous accounts and accusations of abuse and exploitation of Pueblo people by both parties throughout the missionary period in the mid 1600s. Tensions led to the abandonment of many Pueblo settlements, and culminated in the Pueblo Revolt of 1680, after which many of the remaining residents of the area dispersed and integrated into closely related tribes from the pueblos of Isleta in New Mexico and Isleta del Sur in Texas.[40]

After present-day New Mexico was ceded to the US in 1848, the original treaties and land grant boundaries that designated land rights for land grant families and other indigenous populations across the US were dismissed and eroded, leading to the displacement and decimation of many Native American communities and the taking of their lands by Spanish, Mexican and American authorities.

Many Torrance County residents also identify with the exploitations and atrocities experienced by Native American communities throughout the US. For example, focus group participants for this HIA referenced instances of the loss of natural resources, such as the slaughter of buffalo by hunters in the 19th century, that led to a loss of culture, tradition and subsistence practices.

Culture and Spirituality

The spiritual settlement of the Southwest has inextricably linked the past with present identities and traditions, and has interwoven Spanish, American and Native American cultural histories. Spirituality is a defining piece of Torrance County's history, in which both indigenous and Catholic beliefs and practices are common and often blended seamlessly. Shrouded in mysticism and romance, the area is home to five 17th century Spanish missions[41–44] These missions are the site of stories such as that of Spanish Franciscan nun, Sôr (Sister) María de Jésus de Ágreda, who is reported to have mystically "bi-located" to the Southwest between 1620 and 1631 to spread Christianity among the natives of the Salinas district and elsewhere.[45,46] Sôr María de Jésus de Ágreda was, to the Spanish captains and Franciscan fathers, a sign of divine destiny to colonize the Southwest.[41,47,48] Their entrance into Salinas led to the missionizing of the local Native American populations and introduced Spanish settlers from whom some Torrance County residents claim descent.

Identity

After the Treaty of Guadalupe Hidalgo was signed in 1848, the American government polled land grant communities in the eastern Manzano Mountains about whether they identified as Caucasian or Indian. If they identified as Indian, they were designated as Pueblo, as with the Pueblos of Laguna, Isleta, Sandia, etc. (now located throughout the state of New Mexico). Although identification as a Pueblo community offers some protections today, at the time this designation subjected Pueblo communities to loss of land and self-governance, and in many cases children being confiscated and sent to "Indian schools" – boarding schools established to separate children from their native language and culture, and to assimilate youth to Euro-American culture. Land grant communities saw this mistreatment of the Indian/Pueblo communities, which reinforced their future identification as Caucasian/Spanish.[49]

Focus group participants described the American government's attempts to erase both residents' Spanish and indigenous identity. One participant recalled:

> Mountainair wasn't Mountainair, it was a little town by the name of Monte Alto. Willard didn't exist; it was Progreso. Then they [the American government] came and changed the names. And they tried to steal our language when we were going to school here. They would hit us on the hands if we spoke Spanish.

Another resident described the way the Abiquiú, descendants of indigenous New Mexicans, hid their identity to prevent repercussions from American authorities:

> Abiquiú knew that they were mostly Indian, but they told the American government they were Spanish, because if you said you were Indian, they would steal your kids, break your family and take them off [to various Indian schools in the state]. That's why we had to say that we're Spanish, even though a lot of us were indigenous.

During World Wars I and II, land grant heirs had to identify as Spanish to qualify for the military. If they identified as Indian, they were rejected for service or put into segregated groups of Native American soldiers who were often placed on the frontlines and suffered disproportionately heavier casualties.[49]

Existing Conditions

Identity

The nature of identity among Torrance County's long-standing communities is highly charged and political by nature. Several focus group participants cited the mental distress and feelings of anger and

resentment that they currently experience as a result of the attempts to label, control and marginalize ethnic minorities in Torrance County, as this triggers the collective and traumatic experience faced by their ancestors.

2010 Census data indicates that the majority of Torrance County's population identifies as White, with Hispanics/Latinos as the next-largest census group, and smaller numbers of those who identify as American Indian. [See Section IV. Torrance County Today]. Detailed counts of Hispanic/Latinos' specific ethnic or national identification are available from the Census[50] and can be used to roughly calculate the number of individuals in Torrance County likely to identify as land grant heirs, descendants of land grant heirs, or Hispanic families that have resided in New Mexico for multiple generations. Based on our Census calculations, we estimate there are 3,445 individuals in the county with land grant ties, which accounts for approximately 21 percent of Torrance County's population. This assumption is consistent with information from the New Mexico Land Grant Council staff on typical Census self-designations among New Mexico land grant heirs.[51]

Culture and Spirituality

Land grant heirs trace their ancestry to both Spanish and indigenous people, and cite both influences as crucial to their spiritual understanding and self-identity. Among the land grant communities, this identity is not only a historical remembrance, but has been carried out into present-day spiritual practices. For example, descendants of the Sisneros and Baca families, whose ancestors were among the Spanish families that settled New Mexico in 1598,[52,53] continue to inhabit their historic homes in Torrance County and tend to the San Lorenzo chapel in Abó whose land was donated by the Sisneros family.[52,54]

Catholicism also continues to be a major aspect of identity for many people in Torrance County. A 2002 survey showed that a higher proportion of county residents are affiliated with a church relative to the rest of the country – 78 percent of Torrance County's population compared to 52 percent nationwide – and that three-fourths of residents who are affiliated with a church are Catholic.[55]

Connection to Culturally Significant Sites in Torrance County

The mix of Spanish and indigenous history in Torrance County is also apparent through the presence of numerous culturally significant sites, including all three sites of the Salinas Pueblo Missions National Monument (Abó, Gran Quivira and Quarai), which are either entirely or partially within the county. These sites are listed on the National Register of Historic Places, along with 12 other historic sites or features located throughout Torrance County.

Though these missions are in ruins now, their legacy continues to reverberate in the everyday activities of the area. For example, the town of Ágreda, Spain, currently recognizes a "sisterhood" with New Mexico due to their shared history with Sôr María de Jésus de Ágreda.[45,46] The apparition and image of Sôr María de Jésus de Ágreda are still revered among Torrance County residents and commemorated as an part of both Hispanic and Native American residents' Catholic identity, and a commemoration of her occurs annually in Torrance County, rotating among the three Salinas Pueblo Mission sites.[56]

In focus groups for this HIA, land grant heirs expressed that sacred sites in Torrance County are crucial to their identity and culture. Numerous other tribes outside of Torrance County have also been closely linked to this region, including the Pueblo of Isleta, the Pueblo of Ysleta del Sur, Pueblo of Sandia, Hopi, Piro/Tompiro, Jumano, Mescalero Apache, Zuni, Jemez, Acoma, Santo Domingo, Kiowa and Wichita/Caddos, and others[40] located throughout New Mexico and the Southwest.

While not all tribal governments publish population estimates, among those that do so, we estimate that currently there are at least 37,000 Native American people with heritage tied to the Abó area, including those of Ysleta del Sur,[57] Sandia,[58] Zuni,[59] Jemez,[60] Kiowa[61] and Wichita/Caddos[61] descent. Given the lack of data on other tribes, this figure is a significant underestimate of the true number of Native Americans with cultural affiliations to sites in Torrance County.

Many lesser-known sites, including those not made publicly known by local preservation authorities in order to maintain the sites' integrity, and others whose locations are no longer known, are also spread throughout Torrance County on both public and private land. [For more on culturally significant sites in Torrance County see Section V.2. Land Use] As one focus group participant put it:

> You can't throw a rock without hitting a culturally sensitive site [in Torrance County].

The prevalence of sacred sites, both marked and unmarked, on lands currently and historically inhabited by Native American tribes or others, is not unique to Torrance County. In Oklahoma, for example, where the US government drove tribes from the East Coast, the difficulty in avoiding Indian burial or archaeological sites or to circumvent the patchwork jurisdiction of tribal governments has been noted in the process of exploring possible routes for the proposed Keystone XL pipeline.[62] As stated by a representative for TransCanada, the company proposing the Keystone XL pipeline:

> Sometimes there are areas very significant to the tribes that don't bear any physical evidence . . . It might be used to hold ceremonies, but if you walked there you wouldn't see any evidence.

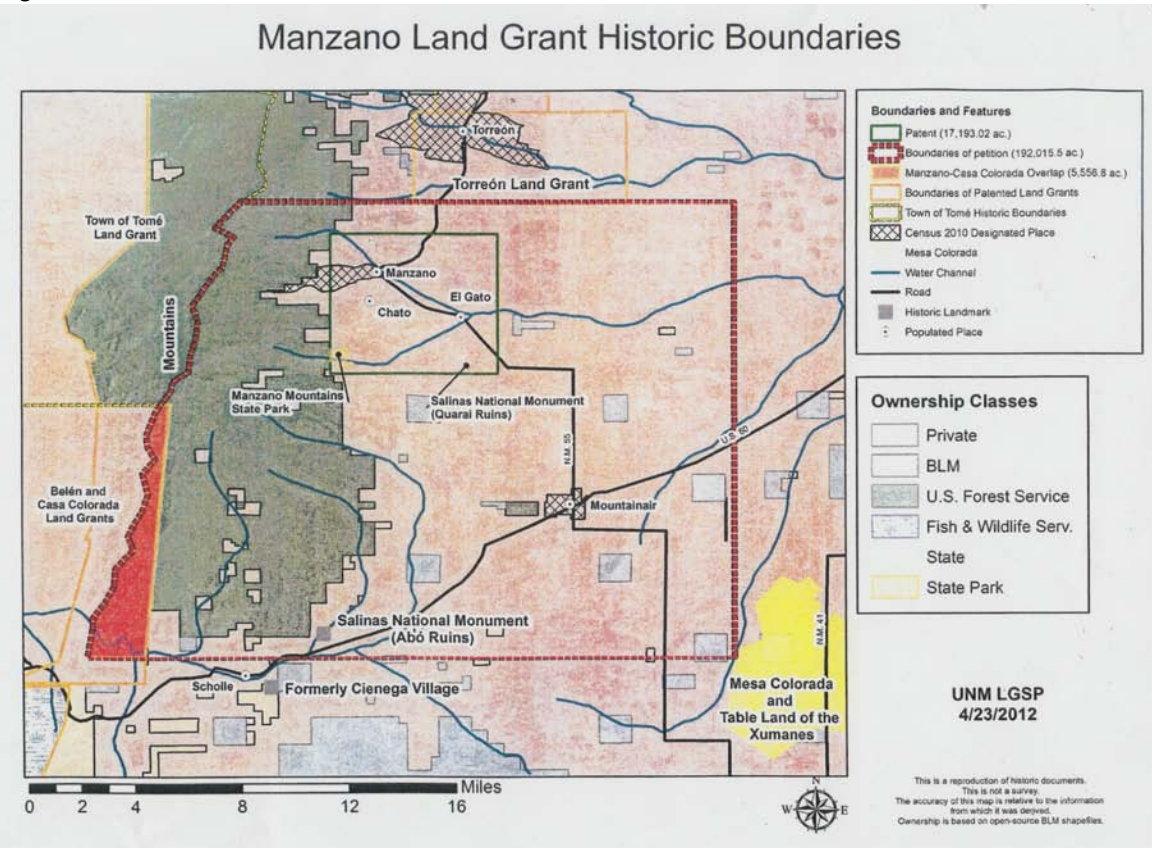
Additionally, sacred sites may not have clear boundaries, as explained by the aide for cultural and historic preservation for the Sac and Fox Nation:

> Some things are sensitive to us. If they want to go through a grave, the ground around it may be sacred, too.[62]

Current Impacts of Historic Conflict

Over time, New Mexico's land grant communities have lost of over two-thirds of their original land. [See Section III. Background] This loss of land commonly occurred through unethical and fraudulent means to American land speculators, US government agencies including the Forest Service[21], National Park Service, and as a result of the Homestead Act in 1862. An example of the disparity between the ancestral land grants and the greatly reduced present boundaries is the Manzano Merced land grant located in Torrance County east of the Manzano Mountains, which has shrunk to only a small fraction of its former extent. Much of this original land grant has been ceded to private use and the US Forest Service. The trauma of the history of genocide, dispossession, loss of land and displacement of communities with a history in Torrance County has led to a deep distrust of government institutions and recurring stress triggered by the similarities in more recent events.

Figure 7. Manzano Land Grant Historic Boundaries



Source: University of New Mexico Land Grant Studies Program

The above map shows the original, ancestral extent of the Manzano Merced land grant (thick red dotted line) in comparison to the much-diminished current land grant (box in the upper central portion of the map, bounded by the thin green line).

Connection to the Land

Another aspect of Torrance County's residents' connection to the land is encapsulated in American writer Barry Lopez' concept of *querencia*:

> A place on the ground where one feels secure, a place from which one's strength of character is drawn – a place in which we know exactly who we are.[63] . . . (The desire for *querencia*) is both a response to threat and a desire to find out who we are. And the discovery of querencia hinges on perfection of a sense of place. A sense of place must include, at the very least, knowledge of what is inviolate about the relationship between a people and the place they occupy, and certainly, too, how the destruction of this relationship, or the failure to attend to it, wounds people.[63]

These sentiments were echoed by focus group participants, including land grant heirs and more recently-arrived artists and retirees, who expressed how the land they lived on was a part of their individual character or community identity, and also expressed a desire to protect this land from threats that would alter the sense of place that Torrance County has cultivated due to its unique cultural history. These sentiments are again, not unique to Torrance County's residents, but are echoed by similar communities across the country. A lawyer who works closely with tribes in South Dakota who are opposed to the proposed Keystone XL pipeline told *The Washington Post:*

> Opposition [to pipeline projects] is rooted in Native American belief. Above all the land is sacred. It's not just a mantra. People really do see this as sacred land. It really causes a lot of people a lot of pain, particularly the elders. They recognize the damage this [the proposed pipeline] has the potential for.[62]

Social Cohesion

Throughout New Mexico and beyond, traditional activities continue to bind generations of Hispano families together.[64] As one focus group participant stated, "Hispanic families are really united. We're all together, we support each other." Focus group participants also expressed that, despite the racial and ethnic differences among Native Americans, land grant heirs, homesteaders, artists and retirees in the area, the preservation of the county's traditions and cultural heritage are important factors in maintaining a strong sense of place and community for all residents. While there are a number of health concerns in Torrance County, data also shows the distinctive presence of protective health measures among the county's residents, which is another indicator of the community's strong sense of family, community and culture. [See Section IV. Torrance County Today]

Culture and Connection to the Land and its Relationship to Health and Well Being

Culture is an important social determinant of health,[65] and research shows that specific aspects of culture can have a direct relationship to health outcomes, especially those associated with mental health.[65,66] The historic experiences of populations in relation to their land and culture, even from generations past, can also impact health outcomes.

Connection to Cultural Places

Although destruction of cultural places is not an uncommon concern when it comes to proposed development projects, it is a phenomenon that is not commonly discussed in the academic literature. This is likely because, although there is concern about development-related threats to culturally or spiritually significant sites, and this concern sometimes receives attention in the news media, the destruction still moves forward, and there is a lack of reporting on the lasting effects of these impacts.

In cases where concerns about these impacts are considered by government regulatory bodies to be mitigated – for example through excavation of threatened sites by archaeologists – little if any follow-up study or reporting is encouraged or conducted. In rare cases where development construction reveals evidence of damage to or destruction of important cultural or spiritual sites, reporting often focuses on whatever was learned about the sites before they were destroyed, and not on the lasting impacts of their destruction to impacted communities.[67]

Community health measures in Torrance County, such as the prevalence of chronic disease and poor mental health outcomes, as well as high rates of teen pregnancy and suicide,[68] show that local populations demonstrate effects associated with *historical trauma* and *acculturation stress*. These are indicators of susceptibility to the potential impacts of loss of culture observed in other settings.[69]

Historical trauma

When historic experiences are significant and negative, they can become embedded into a culture's collective experience in what is known as *historical trauma*, passed down through generations within communities that have experienced a history of large-scale, catastrophic events.[70–72] It can also be described as residual, community-level psychological injuries due to collective loss, or as historical unresolved grief.[70] Building on knowledge of trauma responses and chronic stress, historical trauma researchers have suggested that present-day reminders of past traumas can exacerbate the negative

Historical trauma is understood to be intergenerational and cumulative over time. It is distinct in this way from more individual experiences of trauma, like Post Traumatic Stress Disorder (PTSD).[72] Historical trauma is thought to be passed down through physiological/genetic, environmental and social pathways.[72,73] In fact, higher prevalence of disease and trauma symptoms have been found in certain populations even several generations after the original trauma occurred.[73]

Similar to other forms of trauma, historical trauma is expressed and felt through a stress response to certain triggers (reminders) in one's environment.[71,73] Stress responses elevate an individual's level of cortisol, the hormone associated with stress.[77,78] Some of the physical health effects associated with experiences of stress response and chronic stress are hypertension, coronary heart disease and stroke.[77]

The stress response of historical trauma develops in part as a result from an individual seeing their present-day experiences through the lens of the past traumas of their community.[71,73] These reminders can be triggered by visual cues or through experiences of perceived discrimination and threats to livelihood.[71,74,79] Triggers can also include observing persisting inequities in one's community, such as poverty, that are lasting results of the past loss of livelihood, loss of culture and discrimination.[71] Exposure to the traumatic history of one's community history can induce what some researchers call "vicarious trauma," where the trauma is re-experienced by that person, without even having been present for the original trauma.[73] Additionally, researchers suggest that where historical trauma is present, reminders of the past historical trauma through present-day events and experiences can heighten one's stress levels.[70,71]

psychological effects that historically marginalized communities experience in areas where historical trauma is present.

