Nancy Hilding
President
Prairie Hills Audubon Society
[redacted]
Black Hawk, SD 57718
July 6, 2015.

Attached find exhibits re Keystone XL

#1. Downloaded web page from State Dept for FSEIS

#2 Downloaded web page from State Dept for FEIS
Also cover page of FEIS

#3 Final Supplemental Environmental Impact Statement
Executive Summary
about 44 pages, superseded

#4 Canadian Energy Pipeline Association
Pipeline Abandonment Assumptions
Sept 2006 - April 2007
about 23 pages - I did not include Appendix which would add 60 or so more pages

over

these documents are
offered to supplement
my statement

Naman Ahuja

#1

Hildebrand July 6 2015

PROJECT INFORMATION

Project Home Page
Final SEIS
Project Documents
Administrative
Contact Information
Links

Archived Documents

Final Supplemental Environmental Impact Statement (SEIS)

Home > Final SEIS

Note: If you have trouble viewing any of the PDFs on this site, please download the latest version of Adobe Reader or reload the latest version if it is already installed on your computer.

Executive Summary

Executive Summary [3675 Kb]

Errata Sheet

Errata Sheet [4197 Kb]

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1.2 Overview of Proposed Project [238 Kb]
1.3 Purpose