Historical trauma has been documented among many different communities, including Native Americans, African Americans, families of those interned in Japanese-American camps during World War II, and many other groups around the world.[71–74] It has since also been applied in understanding similar patterns of poor health among the descendants of various populations whose histories include mass displacement and land loss, loss of livelihood, forced loss of culture, war, genocide and discriminatory targeting of a community.[70–73,74] In the context of Torrance County, both Native American and land grant families belong to groups with a heritage historically linked to historical trauma.

Though more limited, research has linked health disparities among Mexican-Americans, many of whom have indigenous ancestry (17 percent of Torrance County's population[50]), and Spanish-descended communities in the Southwest (an estimated 21 percent of Torrance County's population) with historical experiences of land dispossession, colonial settlement by Spain and the US and discrimination.[19,72] In describing the continued psychological effects of these experiences among New Mexico's land grant family heirs, historian Phillip Gonzales characterized present-day feelings among these populations as defined by "bitterness, resentment, and hostility."[21]

Children and grandchildren of survivors of trauma who themselves experience historical trauma are more likely to have shorter life expectancies, and demonstrate poor physical and mental health outcomes such as anxiety and depression, and trauma symptoms such as hyper-vigilance, distrust, feelings of vulnerability, and psychological distress; all of which can contribute to dysfunctional interpersonal relationships and inhibit healthy development and functioning.[71,73,75]

Chronic stress has several specific detrimental physical health implications, including impairment of the nervous, cardiovascular and immune systems, and

is associated with diabetes, hypertension, and cardiovascular disease.[73] Historical trauma has also been associated with increased substance use and abuse, specifically in research with Native Americans and Mexican Americans, thought to be as a coping mechanism for present-day stressors.[72,74,76]

Acculturation Stress

Torrance County, and New Mexico in general, has experienced several waves of encounters between indigenous or long-standing cultures construed as "traditional" coming into contact with new cultures that changed the established social order. Examples of this include Native Americans' encounter with European colonizers, the Spanish and Mexicans' conflict with American territorial expansion and the current rural/agricultural culture coming into contact with industrial, corporate-driven culture.

These intersections can be sources of acculturation stress, caused when one culture comes into contact with an external culture that imposes involuntary change, which can include a change to the environment, as well as loss of cultural traditions and lifestyles. Acculturation stress has been widely studied since the 1980s, particularly in the context of "modern" culture — with its focus on material wealth and individualism — and its encounter with more "traditional" cultures, such as Circumpolar people in Canada.[65,66] However, while acculturation stress is known to affect indigenous cultures in particular, it can affect non-indigenous cultures as well.[80]

Stress is a facet of everyday life, but the impacts of acculturation stress go well beyond more typical types of stressors. Those who suffer from acculturation stress may suffer mental health problems, including intense feelings of marginality, alienation and disenfranchisement or identity confusion. Acculturation stress may also lead to other serious behavioral health problems, including homicide, suicide, substance abuse and domestic violence.[81] The literature shows that marginalized youth are especially susceptible to the effects of acculturation stress,[69] underscoring the multi-generation effects that involuntary cultural change can bring about.

In a study of Inuit women suffering from acculturation stress, participants linked grief from culture loss to problems with identity, feelings of being socially excluded and a decline in overall wellness.[82] Among Inupiat youth, social disintegration, acculturation stress and rapid social and economic change have been linked to high incidence of suicide and alcohol abuse.[69]

Social cohesion

Social cohesion refers to the overall state of social bonds within a society, and is based on factors such as shared values, social order and social control, solidarity and equity, social networks and identity. Common measures of social cohesion include civic engagement, interpersonal trust, trust in institutions, willingness to discuss problems with neighbors and engagement in political activities and voting.[83]

Studies have found that communities with high levels of social cohesion have better health than those with low levels of social cohesion, and also have lower infant mortality rates and lower levels of crime and violence. Other positive impacts of socially cohesive communities include lower stress, a reduction in cognitive impairment in the elderly, lowered probability of being overweight in women and longer lifespan.[84]

Socially isolated people tend to die at two or three times the rate of people with a network of social relationships and sources of emotional support.[85] Research also show links between *perceived* positive social cohesion among neighbors and reduced heart attacks.

Similar to social cohesion, social integration refers to the degree of an individual's sense of belonging to a community. Social integration has been shown to weaken in times of rapid change. This was seen in

striking form in boomtowns – areas rapidly developed as a result of resource extraction activities – where a lack of social integration led to increases in substance misuse, violence, crime and family breakdown.[86]

Impacts to Culture and Connection to the Land from Similar Projects

Cultural analyses conducted for environmental impact assessments of development projects in indigenous and land-based communities often focus only on cultural resources that are discrete archaeological sites, rather than on broader landscapes and intangible resources like lifeways that are critical to cultural identity.[87] As a result, even though development projects may affect cultural practices, cultural identity, and social cohesion, there is little documentation of these impacts in the academic literature or in published environmental assessments. Assessments that fail to analyze such impacts provide no basis for them to be taken into account by government decision makers.

Another reason for the lack of documentation of these impacts may be that such factors are best examined through in-depth, qualitative research methodologies, including ethnography, interviews and focus groups. These methodologies are time and resource intensive relative to quantitative analyses and surveying of the development area – methodologies that may not be adequate to capture the nuances of cultural and social issues.

Additionally, culturally and spiritually significant land areas span beyond just archaeological sites or historic buildings to include tribal spiritual sites, cultural landscapes and culturally valued plants and animals. Destruction associated with development projects is wider spread and even less well documented for these types of areas, whose tangible boundaries tend to be ill-defined. While it is common to describe the values that specific sites may have or what their loss may mean in archeological or architectural terms, it is harder to describe exactly what has been lost when a development is constructed in or through a landscape that people value for its traditional, cultural or spiritual associations.[67]

In focus groups, land grant heirs in Torrance County expressed that for unmarked/ sacred sites even well-meaning unearthing of remains, such as archaeological excavations at National Park Service sites, represented shocking violations of the sanctity of those sites and the human remains they contain. Focus group participants also made direct connections between the proposed Lobos CO_2 Pipeline and past development projects that have had adverse impacts and inequitable outcomes on their communities, and expressed that they are experiencing the same feelings of marginalization and impending loss that have come up for then in previous projects. For example, one resident stated:

> I think a correlation here is specifically with the [BNSF] railroad. And in many ways, this pipeline coming through is the railroad all over again, where a major corporation is coming through and basically just taking everybody's land, changing the cultural identity of this area. This one thing is just a repeat of that.

Evidence indicates that the existing Cortez CO_2 Pipeline which runs through Torrance County and is owned and operated by Kinder Morgan, was constructed in the 1980s amidst controversy over its designation as a common carrier for eminent domain purposes and concerns over the potential destruction of Anasazi tribal artifacts and remains in the state of Colorado and elsewhere along the pipeline's route.[88] Follow-up study to better understand the impacts of the construction and operation of the Cortez CO_2 pipeline in regard to these concerns are unavailable.

Concern about the impacts of recent development projects that have disturbed culturally and spiritually sacred sites around North America are widespread.

TransCanada's plan to dig a trench and bury part of its $7 billion, 1,700-mile Keystone XL pipeline from Alberta, Canada to refineries in Texas, has raised a great deal of concern about impacts to sacred cultural sites amongst a host of Native American communities.[62] Representatives from the Sac and Fox Nation have expressed worry about the potential for pipeline construction to dig up unmarked graves, such as those in which masses of Native Americans were buried after dying from smallpox, or other sacred archaeological sites. The concerns pertain not only to designated tribal lands, but to private lands as well. The Caddo Nation of Oklahoma, which contains homelands in four states, "wrote to the federal Advisory Council on Historic Preservation warning of 'imminent and irreparable damage' [from the proposed pipeline excavation] to an archeological site in Lamar County, Texas."[62]

In 2011 Arizona's Game and Fish Department began construction on a public fishing pond at Amity Pueblo, a sacred site for the Zuni people, unearthing and destroying remains that date back as far as 900 A.D. In this instance the damage caused was attributed to missteps and lack of compliance with regulations.[89] The desecration at Amity Pueblo left Zuni tribal members in disbelief, feeling sorrow as well as anger and frustration. "It was so sad looking at all the remains, lying there," remembers Kucate, head tribal councilman for the Pueblo of Zuni. A high-ranking medicine man explained, "In our way, there are still connections to our ancestors who lived [in Amity Pueblo]. These individuals are not resting in peace." One member of the tribal pueblo explained:

> When things like this happen, it really hurts us because no one even asked [what we thought] until after they've done the damage. It's leaving us natives out of our own aboriginal lands.[89] The first Spanish explorers came here and really put the Zuni in a situation where we almost lost our culture. . . Our religious ceremonies and practices were impeded by . . . the invaders. Some of our sacred ceremonies had to go underground to protect what we had.

Most of the Zuni tribal lands were lost to American colonization. The official boundaries of the Zuni reservation established by the US government in 1877 encompassed less than 3 percent of the 15 million acres of the tribe's aboriginal lands.[89]

Impacts of the Proposed Lobos CO2 Pipeline on Culture and Connection to the Land

Given the history and existing conditions of populations in Torrance County, as well as the relationship between culture, residents' connection to land and health, we predict the following impacts as a result of the proposed Lobos CO_2 Pipeline activities.

- Due to the strong connection that many Torrance County residents and beyond have to culturally and spiritually significant sites in the area, and the sensitivity as well as wide geographic span of these sites, any damage caused to these sites by the proposed project would likely lead to a loss of communities' current and future identity and connection with their culture, history and community.

- Given the past traumatic experiences of populations in Torrance County associated with loss of land and culture and mistreatment by government and private entities, proposed pipeline project activities (e.g. process of acquiring land for a right-of-way, construction, and pipeline maintenance) could trigger historical trauma.

- The development of an industrial project such as the proposed pipeline would changes the existing rural, agro-pastoral landscape that local communities strongly link to their identity, history and tradition. [See Section V.2. Land Use] During focus groups, participants repeatedly expressed that the pipeline's proposed activities represented an involuntary change to their environment and culture, which they struggle to pass on to their children. Given the mix of indigenous people, land grant communities, homesteaders, retirees, artists and relative newcomers in Torrance County, as well as the unique, rural, traditional culture of the area, many groups potentially impacted by the proposed pipeline are at risk for acculturation stress in the event of an involuntary change such as the development of the pipeline.

- The potential for proposed pipeline activities to impact the traditional character and uses of the land in Torrance County [See Section V.2. Land Use] would likely weaken local populations' sense of place and community, which could lead to adverse impacts on the strength of individual and community identity and social cohesion.

    - Overall, focus group participants felt that the impacts of the proposed pipeline project on social cohesion were already being felt. In the words of one resident, "This pipeline has disturbed us. It distances us. From the very beginning that it started, it has disturbed our mind, our soul, our spirit, you name it. It's very disturbing."

    - Other residents felt that the pipeline has had positive impacts on social cohesion, although not by design: "To some extent, I think this pipeline has brought factions together, not completely, but I see much more involvement and much more cohesiveness [in terms of opposing the pipeline] around this issue than we had about [previous developments]. And that's a good thing, Kinder Morgan has done us that favor at least." Some residents expressed caution about this impact by noting that social cohesion had increased "only by a little bit, and it's very, very fragile, and can be broken in just a minute, in a second" and that the pipeline was setting up a "neighbor against neighbor" dynamic that was detrimental to pre-existing social cohesion.

V.2. LAND USE

"To take away the connection to the land… to take a part of us… it is like missing a limb." – HIA focus group participant

Land use – the utilization or modification of the natural environment to fulfill human needs, such as for agricultural, ranching, urban or industrial purposes – plays a crucial role in determining health outcomes. In Torrance County, land use is deeply embedded in the history and tradition of the region, and affects the livelihood and lifestyle of families that have lived in the region for generations — including Native American communities, land grant heirs, families that settled in the Valley during the time railroads were built, and multi-generational Hispanic families — as well as newcomers. Large-scale developments such as the proposed Lobos CO_2 Pipeline can impact land use in a number of ways, including through changes to traditional and current land use practices such as farming or ranching, alterations to the aesthetics of the landscape, and shaping future land use decisions and opportunities.

Background

Archaeological evidence suggests that ancestral Native American populations practiced agriculture in New Mexico at least two thousand years before first contact with Spanish colonizers in 1540. In fact, crops, including corn and squash, were first introduced into New Mexico from the south (present-day Mexico) between 1500 and 1000 BCE, and stable, long-term agriculture began to take place as early as 200 CE. After contact with Spanish colonizers in the mid 16th century, livestock and ranching were also introduced into New Mexico.[22] Both crop and animal production have been staples of land use and traditional culture for the successive waves of settlers that have arrived in Torrance County from the prehistoric and Pueblo periods[16,22] through the land grant period[20] and into the 20th century after the arrival of homestead families in New Mexico.[22]

Historians and anthropologists attest to the fact that the Pueblo people's material culture revolved around agriculture,[16,17,90] and that "crops… were the backbone of their subsistence economy long before [the arrival of the Europeans],"[17] primarily through the growing of corn, beans and squash.[90] Historian James Vlasich writes of the deep ties between agriculture and the unique culture and identity of the Pueblo people: "The practice of irrigational agriculture has always set the Pueblo Indians apart from other native groups on the New Mexican frontier. For centuries, farming has been the foundation of the economy of all nineteen Pueblo Indian groups and their ancestors."

Although the Homestead Act of 1862, which promoted the settlement of land in the western states for farming and ranching[22] was broadly consistent with the traditional, rural land uses in the region[22], it also led to a shift in the demographics of places such as Torrance County, as more migrants from other parts of the US moved to the area, and marked the beginning of a transition towards larger-scale agricultural operations.[23] This period during the late 19th and early 20th centuries was also when a number of railroads and highways were built in the area, and established major corridors along which commercial development continues today.[18,91]

During the 20th century, Torrance County experienced significant population fluctuations and further changes to land use. [See Section III. Background] Following a drought in the mid-1900s, there was a decline in farmland used for crop production and a parallel rise of lad used for ranching.[18] To this day, ranchland continues to dominate the county's landscape.[18]

More recent land use decisions in Torrance County have led to an increase in commercial development projects such as wind farms and pipelines. Pipeline construction beginning as early as the 1980s[88] has led to the current count of eight gas or liquid transmission pipelines in Torrance County, according to Department of Transportation data. [See Section III. Background] The County's first wind farm, the High Lonesome Wind Farm, became operational in mid 2009,[92] with a second, the El Cabo Wind Farm, planned for development but currently stalled in the construction phase.[93]

Existing Conditions

Existing Land Use Policy

Land use policy in Torrance County is currently laid out in the County's Comprehensive Land Use Plan, which is an official policy document intended to serve as an indication of "how the local residents and their elected officials want the regional community to develop" in the coming decades, and is a legally binding document requiring that the zoning regulations of the county be consistent with the land use plan.[18] Torrance County's land use plan states that Torrance County is "a product of historical evolution and its future is generally expected to be an extension of present day development activities."[18] The plan remarks:

> To a large extent, the patterns of future development in the county have already been set by the existing infrastructure and current form of development. There is a high possibility that the future pattern of development will be essentially an expansion or extension of the existing pattern.[18]

The Torrance County Land Use Plan's goals include:

- Balance the needs of a growing population while retaining the rural residential character and culture of the county;
- Improve or maintain community appearance and character;
- Establish positive long-range planning guidelines for a diversity of growth and development that does not jeopardize the environment; and
- Protect those areas of the county that are historically, culturally, geographically or environmentally unique and/or fragile.

The County's land use plan also resolves to encourage energy infrastructure and economic development through the recruitment of wind and solar energy initiatives in the county, and through attracting other developers, but only insofar as this would bring a long-term benefit to the county and maintain the integrity of the environment.[18]

Current Land Uses and Designations

The vast majority of Torrance County is zoned for agricultural use,[91] a designation intended for cattle grazing, horse ranching, farming and lumbering.[94] Farms in Torrance County are typically large in size, averaging over 3,000 acres in 2007.[95] However, data from the Western Rural Development Center indicates that while as of 2007 approximately 84 percent of Torrance County's land was designated as farmland, (about 1.8 million acres of farms out of 2.1 million acres total in the county) less than 2 percent or 25,000 of those 1.8 million acres of farmland, was used as harvested cropland.[95]

Although farming and ranching have been the staple of the historic and traditional economy in Torrance County, they are giving way to non-agricultural commerce. In 2013 crop production made up just 2 percent of annual employment, while beef cattle ranching, farming and feedlots made up less than 1 percent.[96] Focus group participants expressed concern that these figures may not capture subsistence,

non wage-producing farming and ranching activities, yet they still reveal a trend away from traditional land use in Torrance County as a significant economic factor.[96] [See Section V.3. Economic Vitality]

Torrance County's existing planning and zoning ordinances aim to maintain the county's historic rural and small town characteristics. Significant portions of the land in western Torrance County have been specially designated as agricultural, rural and village preservation zones,[91] which are intended to protect and preserve historic uses of the designated areas through a variety of means, including by imposing minimum lot size restrictions (for agricultural land specifically) and by limiting the type and amount of development permitted in the area.[94]

The State of New Mexico recognizes 23 land grants as units of government within the state,[97] with an additional 8 land grants recognized, but without unit of government status.[98] As mentioned previously, this political recognition is significant, but excludes large portions of the original land grants' geographic extent. The land surrounding Torrance County's state-recognized land grant communities has been specifically zoned for rural community preservation in an effort by County authorities to preserve land grant heirs' cultural and historic legacy.[18]

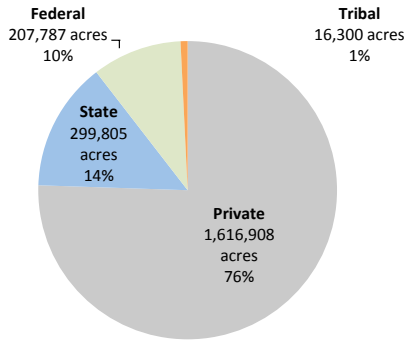
Continuation of traditional land use by land grant heirs and other New Mexico residents is largely dependent on access to resources – including water, lumber and firewood – on former land grants that are now federally managed. Conflict over increasing federal regulation and environmental impact litigation further compounds the difficulty that land grant heirs and others experience in accessing the resources necessary to successfully farm and ranch these lands.[19] The loss of common land in New Mexico has also contributed to the shift in land use patterns away from subsistence agro-pastoralism and towards commercial ranching and timbering controlled by larger corporations and outside entrepreneurs.[23]

Current Land Ownership in Torrance County

Torrance County is currently comprised of over 2 million acres of land owned by a variety of entities. In 2010, the vast majority of Torrance County's land (approximately 76 percent) was privately owned, while the remaining land was owned by the state (14 percent), the federal government (10 percent) or Native American tribes (1 percent).[95]

Figure 8. Acreage and Percent of land in Torrance County by ownership type, 2010

	Acres	%
Private	1,616,908	76%
State	299,805	14%
Federal	207,787	10%
Tribal	16,300	1%
Total:	2,140,800	



Source: Western Rural Development Center, 2010

Existing Pipeline and Industrial Developments

As discussed previously, there are currently at least eight resource transport pipelines operating in Torrance County. These pipelines carry materials including natural gas, crude oil, and liquid CO_2. In addition, commercial wind energy facilities are rapidly expanding in New Mexico. There are currently 10 commercial wind farm facilities in operation in the state, all of them having been built since 1999, and some of which have seen multiple phases of development to expand their capacity. Four of these facilities were built on public, state trust land, and one facility, the High Lonesome Wind Farm, lies within Torrance County. One operational wind farm facility, the El Cabo Wind Farm, was slated to be built in Torrance County, but construction for this project was halted indefinitely in 2014.[99]

Natural and Cultural Resources in Torrance County

The western portion of Torrance County, from Moriarty in the north to Mountainair in the south, is where the largest portion of the county's population is located, and is the area considered richest in the natural and cultural resources that make Torrance County unique. It is also the epicenter of Torrance County's land grant communities.

Torrance County is tied to its heritage in large part through its natural and cultural resources.[100,101] The county partially contains two nationally protected areas: the Cibola National Forest and the Salinas Pueblo Missions National Monument. The US Forest Service also manages a National Wilderness Area in the Manzano Mountains in eastern Torrance County. All three sites of the Salinas Pueblo Missions National Monument (Abó, Gran Quivira and Quarai) are either entirely or partially within Torrance County. These three sites are listed on the National Register of Historic Places, along with 12 other national historic sites or features located throughout Torrance County. Numerous other pueblo sites flank these ancient monuments, including Pueblo Blanco, Pueblo Colorado, and Tenabó, among many others.

Many lesser known sites, including sites that are not made publicly known by local preservation authorities in order to protect the sites' integrity, as well as others whose locations are have not been recorded and may be entirely unknown, can be found throughout Torrance County on both public and private land.

Torrance County is also notable for the attributes of its natural and undeveloped environment. The county's dark night skies draw astronomy groups from afar, and the area around the town of Mountainair is home to various attractions and cultural events.

During focus groups for this HIA, both retirees and artists cited Torrance County's natural beauty, including the unique geology of the region, the night skies undisturbed by light pollution and the vistas that often stretch to the horizon, as a primary or significant factor in their choice to move to the county. In the words of one resident:

> The other thing I have is the view. What more beautiful view? Why do you think we live here? What a vista!

Focus group participants also expressed their perception that government agencies – even those charged with stewardship over natural resources – often overlook the value of the land in Torrance County:

> Even the National Park Service, when they first stated that they were going to acquire the land in Abó and Quarai, what they put in their reports was that the land was not good for anything but

> scorpions. That was the only thing that was in the land, scorpions, and God darn it, I've never seen one scorpion yet!

Other focus group participants echoed this sentiment, sharing their feelings that companies such as Kinder Morgan tended to route pipelines through rural areas that they perceived to be empty, under the mistaken assumption that the land does not hold any other useful purpose and lacks natural and cultural resources that merit protection. Historically, areas designated by the US government as tribal lands were allocated as such because they were thought to be worth little. In many cases, however, it was later discovered that these areas were rich in natural resources.[62]

Cultural/Community Identity and Land Use

Despite Torrance County's low levels of agricultural-related employment, data gathered from focus groups for this HIA found that gardening, farming, ranching and subsisting off the land are paramount factors in the identity of Torrance County communities. According to one land grant heir:

> The land gives us everything we need. It gives us our mud to make adobes, our plants so we can eat. Our medicines. Everything that Mother Earth gives us, we have it. We've been blessed. Rich with land, rich with food, rich with God."

Another resident stated:

> We got [our self-sufficiency] from our Native American great-great-grandparents. The potatoes, the frijoles [beans], the chiles [hot peppers], tomatoes, corn… that's all the gifts from the Native Americans, from us. And we still cook in our woodstoves, we still make our own tortillas, our own tamales, our own everything. That's who we are.

Focus group participants, including people with indigenous and Hispanic ancestry, descendants of homesteaders, and others who have more recently come to the county, expressed how the land they lived on was a part of their individual character or community identity, and their desire to protect this land from threats that would alter the sense of place that Torrance County has cultivated for them.

While ethnically distinct, both Hispanic and Anglo populations face common challenges in maintaining their long-standing traditions. Torrance County's Comprehensive Land Use Plan notes:

> Current day-residents of the land grant towns are struggling to maintain their cultural identity as are the descendants [sic] of homesteaders who work in subsistence ranching and farming or those who are presently commuting daily to Albuquerque, Santa Fe, or Belen.[18]

For many Torrance County residents, the responsibility to care for the land is sacred. Focus group participants expressed deep concern for how the land has been affected by past developments and how it might be further damaged by future developments, including the proposed Lobos CO_2 Pipeline. One land grant heir said:

> We will fight to defend Mother Earth. Do not break her, do not touch her with your trenches and chemicals. They're going to ruin everything. They're already starting to ruin our mentality, our spirituality, our emotions. Everything is involved here. And it's disturbing for all of us.

Some expressed concern for the legacy they would leave behind for their descendants: And it's not going to be probably an impact on me, because I'll probably be gone [deceased], but it will be an impact on our children and their children and that's what we're working on." Participants additionally

expressed the importance of freedom and the ability to decide for themselves how to best use and care for the land in maintaining the connection they have to their homes and their chosen way of life.

Land Use and its Relationship to Health and Well Being

Land use directly affects one's sense of place, as well as the social and material conditions of that place. Land use can have a profound effect on social, physical and mental health, and in addition, land use decisions can set precedents for future decisions, potentially compounding or perpetuating health impacts related to those decisions. Many indigenous cultures throughout the world extend the concept of health to include physical, mental, emotional, and spiritual dimensions, and define healthy living as being in harmony with the spirit world, with their community, and with the land.[39]

Land use, social cohesion and health
In areas that have experienced rapid change due to resource extraction, the decline in social cohesion has been found to increase substance abuse, violence, crime and family breakdown.[86] In more general contexts, studies have found that communities with high levels of social cohesion have better general health than those with low levels of social cohesion, as well as lower infant mortality rates, lower levels of crime and violence, lower stress and longer lifespans,[84] as well as lower incidence of heart attacks.[102]

The natural environment and health
A growing body of research shows that natural beauty and being surrounded by a healthy natural environment has a positive effect on well being, including mitigating the effects of everyday chronic and acute stress.[103] In contrast, solastalgia – a term for distress caused by negative changes in the home landscape – has been shown to manifest in depression, outrage and sadness amongst affected populations.[104,105] Solastalgia has been identified in areas associated with agriculture as well as commercial development and resource extraction activities, including mining and tunneling.[106–109] Because major land use decisions can cause potential, unwanted changes to landscapes and natural environments, there is an inherent risk of triggering the negative mental health outcomes of solastalgia through development projects that may have significant, long-term impacts on the land and on local residents' sense of place.

Control over destiny and health
Many local Torrance County residents and their ancestors have struggled intensely in order to maintain what they feel is their sacred responsibility to care for the land. Having the ability take responsibility for how land is used and cared for provides residents with a sense of control. Control of one's destiny or empowerment, which means having the options, choices and discretion to influence aspects of one's life, has been widely recognized as a fundamental determinant of health.[110–113] as it is one of the cognitive processes that mediate between stress and health outcomes. Research shows that individuals with more control, or feelings of control, over their lives tend to experience better health outcomes, while those with less control tend to experience poorer health outcomes such higher rates of cardiovascular disease, hypertension and alcohol abuse, and other impacts related to an increase in vulnerability to stress.[110,114, 115] [See Section V.4. Safety]

Focus group participants from Torrance County cited uncertainty about local land use decisions as a factor contributing to an increase in their levels of anxiety and stress, particularly for those residing on or near the proposed pipeline route. The sentiments expressed by focus group participants are consistent with research showing the relationship between ongoing, chronic stress and adverse mental and physical health outcomes.[116–121] During focus groups, several residents discussed the cumulative

health impacts they felt as a result of proposed and enacted development projects in the area over which the community has had little control. In the words of one resident:

> We're all just stressed out constantly. Stressed about the insurance, stressed about the land values, we're just constantly stressed out. During a proposed biomass plant development, I was exhausted [trying to fight its implementation], and I got shingles. So it was very, very stressful.

Focus groups participants also pointed out the strain on relationships with family and community that stress and energy around existing and proposed changes in land use have led to. Time away from family has been found to be associated with burnout, distress, dissatisfaction, poor general health and other physical problems.[122]

Impacts to Land Use from Similar Projects

Impacts to cultural resources
Examples of some of the ways in which past development projects have impacted archaeological sites, graves, cultural landscapes and other physical cultural resources are presented in Section V.1. As noted previously, while there is some professional literature and media coverage on the threats that proposed projects pose to such resources, there is has been very limited study of or reporting on how their destruction affects concerned communities and other populations.

Scars and physical changes to the land
The addition of a second track to the Burlington Northern-Santa Fe (BNSF) railroad line through Abó Canyon is a local example of the lack of attention to the broader impacts that a development project has had on the landscape in Torrance County. Land grant heirs and other landowners strongly opposed the expansion because of the damage it would do to the landscape, its cultural character, and their traditional land uses, but were unsuccessful in their efforts to persuade BNSF and its federal land use regulators to consider alternative ways to achieve the project's purposes. The second track has now been constructed, and no studies have been reported on whether or how the impacts anticipated by affected communities have played out.[123]

Several focus group participants noted that industrial projects in Torrance County that required what were considered routine, minor disturbances to the land, such as the laying of telephone lines into a new home, left marks and scars on the land that lasted for decades or generations. A right-of-way (ROW) for a pipeline (defined as the land over and around the pipeline; in the case of the Lobos project the ROW would be 50 feet on either side of the pipeline)[124], leaves a significant visual "scar" on the land. The images below show "scars" from rights-of-way for some existing pipelines in Torrance County.

Figure 9. El Paso gas pipeline scar near Gran Quivira, east side of NM SR 55. July 2014.

Figure 10. El Paso Pipeline scar as seen from the intersection of Abo Ruins Road and NM SR60, looking south. July 2014.

Figure 11. El Paso Pipeline Scar just North of Gran Quivira, West side of NM SR 55. July 2014.

Figure 12. El Paso Pipeline Scar on North Face of Chupadera Mesa, looking south from Abo Ruins Road. July 2014.

Pipeline exposure

Although pipelines are intended to be buried below ground, residents in neighboring Sandoval County have documented the visual blight created in instances when pipelines become (and are left) exposed from natural wind and water contact.

Figure 13. Excavation of Kinder Morgan's Cortez CO_2 line by flood waters, Las Huertas Creek, 2006. Source: Las Placitas Association

Figure 14. Excavation of 16/20-inch Enterprise natural gas pipeline by flood waters, Las Huertas Creek, 2006. Source: Las Placitas Association

Typically, pipeline infrastructure is not removed, even after pipeline operations have ceased. In many small, former "boomtowns" where natural resource extraction has taken place, often on Tribal or other land inhabited by Native American communities, evidence of old pipelines, some dating back to the 1930s, and other industrial equipment, remains visible.[62]

Setting precedents for future similar development projects

The presence of prior pipeline or industrial projects have set a precedent catalyzes expansions of and additions to existing pipelines or industrial projects. In Canada, for example, Kinder Morgan is pushing for an expansion (twinning) of its existing 1,150-kilometer TransMountain crude oil pipeline from Alberta Province to Brunaby, British Columbia.[125] Maya von Rossum of the Delaware Riverkeeper Network reflected on the proposed pipeline developments in the Delaware basin, stating "you have the perpetual harms of the pipelines themselves, and the fact that the pipelines encourage and induce more oil and gas extraction."[126]

Sandoval County to the north of Torrance County has seen proposals for expanding the capacity of an existing natural gas pipeline, for reviving dormant lines to carry crude oil, and for twinning the existing Mid-America Pipeline to carry liquid natural gas.[127] The proposal for the Lobos CO_2 Pipeline itself includes the construction of a 40-mile loop of parallel pipeline in Chavez County, New Mexico to accommodate increased production in Arizonan CO_2 fields. During public meetings for the proposed Lobos CO_2 Pipeline, project proponents have argued that the county already has a CO_2 pipeline and that this weakens opponents' case against bringing additional pipeline projects to the area.

A similar catalyzing effect has been seen as a result of the development of wind farms in New Mexico.[128] Former Land Commissioner Ray Powell has proudly stated that his first administration negotiated the first wind farm in New Mexico, and that by 2013, there were four such projects on State Trust Lands, with five additional projects proposed.[129]

Torrance County residents talked in focus groups about some of the ways in which they have been impacted by the High Lonesome Wind Farm located in the Jumanos Mesa area of Torrance County, including the visual pollution posed by the large wind towers and the red aircraft warning lights on these structures that interfere with the area's pristine dark night sky. The proposed El Cabo wind farm project would have used 33,600 acres of State Trust Land and 87,000 acres of private property.[93] The project received a variance for its proposed 500-foot towers, at which height it would have been visible for great distances and would have been likely to visually impact many of the historic and wilderness areas mentioned in this report. Despite this, it was noted by residents that managers of the natural, protected areas in question were not involved in the decision-making or input process.

Another major project currently slated for Torrance County and the surrounding areas is the SunZia high-voltage transmission line, which will span from eastern Torrance County to Arizona, and serve to transmit energy from existing or planned renewable energy projects.[130,131] Residents indicated that renewable energy companies have been scoping the Torrance County area since the SunZia project was announced.

While companies proposing pipeline development often use eminent domain to win easements on land for which landowners refuse to negotiate an agreement, records to be unavailable on the percent or amount of land for pipeline development that was procured by eminent domain.

Eminent Domain: Key Facts

In the US, eminent domain is the state or the federal government's power to seize or condemn private property. While eminent domain is intended for public use, rights over the condemned property may be given to private parties, including corporations. In most cases, state and federal law requires that eminent domain be used only as a last resort after attempting to negotiate to purchase the property. If eminent domain is used, the owners of the property being condemned are entitled to fair compensation.

The granting of eminent domain is dependent on a pipeline project's designation as a common carrier, which means the pipeline will be available for public use or serve a larger public good to serve a larger public benefit. Despite the considerable debate as to what constitutes a common carrier, it is currently up to companies to self-designate their projects as common carriers on an honor system. This has prompted some states, such as Texas, to present proposals requiring a review of such claims in order to create stricter regulations.[33, 132]

In practice, issues of eminent domain are almost always strictly state matters.[59,60] Federal involvement is rare, except in cases where it is deemed that fair compensation of condemned land is not met.[60,61] In the state of New Mexico, eminent domain rights and procedures are regulated by state statutes[61,62] rather than by state constitution. The State of New Mexico's eminent domain laws are favorable to industry; they provide for specific condemnation for oil and gas pipeline companies, including those seeking to transport carbon dioxide.[62,60,63] This may make it more difficult for New Mexican landowners to challenge existing eminent domain laws.

There have also been attempts to limit the use of eminent domain on private property. One such case in Oklahoma led to the first legal challenge to the use of eminent domain in the US. In this case, an Oklahoma family challenged TransCanada's attempts to condemn their land for use in building the Keystone XL Pipeline, claiming that "landowners' property cannot be legally taken by […] a privately-owned foreign corporate entity […] for the benefit of a privately-owned foreign entity."[137] Private landowners also successfully blocked eminent domain attempts by oil and gas developers in New York State by designating local control of land use.[138]

Receptiveness of past project proponents to community concerns

Past pipeline projects across the US have precipitated conflict regarding the receptiveness of developers, and Kinder Morgan in particular, to public suggestions regarding mitigations of expected pipeline impacts. Although landowners and other groups in past projects have expressed a preference for routes that go along existing rights-of-way, cross less sensitive lands, or bury segments of certain pipelines to mitigate impacts, Kinder Morgan has been reluctant to comply, citing the added expense and time required to implement such mitigations.[139] A lawyer who has worked closely with tribes in South Dakota remarked about her experience raising tribal concerns in relation to proposed development projects such as the proposed Keystone XL pipeline, stating that "the consultation process is really broken. Tribal interests are rarely able to be brought forward properly, and when they are, they are rarely listened to."[62]

Impacts of the Proposed CO_2 Pipeline on Land Use

Based on the assessment of existing conditions related to land use in Torrance County, the established links between land use and health outcomes, and documented impacts to land use from similar projects, we predict the following impacts to result from the construction and operation of the proposed Lobos CO_2 Pipeline:

- Focus group participants mapped out the specific areas of Torrance County that they were most concerned as being adversely impacted, as well as the areas that they felt could benefit from the pipeline project (see below). Participants identified many more areas of concern than areas that could benefit. Areas they felt would be adversely impacted included the pipeline route, as well as natural and cultural resources that could be impacted directly (such as through construction damage) or indirectly (such as through compromised views). Potential areas of benefit included populated areas where the pipeline might provide economic benefits.

Figure 15. Locations of Concern (by presence of concern among participants)

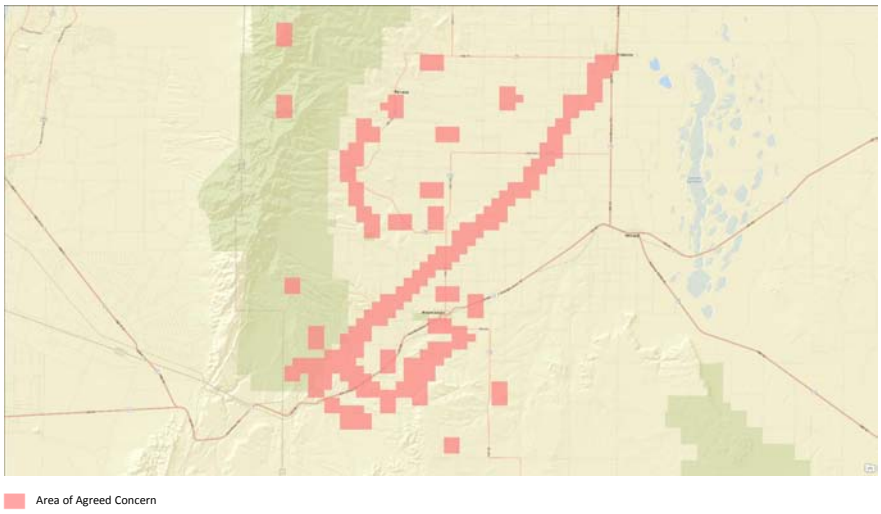


Figure 16. Locations of Benefit (by presence of agreed benefit among participants)

- Construction of the proposed pipeline would bring a major industrial development into Torrance County. As such, the proposed pipeline may further the process of altering the county's rural, agro-pastoral character.
    - This alteration is inconsistent with the goals of Torrance County's current Comprehensive Land Use Plan as well as additional planning and zoning ordinances in the county established to maintain the county's historic rural and small town characteristics.[18]
    - This impact carries a high risk of being compounded by the trend towards large-scale industrial development projects, which would impact a significant portion of county residents, including land grant heirs, indigenous populations and others who adhere to cultural traditions related to farming and ranching, as well as newer county residents who were attracted to the area because of the county's rural nature.
    - Impacts of these land use changes include a potential loss in cultural identity, solastalgia and a decline in social cohesion.

- The impact of changes to land use poses potential risks to historic and cultural resources that play a role in maintaining community composition, character and culture. While Kinder Morgan has stated its intent to identify culturally sensitive sites by consulting with Native American tribes and conducting cultural surveys on public land,[6] the company has a record of being reluctant to comply with recommendations to mitigate impacts, citing the added expense and time required to implement such mitigations.[139] Furthermore, proposed surveys address only direct physical impacts on specific archaeological, historical and cultural sites, excluding consideration of broader indirect and cumulative effects on traditional land uses and lifeways. The destruction of such remains, traditions and lifeways would likely have significant emotional impact on residents, especially those who identify with the Pueblo culture or land grant heirs, leading to further feelings of disconnection to the land, to their ancestry and cultural identity, and to their communities and future generations.

- Pipeline trenching and maintenance which will leave a visible scar along the pipeline route that will be seen from near and remote locations. This physical impact to the land will detract, in a significant and permanent way, from the natural beauty that characterizes the region and gives it value both to residents and visitors. This change could lead to change in the character of the existing vista that has been part of the traditional, and in some cases sacred, landscape; feelings of lack of control over the ability to take responsibility and care for land; and a change in the draw to the area for retirees, artists or other "newcomer" populations whose attraction to the land is heavily based on its natural beauty and pristine landscape.

- Landowners who are opposed to the pipeline being built on their property may be subject to eminent domain, which may lead to a lack of feeling of control. Additionally, the disparity between compensation from easement negotiation versus eminent domain for a pipeline built on residential property may create a disincentive for owners to challenge the threat of eminent domain. The combination of the financial loss that may be incurred due to the pipeline, coupled with the prospects for compensation through eminent domain, may create a sense that resistance to eminent domain is financially infeasible.

V.3. ECONOMIC VITALITY

Pipeline development has the potential to impact economic vitality in Torrance County in a number of ways including through effects on employment, tax revenue and residents' property values. Economic vitality in turn has established connections to health. Torrance County residents have expressed significant concern that potential individual or municipal economic benefits from the proposed pipeline will be minor and/or short lived, and that gains such as additional tax revenue will be outweighed by potential costs. Because the development of pipelines for CO_2 transmission is a relatively new phenomenon, for many issues – such as property values – there is little evidence about the impacts of CO_2 pipelines specifically. This uncertainty is another source of anxiety for residents, who have not been able to obtain clear information on how their personal investments in land or property might be affected by the pipeline.

Existing Economic Conditions

Numerous indicators help paint a picture of the current health of the economy in Torrance County. Employment, tax and income data show that Torrance County currently has a generally smaller and less stable economic base than New Mexico as a whole.

Compared to the state of New Mexico overall, Torrance County residents have lower incomes and face higher rates of poverty. Jobs available in the county are not sufficient to meet the population's employment needs, and unemployment remains a pressing issue for area residents. [See Section IV. Torrance County Today]

Industry, earnings and location of employment

In 2013, approximately 29 percent of jobs in Torrance County were in local government, with the bulk of these jobs in education and health services.[96] Average annual earnings in this industry were about $33,300. Two-thirds of jobs in Torrance County were in the private sector, and about 80 percent of these (half of total employment in the county) were in a service-providing industry.[140] Retail trade jobs made up the largest proportion of the service industry in 2013, at 15 percent total annual employment, and annual earnings of approximately $22,300.[140]

Although Torrance County is a largely rural, agriculturally zoned area [See Section V.2. Land Use], agricultural industries do not provide a significant proportion of county employment. In 2013, crop production made up 2 percent of annual employment, while beef cattle ranching, farming and feedlots made up less than 1 percent.[96] Average annual wages for these sectors were about $16,700 and $23,700 respectively.[96] [See Appendix B. Table B-1]

In 2011 fewer than 20 percent of employed Torrance County residents worked within the county. Although no single town in the county served as a major employment center for residents, Mountainair, where 2.4 percent of employed county residents work, was a distant second to Albuquerque, where one-third of all employed county residents worked.[141] [See Appendix B. Tables B-2 and B-3]

Property values

At 82 percent, the homeownership rate in Torrance County is significantly higher than in New Mexico overall, where the rate is about 69 percent.[27] In focus groups, participants stated that for many residents, the value of their land comprises the majority of their wealth and savings. As one resident stated:

> "There ain't no 401(k). There ain't no pension plan. There's not even a fricking savings account. That 80 acres is all I have…I mean, I've got nothing else."

Although we made numerous attempts to contact the Torrance County Assessor to acquire data about the current value and size of properties that could be impacted by the proposed pipeline project, we did not receive a response. Resident input, however, provided some information on these topics. According to a realtor living and working in Torrance County, the market for land sales in New Mexico has not recovered since the recession hit in 2008, and very little land has been selling in general. The realtor stated that recent sales of ranchland have included prices as low as $250 per acre, while she is hoping to sell improved land (with access to utilities) for $1,000 per acre. Based on their own and neighbors' experience, residents have estimated the price of land can range anywhere from $500 to $5000 an acre. According to real estate data from Zillow.com, the average list price for homes in Torrance County is $147,000.[142] However, this may not be representative of prices for large parcels of land.

Land acreage and sources of costs for maintaining land

According to residents, many landowners in Torrance County live on large properties of 100 acres or more. Personal communication with residents also indicates that there are significant costs associated with maintaining large properties in Torrance County. These costs include native tree maintenance, well maintenance, plowing and grading roads, clearing vegetation for fire protection, erosion control, and fence construction. Residents also shared that those who engage in small-scale agricultural pursuits can incur costs associated with orchard maintenance, farm and garden features, and pest control.

County revenue and expenditures

Local government in Torrance County includes county government, along with individual municipalities and special districts such as school districts. As discussed in Section V.2. Land Use, the majority of the population lives in very small villages or in unincorporated areas of the county.

Torrance County's main sources of tax revenue are property and local and state share taxes.[§, 143, 144] Total revenue for the county in 2013 was $10.6 million, with property taxes comprising about $4.1 million of total revenue, and local and state share taxes about $2.5 million.[**, 145] [See Appendix B. Table B-4] The latter tax category reported lower revenues in 2013 than in pre-recession 2007.[143, 146] Looking to the future, the county's projected total expenditures for fiscal year 2015 are approximately $13 million. About one quarter of these expenditures are designated for spending related to law enforcement. An additional 9 percent is allocated for fire safety, 8 percent for additional emergency services, and 12 percent of budgeted expenditures are designated for the County's Road Fund.[147] [See Appendix B. Table B-5]

Revenues for the county's incorporated towns and cities are lower. In 2013, total revenues for Moriarty, the largest city in Torrance County, were about $7 million.[148] They were approximately $2.6 million for Estancia, and just $769,000 for Mountainair.[145, 149]

Economic Vitality and its Relationship to Health and Well Being

Economic status and well being are major determinants of health. Employment, income, and wealth are all components of socioeconomic status (SES), which has well-established associations with health and mortality.[150,151] People with high SES live longer, healthier lives than those with low SES.[152,151]

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§ The Torrance County budget does not include the revenues and expenditures for municipal governments (e.g. for incorporated towns), school districts, and soil and water conservation districts.

** All revenues are reported for governmental funds, the funds that are generally collected and spent within a year

Employment and health
Unemployment and underemployment are associated with poor physical and mental health.[153,154] A lack or loss of gainful employment can result in a decline in self-reported and functional health, increase in chronic diseases, as well as psychological distress and emotional disturbances. [155,156,157] Unemployment is also linked to behavioral risk factors including alcohol and tobacco use, poor diet and decreases in exercise.[158] Inadequate employment is associated with an elevated risk of depression, as well as chronic diseases such as arthritis, diabetes and heart attack.[155,157,159]

Income and health
Income is an important predictor of health and disease, with people at the top of the income ladder living longer, healthier lives.[160,161] Nationally, people living in the lowest income households have nearly 4 times the odds of death compared to people living in the highest-income households.[162]

For children, the effects of income can begin even before birth: children born to low-income parents are more likely to be born prematurely and low birth weight.[163] Children living in low-income households face a greater likelihood of poor nutrition, injuries and exposure to environmental toxins.[163] The risk of chronic diseases such as obesity, diabetes and heart disease among low-income children is seven times that of children in high income families.[163]

Wealth and health
Wealth, an individual's accumulated assets minus any outstanding debts, is more difficult to measure than income, but also has established ties to health. Higher wealth is associated with lower mortality, better self-rated health, and lower levels of obesity and cardiovascular risk factors, and wealth has been linked to mortality even when controlling for income.[164]

Land and home ownership are major asset categories contributing to wealth, and as mentioned above, comprise the bulk of wealth and savings for some Torrance County residents. The ability to build wealth through property ownership is in large part dependent on the ability to obtain a property mortgage as well as homeowners' insurance. Therefore, if the ability to obtain a bank loan or insurance is threatened, this can have an impact on the health outcomes associated with wealth.

Municipal wealth and health
The wealth or budget constraints of a municipality impact the types and quality of public services (e.g. law enforcement, emergency services, social services, etc.) that can be offered to residents. The availability and quality of public services can affect health in numerous ways, more directly through the provision of health care related resources and indirectly by improving perceptions of safety and promoting social cohesion in a community.

Impacts to Economic Vitality From Similar Projects

While there is a growing body of research on the impacts of industrial oil and gas activities on economic indicators such as property values, much of it focuses on well drilling activities rather than on pipelines. However, oil and gas activities that are similar to the Lobos Pipeline serve as the best available proxy when considering the economic effects of the proposed Lobos CO_2 Pipeline.

Property values
The proposed pipeline's potential impact on property values is of primary concern to Torrance County residents, who have expressed fears that land they own may no longer be a viable investment if the pipeline is built. In the words of one resident, "[T]here's going to be signs all over your property saying

CO_2 line [if the pipeline is built],[*sarcastically*] so that would really make your property sell well."

A recent guide for landowners published by the nonprofit Pipeline Safety Trust, and funded by the Pipeline and Hazardous Materials Safety Administration, acknowledges that little public information about the impact of pipelines on property values is available, and that the most studies of property values in association with pipelines are conducted and/or paid for by the pipeline industry.[165] The guide states that there does appear to be "limited long-term loss" of property value associated with pipeline presence, based on matched-pair studies. While owners are compensated for the land used by for pipeline rights-of-way, it is generally not possible to determine whether they were adequately compensated for any loss in property values, because pipeline operators require confidentiality agreements when negotiating terms for purchase of land or easements.[165]

Examining the literature on pipelines and property values, we found no studies that examined the impacts of carbon dioxide pipelines specifically, including for the existing Cortez CO_2 pipeline running through Torrance County. We did review studies investigating how residential property values are impacted by proximity to transmission pipelines. We found 10 publicly available studies[166,167,168,169,170,171,172,173,174,175], after accounting for duplicate works that use the same data set[168,176], and excluding non-original research.[177]

The studies included investigations of natural gas, [166,167,168,170,171,175] , including "sour gas" containing hydrogen sulfide, [166] oil,[166,169,174,172,174] and gasoline[169] pipelines. Six of the studies focused on pipelines with no known major safety incidents, while four examined pipelines for which there were well-publicized major safety incidents, including significant leaks and explosions.[169, 172,173, 174] The literature varied in methodology, with the majority, 7 studies, using rigorous hedonic models which break down properties into their individual characteristics — for example, square footage, number of bedrooms, proximity to a pipeline — and estimate the contribution of each characteristic to the value of the property. [166,168,169,170,172,174,177] The remaining analyses used either paired-sales or matched-pair techniques, in which they compared the sales prices of similar properties that differed primarily in terms of their proximity to the pipeline,[171,167] or before-and-after sales comparisons of properties surrounding a major safety incident.[172]

The results of the literature are split, with five studies finding no statistically significant relationship between property values and properties' proximity to a pipeline,[167,168,170,176,177] and five finding a statistically significant decrease in value for properties located near a pipeline.[166,169,172,173,174] In four of these studies, the decrease in property values was associated with a pipeline accident.[169,172,173,174] One study specifically identified a decrease in property value after a gasoline pipeline explosion in Bellingham, Washington, but found no impact prior to the explosion, and none associated with a separate, accident-free oil pipeline.[172] In this study, the strength of impact also varied based on proximity to the pipeline and the amount of time elapsed since the incident.[169] Specifically, while properties 1000 feet away from the Washington pipeline dropped in price by 0.2 percent six months after the incident, properties 50 feet away dropped in price by 4.6 percent. At 100 feet from the pipeline, properties dropped in price by 2.8 percent six months after an incident, compared to 1.9 percent four years after an incident. These results suggest that while the impact of a safety incident may diminish with distance, the effects can be long-standing. [See Appendix B. Table B-6 for a summary of all studies]

The largest decrease in property value was found in the case of an oil pipeline leak in Franklin Township, Ohio. In this instance, the owner of the pipeline, British Petroleum, bought several of the contaminated properties after the incident and subsequently resold them for a 27.2 percent lower value.[172] One

feature of this case that may help explain such a drastic price decrease is that the properties in this study were dependent on well water, and thus contamination from pipeline leaks may have played a significant role in valuations of the properties. The potential for pipeline developments to impact water may have special implications for Torrance County, where water use is overwhelmingly sourced from groundwater as compared to surface water[178], and where focus group data reveals that water is of primary importance to residents. [See Section V.5. Water Quality and Availability]

It is notable that *all* of the studies which found no significant impact of pipelines on property values were conducted by authors affiliated with corporations (e.g. real estate organizations, natural gas industry).[167,168,170,171,175] All of these studies also focused on natural gas pipelines with relatively clean safety records. In contrast, *all* studies conducted by authors affiliated only with academic institutions found statistically significant results showing that pipelines do indeed have impacts on property values, and these studies focused on a wider array of pipeline types, including pipelines which had experienced major safety incidents.[169,169,174,173,172]

While affiliation with a corporation does not in and of itself preclude the validity of a work's findings, the choice of subject (type of pipeline and history of the pipeline) could itself bias the direction of the findings. It is important to emphasize again that these studies looked at the impacts of oil, gasoline and natural gas pipelines, rather than CO_2 pipelines. However, given that Kinder Morgan's record of safety violations has been raised as a concern (see also Section V.4. Safety), this evidence is important to account for when considering the impact of pipeline safety risks and potential for accidents on property values.

It should also be noted that while pipelines may have an estimated "lifetime" of use for a specific project, they are never removed, even when they are no longer being used. Thus, unused pipelines become a contaminating presence in the landscape, and can be sold, re-excavated and put back in to use at any time.

Insurance and mortgages

There is still a great deal of uncertainty about how oil and gas activities, including pipelines, can impact the decisions of lenders or insurers, and this uncertainty is a significant source of anxiety for Torrance County residents, in particular those who are property owners. In the words of one resident:

> I have asked Allstate and State Farm [about the effects of the presence of a pipeline on the ability to obtain insurance] . . . they MIGHT allow modified homeowners [insurance] in the vicinity of a gas pipeline ... I added "Industrial gas pipeline" and they said unlikely, perhaps with a commercial rate ... [However], no one will put anything in writing.[179]

Investigative reporting from Boulder Weekly in Colorado found that some insurance companies have been creating policies that do not cover any losses to property resulting from oil and gas development.[180] In response to concerns from residents, the authors of the Environmental Impact Statement for the Constitution natural gas pipeline in New York State attempted to gather information on how the pipeline could impact mortgages and insurance. They contacted multiple insurers, but found only that while there was potential for residential insurance policies to be affected by the pipeline, "company contacts were not able to speak directly to the…factors that could cause a change in a policy (e.g. type of utility, proximity of the residence to the utility), or provide quantitative information on the potential change in a policy premium."[181]

There is also ambiguity surrounding how pipelines and/or drilling activities can impact mortgage lending. When the Constitution pipeline EIS tried to gather data on the potential for the pipeline to affect mortgage rates or the ability to obtain a mortgage, the authors could not obtain conclusive information from banks or mortgage companies.[181] Mortgages typically state that an owner may not "allow damage, destruction or substantial change to collateral including the use, disposal, storage or release of hazardous materials," where collateral generally refers to the mortgaged property.[182] A landowner with a mortgage who signs a lease for gas or drilling activities may require permission from their lender,[182] although not all borrowers are aware of these requirements.[183]

Fannie Mae and Freddie Mac, the government-sponsored companies that guarantee a majority of US mortgages, do not purchase home mortgages on land that transports toxic chemicals.[180] They also have rules that disallow homeowners from leasing or selling parts of their land for transporting toxic chemicals.[180] Violating these rules could give companies like Fannie Mae and Freddie Mac the right to demand immediate payment of their full loan if a homeowner signs a gas or drilling lease, potentially resulting in foreclosure if the owner cannot pay the amount owed.[184,182]

Employment

There is potential for pipeline development to contribute to economic growth through job creation, and jobs created through pipeline construction and operation may also spur secondary job growth. For those employed directly, operators generally report paying "prevailing wages" for these jobs. However, evidence from other pipeline projects shows that the majority of job growth is short-term, and both temporary and permanent workers may not be residents of the affected area.

An investigation of the proposed Trans Mountain Pipeline Expansion (TMX) Project in Canada conducted by the Simon Frasier University (SFU) determined that Kinder Morgan had significantly exaggerated the number of jobs that the project would create.[185] The company claimed that the TMX, which would triple the capacity of petroleum transported through the Canadian pipeline, would generate 36,000 person-years†† of temporary employment over three years, including direct and secondary job creation. In comparison, SFU's evaluation determined that the project would create just 12,000 person-years of employment.[185] Similarly, while Kinder Morgan stated that 50 permanent jobs created by TMX would generate up to 2,000 "spin-off" jobs, the outside analysis showed that "even with a wide range of spin-offs TMX will only create 800 long-term jobs."[185]

Analyses of other non-CO_2 projects, including much longer pipelines than the proposed Lobos CO_2 project, have found low or even no need for permanent employees. In Pima County, Arizona, Kinder Morgan began construction in summer of 2014 of the Sierrita pipeline, a 60-mile, 36-inch natural gas pipeline. The final Environmental Impact Statement for the project estimated that construction would require 375 temporary employees, with only an estimated 20 percent of workers coming from the local area.[186] This project would not require permanent employees after the pipeline construction is complete.[186]

Taxes

Pipeline construction can be a source of county tax revenue through one-time taxes, as well as annual property taxes paid by the pipeline operator. Existing pipeline projects have demonstrated small-scale economic benefits due to tax contributions. For example, from 2009 – 2013 the combined federal and provincial Canadian corporate tax contribution from Kinder Morgan's 715 mile Trans Mountain Pipeline

†† One person year is equivalent to one year of full time employment for one person

in Canada, which currently transports approximately 300,000 barrels of crude oil per day[187] averaged $1.5 million per year.[188]

In Pima County, Arizona, where Kinder Morgan is constructing the 60-mile Sieritta natural gas pipeline, the County administrator determined that much of the construction materials and activities would be exempt from taxes that would otherwise be distributed to the county.[189] Transaction privilege taxes (an Arizona state tax akin to sales taxes) in the amount of $620,000 would be paid during the Sieritta pipeline's construction, but these funds would be shared between the state of Arizona and local counties along the pipeline route. Ultimately, Pima County's administrator determined that Pima County would receive just $7,334, cities and towns in Pima County would receive $3,870, and Arizona's Regional Transportation Authority would receive an estimated $62,000.[189]

Kinder Morgan also asserted in public meetings that Pima County would benefit from $4.9 million in "ad valorem" property taxes from the assessed value of the pipeline itself. However, the Pima County Department of Finance found that of this amount, only approximately $1.6 million would be realized annually by Pima County based on 2013 tax rates.[189]

Another example of potential challenges to counties receiving estimated tax payments comes from Montezuma County, Colorado, where Kinder Morgan claimed a tax deduction for pipeline transportation costs of carbon dioxide. This claim was ultimately contested by the County assessor's office in 2008, and led to Kinder Morgan paying $2 million in back taxes.

Pima County, Arizona: Case Study

In Pima County, Arizona, the County administrator's office conducted a study to determine costs to the county in comparison to expected tax revenue generated from Kinder Morgan's Sierrita natural gas pipeline, mentioned above. [189] The size and location of this project are similar to the proposed Lobos Pipeline, and Pima County's analysis is the only instance we found of a county calculating additional costs that public agencies could incur due to pipeline construction and operation.

According to the Pima County administrator's estimates, the pipeline project would pose one time costs to the county amounting to over $16.4 million, and projected tax revenues potentially generated by the proposed pipeline project would not offset these costs.[189,191] Their estimation included over $1 million in ongoing annual costs for public safety, as well as costs for road maintenance, repair of damage to ranchlands, law enforcement actions from increased illegal trafficking, erosion and flood control, open space management, and impacts to sensitive land areas.[189]

The only revenue that Pima County initially expected to receive to address these costs was $2.3 million for required use permits, and about $1.6 million in additional funds if Kinder Morgan purchased credits to mitigate damages to sensitive habitats. In June of 2014, Kinder Morgan agreed to monitor the area around the pipeline for 20 years and pay Pima County $4 million to address environmental degradation and harm to riparian habitats,[191] and $1 million is slated for Pima County to purchase conservation lands in order to offset projected damages.

Other potential costs of pipeline construction

Pipeline Incidents. According to data from the Pipeline and Hazardous Materials Safety Administration (PHMSA), property damage from 66 CO_2 pipeline accidents between 1994 and July 2014 totaled $2.5 million.‡‡ This includes costs associated with damaged equipment, lost pipeline contents, as well as damage to public and private property compensated by the operator. Beginning in 2002, costs are reported separately for different cost categories, and accident reports show that between 2002 and 2014, a majority of costs were accrued directly by operators. Approximately $158,000, or 8.5 percent of costs incurred during this time resulted from damages to public or private property that was paid for by the operator. [See Appendix B. Table B-7] However, when landowners lease mineral rights for oil and gas extraction to energy companies, there have been cases, in New York State for example, where landowners are left liable for environmental cleanup while the companies maintain limited liability.[182]

Environmental contamination. Concerns about costs associated with environmental contamination also stem from evidence about Kinder Morgan's other oil and gas related activities. The company recently paid a fine for improperly storing drilling waste and failing to notify the state of Colorado of drilling a new waste pit.[190] While Kinder Morgan was responsive in paying the fines quickly, an official from the Colorado Oil and Gas Conservation Commission stated that "the problems we saw were the violations they had were systematic."[190] [See Section V.4. Safety]

Impacts of the Proposed Lobos CO_2 Pipeline on Economic Vitality

While residents acknowledge that some benefits could be felt at the local level from taxes generated from the proposed Lobos CO_2 Pipeline, many feel, based on their own estimation or the experience with other pipelines projects, that the cost burden resulting from the proposed pipeline would exceed any funds generated as a result of its construction and operation. Furthermore, considerable uncertainty remains about how landowners will be compensated or whether the ability to obtain or maintain a mortgage and insurance will be impacted as a result of pipeline development on their property. Given the existing economic conditions in Torrance County, the links between these conditions and health, and the activities proposed as part of the Lobos CO_2 Pipeline, the following is a list of impacts to economic vitality in Torrance County predicted to result from the construction and operation of the proposed Lobos CO_2 Pipeline.

Impacts to property values and wealth

- It is unclear whether the proposed pipeline activities will lead to changes in property values in Torrance County. However, there is no evidence to show that the presence of a pipeline, such as that being proposed, would benefit property values. Similarly, based on the available evidence, it is unclear if or how the pipeline would affect issues like insurance or mortgages, though there is some evidence that indicates apprehension on the side of loaning institutions about properties that lease land for use in oil and gas development.

- Land that is required by Kinder Morgan for the pipeline right of way will no longer be able to be used by its original owner, and represents a loss of future potential uses for this land area. Restrictions on development within the pipeline right-of-way could prevent landowners from engaging in future income generating land use developments, and may also affect the value of the land. These landowners will receive some monetary compensation for their land, whether it

‡‡ Adjusted to 2014 dollars

is negotiated directly with Kinder Morgan or as a result of the use of eminent domain. However, it remains unclear how much landowners would be compensated, since Kinder Morgan requires that information about compensation for pipeline right-of-ways is kept confidential, and if compensation would make up for any potential financial gains prevented by the loss of use of land during the lifetime of the proposed project and beyond.

- Residents may incur costs to their personal property from temporary or long term damage or disruptions that construction or operation of the proposed pipeline could bring, or from contamination that may result. Kinder Morgan does not clearly state what the company's response would be if property owners claimed lasting damage to their land. There is potential, for example, for heavy construction equipment to lead to soil compaction, for loss of topsoil from digging for the pipeline, or for other impacts that would affect landowners.[192]

Impacts to employment and purchase of local goods and services

- Temporary and permanent employment as a result of the proposed project could result in some benefits for Torrance County residents. Since the estimated number of jobs associated with the pipeline project is for the entire span of the pipeline project from Arizona through New Mexico and into Texas, it is unknown how many of the workers hired on a temporary or permanent basis would be local Torrance County residents. Thus, there is no guarantee that Torrance County residents will be hired for the project, and the number of jobs ultimately provided by pipeline construction is uncertain, especially given that Kinder Morgan's job estimates have been contested in the past.

- The proposed pipeline's construction could have a short-term positive impact on the county's economic vitality through purchase of local goods and services, and possibly through secondary "spin-off" jobs created by an influx of construction workers. In an analysis commissioned by Kinder Morgan, about 40 percent of the materials for pipeline construction, such as fuel, food, and some construction supplies were projected to be purchased locally throughout the entire project area,[11] with owners of hotels and RV Parks seeing gains in particular.[11] However, the analysis also notes that if construction occurred during popular festivals or events, that lodging could then become limited for tourists, which may compromise expected revenues or income associated with these events.[11]

Impacts to tax revenue

- Construction of the proposed pipeline would likely have positive impacts on Torrance County tax revenue, and thus have the potential to impact funding available for municipal services that may have health benefits to local county residents. There may be short-term benefits associated with tax revenue during construction, associated with the purchase of local supplies and services. However the amount of goods that would be purchased locally from Torrance County is unknown, so it is not possible to calculate the potential tax gains in this regard. The $2.3 million in property taxes that Kinder Morgan estimates paying annually should the pipeline project be approved would be shared by the states, counties, and municipalities throughout the project area, so the share that would go towards the budget Torrance County would be a small portion of this total. It is unclear whether these revenues will offset any costs incurred by the county.

- If pipeline activities have an adverse impact on property values or the ability for landowners to sell their land or homes, this could have a negative impact on the municipal tax base in Torrance County.

V.4. SAFETY

The following section explores safety issues concerning the proposed pipeline, as residents in Torrance County have expressed a high level of concern about the additional safety risks that the pipeline could pose to local populations, including exposure to CO_2 and implications of a pipeline failure.

Background

The proposed pipeline is required to adhere to design, construction, operation, and maintenance standards established by the Pipeline and Hazardous Materials Safety Administration.[193] Measures to protect personnel and the public from inadvertent releases due to accidents or natural forces would include Passive Controls, Active Controls, and Procedures outlined in an Operations and Maintenance Manual similar to that for the Cortez CO_2 pipeline system.[193]

Visual inspection of the pipeline will occur at least once every two weeks.[6] Kinder Morgan has stated that they will monitor the pipeline remotely for 24 hours a day, with operators able to adjust, stop, and start equipment from the control center.[6] Kinder Morgan has also stated that it "has developed response plans to respond to unplanned events, and [we] work regularly with local first responder personnel to educate and drill on the procedures. Where appropriate to assure timely and quality response, Kinder Morgan has made donations to emergency agencies in the past and plans to continue this effort in the future."[6]

Existing Conditions

One of the primary threats to safety in Torrance County and New Mexico has been natural disasters, including flooding, ongoing drought, severe winter storms, wildfire and earthquakes. In more recent years, pipeline infrastructure that has a growing presence in Torrance County has also posed safety risks.

Some subsets of populations are, in general, considered more vulnerable to safety risks, including children, elderly people, and those residing in harder to reach, rural areas of the county. A significant population of older adults live in Torrance County and the recent growth of retirees outpaces that in New Mexico and the United States.[194] Undocumented immigrants, and people who don't speak English are a population that may also be at greater risk, and be less able to access resources and information in the face of an emergency.[195]

Existing emergency response infrastructure/ resources

As a rural county with low population density, Torrance County does not have extensive emergency infrastructure that is necessarily able to deal with these risks.[196] Torrance County's website emphasizes that with 1,452 miles of county maintained roads in the 3,355 square miles of county land area, "the sheer magnitude of the area to be served stretches available resources. Law enforcement is based on responses to complaints more than on patrols of the county and the distances which must be traveled may delay all emergency responses, including law enforcement, ambulance and fire."[196]

The County's Emergency Dispatch Center, which receives and directs 911 calls, employs 12 staff and 3 supervisors. The Center dispatches calls for all of the police and fire departments in the county. This includes the Torrance County sheriff's department, three town police departments in Moriarty, Estancia and Mountainair, and eight local fire departments.[197]

There is no hospital in Torrance County. According to personal communication with representatives from the Department of Health, emergency injuries are taken by land or air to the University of New Mexico regional trauma center in Albuquerque. Torrance County is considered a Health Professional

Shortage Area by the US Department of Health and Human Services, and had the lowest ratio of primary care providers to residents of any county in New Mexico in 2013.[198,199] In a 2009 Community Health Assessment, residents identified the lack of after-hours and emergency health care as a priority issue. Concern about Torrance County's limited capability for emergency response was echoed in focus groups conducted for this HIA:

> [T]he town and county don't have the infrastructure or the funding sources to handle any--even a minor problem...let alone a big one. And we don't have emergency response teams. We don't have a hospital. I mean there's a lot of issues…The Sheriff's Department shuts down on weekends. That's not a joke!

Data from the 2014 Torrance County Community Survey indicates that more than half (54 percent) of respondents travel 31 miles or more just to receive health care.[33]

CO_2 *Transport Regulation and Emergency Response Planning Standards*

Interstate pipelines are regulated by the federal Department of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) Office of Pipeline Safety.[133] Eighty-five percent of pipelines in the US are under state authority, and the PHMSA provides about 80 percent of the funds that states spend on pipeline safety.[200] This body regulates the design, construction, operation, maintenance, spill response and safety standards for interstate pipelines.[133] Recently, however, the PHMSA has come under criticism for its failure to ensure proper training and distribution of inspection resources.[200]

DOT regulations classify CO_2 as a "non-flammable gas hazardous material," and pipeline safety is thus subject to the federal regulations for hazardous material pipelines.[133] According to federal regulations, CO_2 pipeline operators are required conduct a risk analysis prior to pipeline construction, and to regularly monitor lines for leaks and to protect against over-pressurizing (a common source of leaks), particularly in populated areas.[201,202,203] Pipeline operators are also required to perform extra analysis and attention to ensuring pipeline safety when they pass through designated high consequence areas.[§§] [204] These include populated areas, drinking water sources, commercially navigable waterways, and unusually sensitive ecological areas, such as those with multiple endangered species.[204]

Some states have additional pipeline safety regulations and protocols.[41] In New Mexico, the Pipeline Safety Bureau conducts inspections and investigates accidents on intrastate CO_2 pipelines. The Safety Bureau also has a partnership with the Federal DOT, which oversees some aspects of intrastate hazardous liquid pipelines in the state.

In addition to these public regulations, multiple companies in the oil and gas industry have partnered with technical advisors through a Joint Industry Project to develop industry guidelines for CO_2 transmission by pipeline for carbon sequestration and storage.[205] These guidelines include detailed descriptions of specific risks to pipeline integrity that should be considered in design, as well as safety measures regarding pipeline location, such as routing the pipeline to avoid ground depressions where CO_2 could accumulate.[205]

According to accident reports from the Pipeline Safety and Hazardous Materials Association, there have been no accidents or leaks from pipelines within Torrance County's boundaries. However, there have been at least 11 leaks documented on the Cortez CO_2 pipeline in other areas in New Mexico, and well as

[§§] As determined by the Office of Pipeline Safety [204]

in Colorado and Texas. The largest accident (in terms of quantity of CO_2 released) occurred in 2005 in Eddy County, New Mexico, when the pipeline vented 2,394 barrels (75,411 gallons) after a corroded bolt on a relief valve broke.[206] The most recent accident took place in 2012, when 15 barrels (473 gallons) leaked from the pipeline in Yoakum County, Texas, due to an operator error. [206] [See Appendix C. Table C-1 for a full list of accidents on the Cortez pipeline][***] None of the accidents on the Cortez pipeline resulted in injuries or deaths.

Residents have documented portions of high-pressure pipelines in the vicinity of Torrance County that have become exposed as a result of flooding in areas where the line is routed below surface waterways and left unrepaired for up to a year.[207] [5] [See Section V.2. Land Use for photos]

Safety and its Relationship to Health and Well Being

Health Impacts of Exposure to CO_2

Little is known about the risks of exposure to the type of high-pressure, supercritical phase CO_2 that would be transported through the proposed Lobos Pipeline. If CO_2 were released from a transmission pipeline, it would rapidly convert to gas in the lower pressure environment. Exposure to CO_2 gas at high concentrations, and particularly in enclosed spaces, can cause serious harm to humans, potentially resulting in death.[209] However, CO_2 is generally considered to be an acute (sudden in onset) health hazard rather than a chronic (long-developing) hazard, with no adverse health effects at concentrations below .5 percent.[210,211]

At high concentrations CO_2 can cause health problems both as a direct toxicant and through asphyxiation, by displacing oxygen in the air.[201] Symptoms of short-term, high-level exposure include labored breathing, headache, visual impairment, and loss of consciousness.[209] These effects are usually reversible if people are removed from high CO_2 environments and receive sufficient oxygen, but when high-exposure to CO_2 is combined with low levels of oxygen, it can lead to irreversible brain, lung, and/or heart damage, and coma. [212–214]

For long term exposure of several weeks, the lowest levels of exposure at which health effects have been observed is 7,000 parts per million, or .7 percent, where continuous exposure led to increased blood acidity.[215] Prolonged exposure to low levels of CO_2 may also lead to increased blood pressure and cerebral blood flow, and to slightly decreased bone formation.[212] While these effects are considered "benign" and reversible for healthy young adults, some researchers have expressed concern that chronic exposure at very low concentrations could pose additional risks for people with existing hypertension, brain injuries, or osteoporosis.[212]

Skin contact with cold gas CO_2 can cause frostbite or dermatitis on skin.[209] Frostbite could be a risk from CO_2 pipeline rupture or puncture, as supercritical CO_2 would cool rapidly and extremely as it expanded during release.[210] Eye contact with CO_2 gas can also lead to redness, burning, and even blindness at very high exposures.[209] Finally, accidental release of CO_2 from a pipeline could cause physical trauma from the rupture or puncture site, as highly pressurized gas would be released at very high speeds.[210]

Risks of Exposure

Occupations that require work with CO_2 in enclosed spaces have a particularly elevated risk for health

[***] Pipeline incident reports available from the Pipeline and Hazardous Materials Safety Administration do not always clearly specify the name of the pipeline. We determined that incidents had occurred on the Cortez pipeline either because the pipeline was identified by name in the report, or based on the location of the accident.

and safety impacts. The bulk of the risks associated with CO_2 exposure generate from the capture and storage of the gas, where very high amounts are present, and less so in its transport.[216,217,218,202]

In the event of a release of CO_2 from an outdoor pipeline, the gas would dissipate more quickly than in an confined area, however, depending on the release volume and ambient conditions, exposures could still occur at levels harmful to human health.[9] The extent of exposure in the event of a puncture or rupture would depend on a variety of factors, including the size of the leak, prevailing weather patterns, proximity to the pipeline, and any containment of the gas in buildings adjacent to the pipeline.[210,216]

Kinder Morgan's own bulletins for emergency responders indicate that responders in proximity to a release from a CO_2 pipeline should be equipped with a self-contained breathing apparatus, owing to the potential for CO_2 to displace oxygen.[219] Vapors from liquefied CO_2 are dense, and are about 50 percent heavier than air, and as a result, can accumulate near the ground in or subsurface spaces.[214,220] For this reason, a current New Mexico CO_2 emergency responder manual cautions to stay away from "low areas" in the event of a leak or rupture.[220] While CO_2 gas is odorless and invisible at relatively low quantities, release from a pressurized pipeline, and especially a large-scale release, could create visible water vapor caused by cooling and condensation of the air.[205]

An Environmental Impact Statement for a CO_2 pipeline associated with sequestration at a proposed power plant states that a puncture or rupture could present an acute risk of asphyxiation for people adjacent to pipeline.[210] This EIS uses a two mile radius as the "region of influence" from an accidental release, although the analysis in the report estimates that the actual area impacted would be significantly smaller.[210]

The analysis indicates that a worse-case scenario for a pipeline leak would involve large scale rupture, with displacement of the soil above the pipeline and complete loss of the contents of the pipeline segment, in calm weather conditions so that the gas did not rapidly dissipate.[201] A risk analysis performed for a proposed CO_2 pipeline in Kern County, California predicted that in the case of a complete pipeline shear, about 75 percent of the CO_2 in the impacted segment would be discharged as gas, while 25 percent would solidify and then vaporize more slowly.[201] The impacts of a leak could also depend on individual factors of people exposed, such as age and pre-existing health conditions.

Stress Related to Potential Safety Risks

In focus groups, residents expressed concerns about safety and anxiety about a potential pipeline accident. Because CO_2 is odorless and colorless in relatively low concentrations, one issue raised was that pipeline leaks could go unnoticed, thus putting residents at risk without them being aware. This and other fears about safety are a source of ongoing stress for local residents:

> You know one of the problems is an acute problem. The pipeline leaks or breaks. The other problem is chronic. And that's, you know, I mean nothing may happen…with that pipeline if it's built, but people have to live with the thought or the idea, the stress, that it might happen all the time…Fear…That's the chronic condition of living with a thing like that.

Even in the absence of an accident, this ongoing stress about a safety accident occurring without warning and the adequacy of infrastructure to address accidents could itself lead to negative health outcomes such as depression and anxiety, cardiovascular disease, and behaviors like smoking and alcohol use.[116,117] Perception of control is one of the cognitive processes that mediate between stress and health. Perceived lack of control over a stressor can increase vulnerability to stress and its attendant health issues. [115]

Impacts to Safety From Similar Projects

Kinder Morgan's Safety Record

From 2006-2014, for all Kinder Morgan pipelines (not just CO_2 pipelines,) there were 129 pipeline accidents†††, leading to over 25,000 barrels of spilled pipeline contents. [See Appendix C. Table C-2]. Since acquiring a huge network of pipelines in a short time period, Kinder Morgan has developed a notably poor safety record.[221] The company has been responsible for 1,800 violations since incorporation in 1997, including nearly 500 pipeline accidents.[221] In 2011 Kinder Morgan was assessed $573,400 in proposed penalties from the federal Pipeline and Hazardous Materials Safety Administration for violations at terminals.[222]

Recent Kinder Morgan pipeline accidents include:

- In 2004, a spill of 1,500 barrels of diesel oil into California marshes. Kinder Morgan plead guilty to water pollution and failure to notify authorities, and trustees settled the National Resources Damage Assessment portion of the case for $1.15 million.[223,221]
- Also in 2004 in California, a gasoline pipeline was struck by a municipal utility backhoe and burst into flames, killing five workers and severely injuring four others. Kinder Morgan Energy Partners was found to be at fault for improperly marking the location of the pipeline, and was fined by the state Fire Marshall, pled no contest to six felony charges and paid over $89 million in penalties and victim compensation.[224] [221]
- In Colorado where carbon dioxide is extracted from reservoirs and pumped through pipelines into Texas and Utah, the Colorado Oil and Gas Conservation Commission, which regulates drilling in the state, has characterized Kinder Morgan as "not being particularly diligent to compliance issues."[225] The company has recently been fined up to $220,000 for environmental violations at carbon dioxide wells it has drilled in the Southwest region of the state.[226]

One report from an independent financial analyst in 2013 indicated that a Kinder Morgan business strategy is to "starve its pipelines and related infrastructure of routine maintenance spending", and highlights concern about the reliability and safety of Kinder Morgan's pipelines. As an example, the report notes that after Kinder Morgan acquired El Paso Natural Gas Pipeline Company in 2012**,** the company "cut maintenance expenses by 70-99 percent**."** [227]

The company's operations and related safety violations encompass more than just for pipelines. For example, officials were implicated in bribery related to illegal dumping of contaminated materials,[228] [229], monetary penalties were levied for violations of the Clean Air Act in Florida,[230] and fines were levied for lying to air pollution regulatory agencies, stealing coal from customer's stockpiles, and illegally mixing hazardous waste into gasoline.[231]

CO_2 Pipeline Failure

In 2013 there were 5,195 miles of CO_2 pipeline in the United States. Information from the Office of Pipeline Safety on the 20 year trend for CO_2 pipelines reports a total of 64 total accidents for the time period from 1994 – 2013.[232] There were 25 "significant incidents" during this time, which include those

††† The terms "incident" and "accident" are essentially used interchangeably when discussing pipelines. The HMSA generally uses "incident" and refers to reports from operator as "incident reports," but in other places uses both terms, e.g. referring to "Incident/Accident Summary Statistics." For consistency we use the term "accident," but other sources may refer to the same statistics as "incidents."

with liquid releases of over 50,000 gallons, or that result in a death or hospitalization.‡‡‡

While the number of accidents appears to be trending upwards as more CO_2 pipeline have been constructed, they have also likely increased because of changes in reporting standards in 2002. Among other changes, after this point operators had to report leaks over 5 gallons, as compared to the previous requirement of 50 gallons.[233] After 2002 there has not been a noticeable trend in the annual number of accidents. The number of "significant accidents" however has been trending upwards over the period from 1994 – 2013 [See Appendix C. Figure C-1]. Annual mileage for CO_2 pipelines in the US is only available beginning in 2004, but based on the data from 2004 – 2013, the annual frequency for CO_2 pipeline accidents is about 1 per 1000 miles of pipeline per year.[210]

Nearly 70 percent of all CO_2 pipeline incidents from 1994 - 2013 were caused by weld, material or equipment failures, with corrosion a distant second, leading to 8 percent of incidents.[234] For all pipeline types, the cause of accidents is more evenly divided, with 29 percent due to weld, material or equipment failure, 18 percent due to corrosion and 18 percent due to excavation damage, among other causes. [See Appendix C. Figure C-2]

All combined, CO_2 pipeline accidents from 1994 to 2013 resulted in over 70,000 lost barrels of CO_2, one injury, and no fatalities. The largest single release was 24,659 barrels, or about 777,000 gallons, from an accident in 2006 in Raleigh, Mississippi.[206] [See Appendix C. Table C-3]

Emergency Response Procedures for Other CO_2 Pipelines

Emergency response procedures associated with CO_2 pipelines vary depending on the pipeline operator. The Joint Industry Project safety guidelines include a wide range of potential measures to minimize impacts in the face of an accident. Among these are audible and visual alarms, public signage such as highway signs for at-risk locations, education of third party responders, and design and identification of escape routes.[205]

The Dakota Gasification Company's stated safety procedures for their 205-mile CO_2 pipeline, running from North Dakota to Canada, is an example of a more comprehensive/extensive protocol. It includes an "out call" system with four hundred dedicated phone lines that deliver recorded messages alerting residents of the pipeline emergency within one minute of a declared emergency.[235]

The protocol also calls for personnel dispatched in an emergency to include a five-person emergency response crew of hazardous material technicians to "to assess the emergency, establish the hot zone, assist the first responders, and carry out an action plan to resolve the emergency situation."[235] First responders are expected to consist of local or County fire, medical, and law enforcement personnel. The company's Safety Officer, a trained hazardous materials technician, would work under an Incident Commander, who is "responsible for directing and coordinating the overall emergency response."[235]

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‡‡‡ The full definition of "significant incidents" is as follows:
"Fire First Incidents: Gas distribution incidents with a cause of Other Outside Force Damage and sub-cause of Nearby Fire/Explosion as Primary Cause of Incident.
Significant Incidents are those including any of the following conditions:
1. Fatality or injury requiring in-patient hospitalization
2. $50,000 or more in total costs, measured in 1984 dollars
3. Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more
4. Liquid releases resulting in an unintentional fire or explosion."[48]

Impacts of the Proposed Lobos CO_2 Pipeline on Safety

Given the increasing prevalence of CO_2 pipeline accidents, and that the proposed Lobos Pipeline would be the second CO_2 pipeline running through Torrance, the project would increase the risk of a CO_2 pipeline safety accident in the county, and add to the existing safety risks posed by natural disasters and other conditions in the area.

- Considering the estimated annual frequency for CO_2 pipeline accidents is 1 per 1000 miles of pipeline per year[210], that the preferred pipeline route is just over 200 miles (214 [236]), and the operational life of the pipeline is expected to be 60 to 100 years[6], between 12 and 20 accidents can be expected from the proposed Lobos Pipeline during its lifetime. The severity and magnitude of impacts resulting from the accidents depend on the type of accident, and the population and/or environmental elements exposed.
- Given the limited nature of the existing emergency response resources in Torrance County and the number of existing threats to safety, in the event of a rupture of the proposed Lobos CO_2 Pipeline, Torrance County's emergency response services would be strained or inadequate to provide a sufficient response. The inability to respond adequately to a CO_2 pipeline accident would increase the likelihood of adverse health outcomes resulting from the accident. Resources would be diverted from other potential emergency response/ safety needs, thus leading to adverse health outcomes from the safety event that is unable to receive the necessary attention from emergency responders. In the event of a pipeline accident that affects a more remote or difficult to reach area of the county, these populations are particularly vulnerable to safety impacts, along with the significant population of older adults that live in Torrance County.
- The presence of a CO_2 pipeline, regardless of whether a pipeline accident occurs or not, would increase levels of stress and fear amongst residents. The perception of risk related to the safety of the pipeline is exacerbated as a result of Kinder Morgan's existing record of pipeline accidents and other safety violations, as well as evidence from neighboring counties of a lack of attention to safety risks associated with existing pipelines.

V.5. WATER QUALITY AND AVAILABILITY

"The first big issue here is our water, because I don't see anybody here that looks like a camel that can survive seven days without water, or that can live without water. To me, that's a priority. Everything else follows: the historical, the cultural, our land, everything." - HIA focus group participant

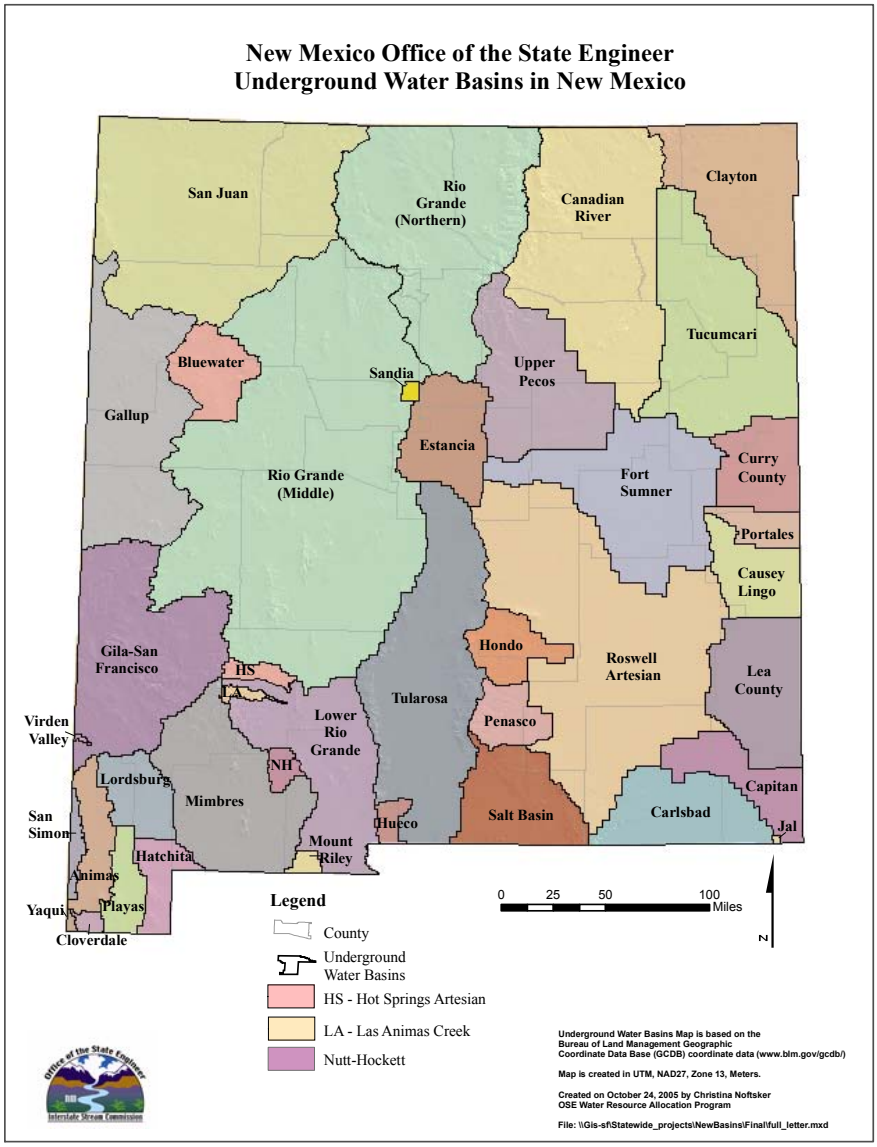
The proposed Lobos CO_2 Pipeline will cross two large rivers[5] – the Rio Puerco and Rio Grande – and, depending on the route selected, between 110 and 312 waterbodies.[237] When identifying issues of focus for the HIA, Torrance County residents resoundingly expressed the paramount importance of water, and their concern about the potential impacts of the proposed project to water quality and availability.

Geography Used in the Water Section

Where available, data and statistics about water quality and availability was collected at the county level. However, when relevant information was not readily available at this level, we used the closest geography for which information is available and relevant. Often this was the Estancia Basin, a topographically closed basin with an area of about 2400 mi^2. Torrance County encompasses 80 percent of the land area within the boundaries of the Estancia Basin, when land area is defined by water features.[238] Water-related data and information was also found from:

- *Soil and water conservation districts*: Three districts – East Torrance, Claunch-Pinto, and Edgewood – overlap with Torrance County, as illustrated in Figure D-1 in Appendix D. These three districts make up the Estancia water planning region.
- *Water planning regions*: The Estancia Basin Water Planning region encompasses Torrance County and extends just beyond it to include slivers of Bernalillo and Santa Fe counties, as shown below.[239]

Figure 17. New Mexico Underground Water Basins, 2005.



Source: New Mexico Office of the State Engineer. Accessed August 1, 2014. Available at: http://www.ose.state.nm.us/PDF/Maps/underground_water.pdf

Background

The Connection to Water in Estancia Basin

Focus group residents discussed how the importance and significance of water in Torrance County began in prehistoric times

> Water here is so sacred. There have been petroglyphs in the area that talk about the quality of the water. I mean, just look at our [dry] climate, and think about how important water is to us. It is crucial. No living thing can get by without water. None.

Residents also described the historic and cultural importance of water in the Estancia Basin area, highlighting how settlement patterns, for land grant and other pre-colonial settlements, were determined by the availability or lack of water, as well as by the quality of water in certain areas.

> If the water wasn't there, the pueblo wouldn't have survived. The Indians survived on it, and we survived on it, and our kids are going to survive on it, and it's going to be impacted. And we don't want that.

Land grant residents further stressed a direct connection between concerns over water access and quality and concerns over their cultural identity, and that if water was compromised, so too would be their property, way of life, culture and history.

Another resident noted that there are springs in the area that were used by indigenous Pueblo peoples in the 1100s, and that are still being used and cared for by long-standing land grant families. She described the way in which water was a unifying force for indigenous people in the past, and that it continues to be so today.

Water Use in the Estancia Basin

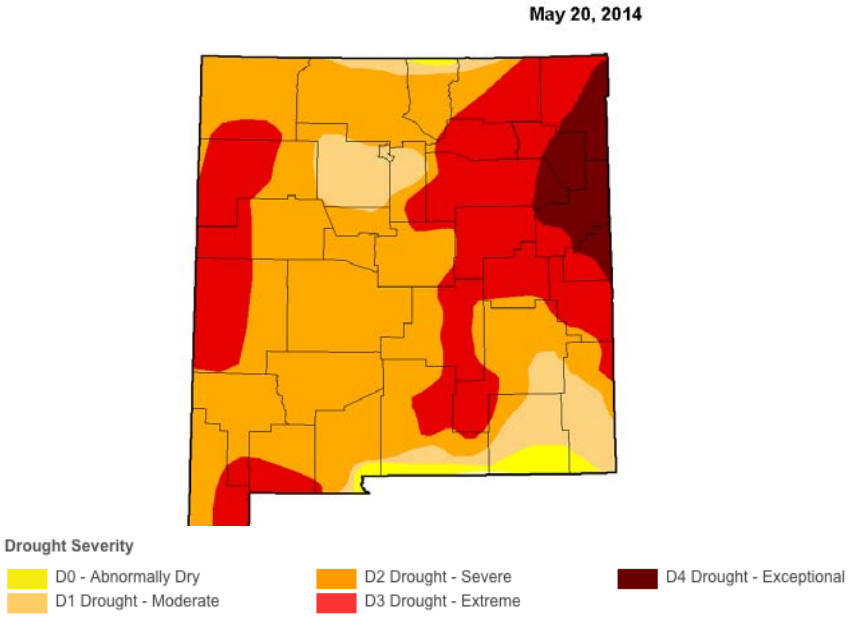
Historical analysis shows that more than 2 million acre-feet was depleted from the Estancia Basin from 1940 to 1996, 63 percent of which came from aquifer storage. These conditions resulted in water level declines of about 60 feet at the main pumping centers. In 1999, assuming future irrigation would decrease by 5 percent from 1996 levels of use, it was estimated that aquifer storage would maintain future development for at least 40 more years, and that water levels at the main pumping stations would drop an additional 60 feet by the year 2036.[240]

Existing Conditions

Water Availability in New Mexico and Torrance County

Strained water resources are a national concern, and as a state with extremely limited water resources, New Mexico is not immune from this worry. New Mexico has the lowest percentage of water area of any of the 50 states in the US.[241] The state also experiences drought conditions ranging from abnormally dry to extreme drought.[242]

Figure 18. Drought Conditions in New Mexico, including Torrance County, May 20, 2014.



Source: Unites States Drought Monitor, available at http://droughtmonitor.unl.edu/Home.aspx

Recent studies also show that demand for water from the Colorado River Basin, which more than 33 million people throughout western states including New Mexico depend on, will soon outstrip supply.[243] This indicates that limited groundwater reserves in the western states will increasingly play a role in meeting future water needs.[244]

Limited Water Resources in the Estancia Basin

The Estancia Basin is considered water resource limited, according to the Estancia Basin Regional Water Plan Update. Of the two common categories of water sources – surface water and groundwater – the Basin has no significant surface water resources or infrastructure to draw surface water from outside areas. Although deeper water sources exist in parts of the Basin, declines in water levels have been noted, and at the writing of the Plan Update it was uncertain how much water was in these deeper sources.

In 2010, the most recent year for which data are available, water use in Torrance County remained overwhelmingly sourced from groundwater as compared to surface water.[178] Residents and the economy of the Estancia Basin rely on precipitation and groundwater for water supply, predominantly from the Valley Fill Aquifer.[238] The 2010 Water Plan Update stated that the Estancia Basin, under then-current conditions, "could not achieve 'self-sufficiency' with respect to water use within a 40-year planning window."[238]

A conservative estimate as of 2010 was that the Estancia Basin groundwater system likely loses approximately 25,000 acre-feet of water per year.[238] Given the most recent estimate of groundwater in storage in the Valley Fill Aquifer (6,580,000 acre-feet in 1995), at this rate of loss, the Valley Fill Aquifer would be dry in less than 250 years.[§§§] If the rate of groundwater loss increases, this timeline would shorten. [See Appendix D. Table D-1 for more about estimates of groundwater storage in the Estancia Basin]

In describing water levels, it is important to also look at soil quality. How quickly or slowly soils are saturated when wet can affect the potential for runoff [See Appendix D. Figures D-2 and D-3 depicting soil quality for the Western and Eastern Estancia Basin]. The majority of both Western and Eastern Estancia are characterized by clay-type soils that transmit water slowly, and have greater potential for water runoff. There are also areas of Torrance County (such as in the far northeast and far southwest) where groundwater is shallow, and is more susceptible to groundwater contamination.

Residents in the focus groups expressed deep concern over the scarcity of water in the region

> We don't have much water, and the thought of even a minor threat to our water supply is huge. It's huge. The Estancia Basin won't go through three more generations of people with water. It won't. It's not there.

Residents also expressed concern for the effect that water scarcity would have on traditional farming and ranching lifestyles, citing previous state predictions about the longevity of the Estancia Basin's water supply:

> Several years ago, the State Engineer closed the Estancia Water Basin to any new water development. And probably ten years ago or so, the Soil and Water Conservation District had put

[§§§] This calculation considers a loss of 25,000 acre-feet per year starting in 1995.

> out a little pamphlet that was talking about water here, and at that time, they projected that maybe there was another 125 years of water in the basin. What's happing is that as the fresh water is pulled out, saline water is coming into the aquifer to replace it. The water here is very, very fragile, and there's not much left of it. And it's going to make a huge impact on the agricultural community that has been farming and ranching off of the water in this basin for a long, long time. And that basin is soon to be depleted of its water supply.

Demands on Water Resources

Agricultural water use. Both historically and today, the main water use in Torrance County is agricultural irrigation. In 2010, 95 percent of water used was for irrigation in agriculture [See Appendix D. Table D-2).[****] This is the case even though only 2 percent of Torrance County's designated farmland is used as harvested cropland.[95] The percent of the county's water use for agricultural irrigation is higher than the percentage in the state overall (only 79 percent for the state). Between 1996 and 2008 the total irrigated land in the county increased an estimated 7,000 acres (from more than 24,000 acres in 1996 to more than 31,000 acres in 2008).[238]

Wells and community water systems. Community and domestic well supplies comprise approximately 5 percent of pumping needs for the Estancia Basin. Miscellaneous other uses comprise approximately 2 percent of total water use.[238]

Historical trends suggest 65 percent of residents in the Estancia Basin are supplied with water through a community water system and the remaining 35 percent through domestic wells.[238] [See Appendix D. Table D-3] There are more than 11,200 wells in Estancia Basin, approximately two-thirds of which are in Torrance County. Nearly all of the wells in Torrance County are active, and 48 supply water for public uses.[238] A report prepared for Kinder Morgan about the proposed Lobos CO_2 Pipeline indicates that there are 11 public or private water supply wells or springs within 150 feet of the proposed pipeline.[12]

The once rural and agricultural communities of the Estancia Basin are now growing in population size and becoming linked to the economic bases of Albuquerque and Santa Fe, however these areas remain dependent on the limited water from the Basin.[238]

Permitted water rights. It is estimated that only one-third of the water rights (61,000 out of 159,000 acre-feet per year) that have been issued from the Office of the State Engineer have been used since 2005. Use of the remaining approximately two-thirds of the issued water rights would far exceed the capacity of the Estancia Basin - putting the Basin "in a grave and potentially disastrous situation."[238]

Limits on water level declines in the Estancia Basin. In recent years, action has been taken in the Estancia Basin to address declining water levels and concerns about deteriorating water quality. In 2002, the Office of the State Engineer provided guidelines that declared protections for areas where there are excessive rates of water level decline, including no new approval of groundwater appropriations and restrictions on how much groundwater levels can be allowed to decline.[245,246]

Water Quality

The Office of the State Engineer wrote in 2002 of Estancia Basin that, "Water quality is marginal for some purposes in the basin and may be deteriorating further."[246] Deteriorating water quality was also a concern at the writing of the Estancia Basin water plan in 1999. [247] Specific concerns at that time

[****] Statewide water use is reported every five years in New Mexico, so the most recent year was 2010

included observed increases in nitrate levels, and fears about abandoned wells, poorly functioning septic systems, an E. coli outbreak in Estancia in the late 1990s, and concern about agricultural contamination.[247]

Groundwater quality. Torrance County has 15 closed sites from groundwater cleanup that date from pre-1990 to 2007 (for sites where dates are reported), meaning the concern has been resolved.[248] Currently, there are no active groundwater cleanup sites in Torrance County.[249]

Tap water quality. Currently, there are 35 water systems in Torrance County identified by the State Department of Health, of which 80 percent are active, and that together serve more than 12,700 people.[250]

Data collected from 2004-2009 about 19 of the County water systems describe that two of these systems – Cassandra and Homestead – at some point exceeded legal limits of certain contaminants. Cassandra had high levels of arsenic and lead. Homestead had high levels of three groups of contaminants: alpha particle activity, alpha particle activity (excluding radon and uranium) and nitrate.[251]

Nearly all systems, although legally in compliance, fell short of public health goals set by the EPA for certain health contaminants.[251 252] The contaminants most reported out of compliance with health goals were: combined radium (226 & 228), combined uranium, lead, radium -226, and radium -228.[251 ,252] [See Appendix D. Tables D-4 and D-5]

Quality and Availability of Water and its Relationship to Health and Well Being

Access to water is essential for all life. Water quality and availability can impact health and well being of individuals and communities. Access to water can be restricted by low coverage, poor continuity, insufficient quantity, poor quality and excessive cost.[253] Decreasing availability of water can lead to concentration of contaminants such as heavy metals, industrial chemicals and pesticides, sediments and salts.[254] Poor quality of water can lead to outbreaks of infectious diseases, and chemical contamination of drinking-water may cause chronic illness.[253] Climate change poses a significant threat to the sustainability of water resources in the coming decades. Currently nearly every US region is facing some increased risk of seasonal drought. Drought conditions can fuel wildfires, promote the growth of harmful algal blooms and other microorganisms that can affect drinking water supplies, and could have serious consequences for crops yields and food security issues.[254]

Perceptions of water quality and availability

The perception of environmental contamination may lead to psychosocial stress in communities, families and individuals.[255] The existing and historical context in Torrance County is important to consider when looking at the affects of perceived environmental changes and health. For example, research finds that farmers facing the pressure of climate change and prolonged drought report higher levels of distress and helplessness due to repeated exposure to uncontrollable life events.[256] For communities overall, solastalgia has been associated with mining and tunneling activities in countries such as Australia and Sweden.[108,107] The health effects of sostalgia can include depression, outrage, and sadness.[257] Stress can increase the risk for heart attacks, cognitive impairment, inflammation, immune system impairment and depressive symptoms.[258, 259]

Case studies find that whether or not chemical contaminants are present, the concern and worry about them can manifest into very real physical symptoms, such as headaches, nausea, vomiting, high blood pressure, and high urinary cortisol levels.[260,258]

Water contamination

People can be exposed to contaminants in water through drinking it, eating foods prepared with the water, eating produce or meats that were grown or raised on the contaminated water, breathing chemicals that have vaporized from the water (when showering, bathing, or flushing toilets), or absorbing them through direct contact with skin while showering or bathing.[261] Drinking water contaminants – even at very low concentrations – can have myriad effects on human health.[261]

Herbicides

Herbicides, which are a source of contamination, are substances applied in order to destroy unwanted vegetation. Like pesticides, herbicides can run off into surface water or leach into groundwater and affect the quality of drinking water. Factors that affect whether herbicides will reach drinking water include characteristics of the soil and herbicide, how often and in what quantities the herbicide is used, and characteristics of the land, such as the degree of slope near surface water, and if a high water table that is susceptible to groundwater contamination.[262]

When exceeding acceptable thresholds in drinking water, herbicide contaminants (e.g., dalapon, diquat, endothall, glyphosate, picloram, and simazine), including those specifically associated with rights of way runoff, can be associated with a range of health outcomes according to the US EPA, including kidney issues, cataracts, stomach and intestinal problems, reproductive difficulties, liver problems and blood-related problems. [263]

Impacts of CO_2 Release on Water Quality

The effect of long-term exposure of CO_2 on ecosystem health is considered to be a knowledge gap.[264] Scientific literature does describe that CO_2 release has the potential to decrease the pH of potable water and increase the presence of dissolved metals, or change water hardness.[213, 265 266]

Extreme pH values are a recognized irritant: "Below pH 4, redness and irritation of the eyes have been reported, the severity of which increases with decreasing pH. Below pH 2.5, damage to the epithelium is irreversible and extensive. In sensitive individuals, gastrointestinal irritation may also occur."[267, 268]

Low pH also has the potential to leach metals from the surrounding environment that are toxic to humans at levels exceeding the limits set by the US EPA.[269] Some metals such as uranium are naturally occurring and abundant in the Southwest, and, as such there is concern that acidic groundwater pH will mobilize such metals from the surrounding geology and expose well-water consumers to their toxic effects.[270] Dissolved solids may also increase in concentration with decreasing pH.[213] Though these have no reported health effects, they can negatively impact water aesthetics such as odor, taste and turbidity.[269]

Impacts to Water Availability and Quality From Similar Projects

Water availability

Construction and operation activities associated with pipeline projects require a significant amount of water use. These activities can include: hydrostatic testing (flushing pipes with water to check for strength of the pipes and any leaks); dust abatement; equipment cleaning; and well simulation.

A comment from the Colorado Department of Natural Resources (DNR) Division of Water Resources on the environmental impact statement for the Cortez CO_2 pipeline expressed concern about the impact of the project on an area which, similar to Torrance County/Estancia Water Basin, has a "critical water

supply situation."[271] The comment cites the following figures from the EIS regarding projected water use required to support pipeline development and operations:

- A maximum of 273,000 gallons of fresh water for each of the proposed wells
- Approximately 7,500 gallons of water with a possible additional 40,000 for simulation of each of the 140 wells
- Twelve to 24 acre-feet of water for hydrostatic testing of each pipeline spread
- One-half acre-foot of water for hydrostatic testing of each gathering line stream crossing
- Water for dust control and construction of 39 miles of new roads and 13 central facilities

The DNR went on to say that they "do not agree with the statements [in the EIS] that the impact of the proposed [CO_2 pipeline] project on ground and surface water is limited or minimal", and suggested that the BLM examine the impacts of the project on water quantity in more detail rather than focus on water quality, given that "there are few feasible ways to increase total quantity of water in an arid state [such as Colorado]."[271]

The following are some of the estimates of water usage required for other proposed CO_2 pipeline projects:

- Hydrostatic testing for the Greencore 20-inch diameter CO_2 pipeline, spanning 231 miles from Wyoming to Montana, was projected to use more than 18 million gallons of water.[272] Water consumption for drilling for the pipeline project was expected to require 370,680 gallons of water.[273] The EIS stated that additional water will be needed for dust abatement, but did not specify an amount.[274]
- An 81-mile, 12-inch diameter CO_2 pipeline in Texas estimated the use of 1.25 million gallons of water for hydrostatic testing, and an additional 500,000 gallons of water for dust abatement, equipment wash-down and other construction needs.[275]

The use of heavy equipment in pipeline construction and maintenance operations would also compact the soil in a way that could further reduce its ability to absorb water, and activities such as blasting, clearing, grading, trenching and stock piling could lead to the diversion or elimination of underground water pathways, changing the pattern of underground water recharge. Areas with a high water table, where groundwater is shallow, are more susceptible to impacts from these types of activities. An Environmental Information Report prepared in 2013 for a proposed crude oil pipeline spanning from North Dakota to Minnesota indicated that pipeline construction is most likely to disturb the upper 10-feet of the project area, and that short term fluctuations in groundwater levels may result from activities such as trenching, backfilling, and dewatering, that encounter shallow surficial aquifers.[276]

Water quality

CO_2 wells and carbon capture/sequestration projects where accidents have resulted in carbon release have been found to affect water quality by decreasing the pH, increasing the presence of dissolved metals, or changing water hardness.[213, 265, 277] These potential changes to water chemistry could affect shallow groundwater used for potable water as well as for other needs.[277] A study conducted by scientists at Duke University found that leaks from carbon dioxide stored deep underground "drove contaminants up [in samples from freshwater aquifers] tenfold or more, in some cases to levels above the maximum contaminant loads set by the EPA for potable water"[278]

The aforementioned Environmental Information Report on the proposed pipeline in the northern US indicates that the blasting activities used in the process of installing a pipeline have the potential to

adversely affect water quality and water yields in nearby water wells.†††† The report also pointed out that the accidental release of construction related chemicals, fuels, or hydraulic fluid (associated with fuel storage, equipment refueling and maintenance) during construction could introduce contaminants into groundwater, and as a result have an adverse effect on groundwater quality, in particular near shallow water wells.[276]

A resident from Sandoval County in New Mexico where a growing number of pipelines are present recently expressed his concern about the potential for a pipeline spill to impact water quality in a local newspaper, stating "The gas products, refined products, all that stuff [transported by the pipelines] would run through the sand and gravel like Kool-Aid and hit the groundwater, and we're pretty much done here . . . We only have one water supply."[207]

The oil and gas industry's track record for accidents and safety violations [See Section V.4. Safety] that have led to impacts on water quality are cause for concern for places considering the introduction of pipelines and related oil and gas developments. One recent case in California found that nearly 3 billion gallons of oil industry wastewater from at least 9 wastewater disposal wells were illegally dumped into aquifers that supply drinking water and farming irrigation, even though these aquifers were supposed to be protected under federal and state law. Testing of the polluted water in this area found high levels of arsenic, thallium and nitrates, leading to concern about current exposure to contamination as well as long-term threats to health and ecosystem well being.[279] [280]

Impacts of the Proposed Lobos CO_2 Pipeline on Water Availability and Quality

Impacts to Water Availability

Even before the construction, maintenance, and operation of a pipeline, water availability is likely to continue to decrease for Torrance County overall. A draft report prepared for Kinder Morgan about the proposed Lobos project acknowledged that "activities associated with the construction of the Lobos Pipeline could potentially affect groundwater resources."[12] Given the heavy reliance on groundwater in Torrance County (and New Mexico overall), this impact has significance for the current and future health and well being of a broad spectrum of residents.

- Water usage for construction and testing of the proposed pipeline would contribute to already decreasing water levels in Torrance County. Depending on the source of the water being used for the project, water usage for the project's activities may divert water from existing uses. Given the main use of water resources in the county is for agricultural irrigation, effects may be felt in that sector in particular.

- Given the estimation that the use of remaining issued (but currently unused) water rights would far exceed the capacity of the Estancia Basin[238], this proposed use of water rights for the Lobos Pipeline project could contribute to putting the Basin "in a grave and potentially disastrous situation."[238] Focus group residents discussed ways in which they could foresee the use of water rights for this project spurring challenges and disagreements about local rights of determination on water, as well as empowering developers to seek to acquire water rights as well as land rights.

- Water availability could be impacted by the pipeline construction activities such as blasting, trenching and other use of heavy machinery that affect the flow of groundwater. Areas with

†††† This report looked specifically at impacts to a bedrock aquifer.

shallow groundwater are more highly susceptible to impacts from these types of construction activities. Residents expressed specific concern that the pipeline construction activities could shift underground water channels away from existing wells and leave residents without a water source.

- In the case of an accident that caused contamination of water during pipeline construction or operation, there are limited alternative sources of water for residents, businesses and to fill other water needs in Torrance County. Therefore, the potential for a pipeline accident not only threatens water quality, but water availability as well.

- Changes in water availability could also require residents to invest in new or different ways of accessing water, which may also affect household budgets.

Impacts to Water Quality

Impacts to water quality as a result of the proposed pipeline will depend on how Kinder Morgan proposes to handle aspects of the proposed pipeline project, including use and disposal of water during construction; ROW maintenance and use of herbicides; and accident risk; and proximity of activities to water sources.

- Because of the impervious soil type, and hilly landscape in areas of Torrance County, use of herbicides to maintain the pipeline ROW would be likely to runoff and lead to contamination of ground or surface water. Given that such a large portion of the population in the county depends on groundwater for drinking and other uses, this type of contamination would affect a large number of residents. The degree to which people would be affected would depend on the concentration and type of contaminants released, as well as the existing vulnerability of the population exposed to the contaminants (e.g. children, elderly, etc.). The use of herbicides and other project activities that could impact water quality could also impact residents' perceptions of water quality, leading to stress and related adverse health outcomes.

- In the case of an accident during pipeline operation water sources could be exposed to CO_2, which could result in lowering of the water's pH, and the presence of harmful contaminants could increase. The severity of the impact on health would depend on the amount of CO_2 released, and the number of residents exposed to the contaminated water source. An accident during pipeline construction could lead also lead to water contamination, the magnitude and severity of which would depend on the type and amount of substances released into water sources.

VI. Conclusion

The HIA finds that the proposed Lobos CO_2 Pipeline provides few benefits for Torrance County, while there are numerous ways in which the project has the potential to adversely impact the health of local residents. Traditional assessments often fail to include a comprehensive analysis of issues such as culture and historical connection to the land, the impacts of changing land use, and the health and equity impacts of changes to economic vitality, exposure to safety risks, and water quality and availability. This HIA aims to raise these issues and the voices of residents who would be impacted by the proposed pipeline, so that they can be included in decision making processes for this and other similar projects.

The HIA highlights the unique aspects of history, culture, community and physical environment in Torrance County. Data and analysis presented in the HIA show that while there are many strong social and cultural ties, local communities struggle with high rates of poverty, unemployment and other socioeconomic and health challenges. Given this, it is crucial that decisions about future development in the county recognize and address potential adverse impacts to health and equity, as well as ways in which existing conditions can be improved, particularly for the most highly affected populations. It is important for decision makers to recognize that even though the intensity of individual impacts such as those described in the HIA may vary from minor to severe, that cumulative impacts such as increases in chronic disease and poor mental health can be significant and long term.

Recommendations included in this HIA offer ways in which decision makers and other project stakeholders can ensure that the protection of the health and well being of Torrance County residents is made a priority. These recommendations and the values and principles deeply held and expressed by many residents as a part of this HIA process can serve as important guiding principles for future decisions that will affect many generations to come in Torrance County and beyond.

VII. Recommendations

General Recommendations

Based on the findings of this HIA, we recommend that:

- Kinder Morgan – as the project sponsor – establish a mitigation fund to allocate resources and services to address the adverse impacts of the proposed pipeline on mental and physical health. The fund should be managed by an independent body that includes representation from impacted communities.

- With community input, relevant federal and state agencies develop a guidance document for pipeline development in New Mexico. The guidance document should provide examples of best practices to measure, assess, and address how, at a minimum, project activities affect the health and well being of local communities through changes to the following categories:
    - Land Use
    - Culture and Connection to the Land
    - Water Quality and Access
    - Economic Vitality
    - Safety

Land Use

Based on the findings of this HIA, we recommend that:

- In an effort to address potential future conflicts between proposed pipeline projects – and development that may be spurred by these projects – and the County's Comprehensive Land Use Plan, the Torrance County Planning and Zoning Board develop and implement a cohesive planning process and plan to guide future development in alignment with the county's updated Comprehensive Land Use Plan.

- The Torrance County Planning and Zoning Board update the Plan through an inclusive process that engages representative leadership from diverse sectors of the Torrance County community including, but not limited to: County, municipal and land grant governing bodies; agriculture/ranching; business/economic development; school districts; public health and safety; soil & water conversations districts; water planning boards; and community, neighborhood/land owner associations.

- The Torrance County Planning and Zoning Board and the County Commission proactively use the updated Comprehensive Land Use plan to guide County zoning policy and decisions.

- The Torrance County Planning and Zoning Board and the County Commission create and support the development of local delivery systems for energy and water resources that are compatible in design, scale and sensitive to local conditions.

- The Torrance County Commission in collaboration with the County Planning and Zoning Board research and designate north/south and east/west utility corridors for infrastructure development. The process for determining these corridors should take into consideration broad community input, existing patterns of land use, historical and cultural impacts, economic impacts, quality and way of life, fragile ecosystems and resources, health and safety. They should also prioritize the use of existing industrial corridors and align with the County's updated Comprehensive Land Use Plan.

- Additional research regarding potentially impacted resident's connection to land, land uses and health be conducted and presented to decision makers for consideration in any decision related to the proposed pipeline project.
- Decision makers in Torrance County and other areas along the proposed pipeline route be provided with information about the impacts of developments similar to the proposed project on land use and health. In order to do this in Torrance County, the County's Zoning Ordinance should allow for the requirement of a health impact assessment in addition to an environment impact assessment as part of the permitting process for proposed infrastructure development projects of this nature.
- In order to ensure more effective consultation with local residents about projects that affect them and their connections to the land, members of tribal, land grant and other communities with historic ties to the land in Torrance County be involved with, or conduct their own studies of sensitive sites/ landscapes that could potentially be impacted by the proposed pipeline project.

Culture and Connection to the Land

Based on the findings of this HIA, we recommend that:

- County decision makers involved in the pipeline project consider the proposed pipeline's impacts on social cohesion, cultural landscapes and local identity not only after implementation, but throughout the planning process.
- Additional research regarding local population's connection to culture and the land in Torrance County be conducted and presented to decision makers for consideration in any decision related to the proposed pipeline project. If adverse impacts are identified, recommendations should be identified for how to mitigate those.
- Members of tribal, land grant and other communities with historic ties to the land in Torrance County be involved with, or conduct their own, studies of culturally and spiritually sacred sites that could potentially be impacted by the proposed pipeline project.
- The short and long-term impacts of developments similar to the proposed pipeline on cultural sites/landscapes, and connection to culture and identity, be studied, and the findings presented to decision makers in Torrance County and in other areas along the proposed pipeline routes.
- The Environmental Protection Agency and Council on Environmental Quality work with agencies such as the Bureau of Land Management to ensure that impacts to cultural resources from proposed projects requiring an EIS are more accurately and comprehensively addressed. Specifically, we recommend that these agencies improve the way in which impacts on cultural landscapes, resources and local identity are included, measured and assessed in the scope of research. Analysis of these issues in the EIS process should include the voice and perspectives of communities who would be impacted by proposed projects.

Economic Vitality:

Based on the findings of this HIA, we recommend that:

- Torrance County Commissioners require the Estancia Valley Economic Development Association or another qualified independent contractor to provide a comprehensive study of the economic impacts of the proposed pipeline. The study should include an analysis of loss of use costs, amount and distribution of tax revenues, award compensation and cost benefit analysis – such as was included in the analysis conducted by Pima County, Arizona's Administrator's Office regarding

Kinder Morgan's proposed Sierrita natural gas pipeline. The study should be made available for public review and comment.

Safety:

Based on the findings of this HIA, we recommend that:

- The Torrance County Emergency Manager ensure that for pipeline developments of any kind, a protocol for the highest standard safety procedures are put into place before the project becomes operational. For CO_2 pipelines, including the proposed Lobos project, safety procedures should follow the gold standard set by the Dakota Gasification Company for their CO_2 pipeline running from North Dakota to Canada.

- Any resources required to implement, monitor and maintain such safety protocols be provided by the project sponsor.

- The County Emergency Manager be trained in the highest standard emergency response protocol for CO_2 pipeline accidents. The project sponsor should provide the necessary resources to provide such training.

Water:

Based on the findings of this HIA, we recommend that:

- Given the lack of knowledge about the impacts of CO_2 pipelines and CO_2 release on ecosystem health, including water resources, prior to any decision about the proposed project, additional studies be conducted to:
    - Model the impact of potential CO_2 release(s) from the proposed pipeline on water resources, accounting for the level, duration and location of the potential exposure to CO_2 from the pipeline
    - Assess the impact of project construction on water use and its relationship to supply, access and quality
    - Assess the impact of project construction activities on ground and surface water sources specifically

  Given the varied water table and soil type found throughout Torrance County (and the entire proposed pipeline route), these studies should account specifically for site-specific geochemical characteristics, and pay particular attention to areas of shallow groundwater that are more susceptible to being adversely impacted by the proposed pipeline activities.

- Kinder Morgan – as the project sponsor – establish a mitigation fund to allocate resources and services to address the adverse impacts of the proposed pipeline on water supply and access. The fund should be managed by an independent body that includes representation from impacted communities.

VIII. List of Appendices

VIV. References

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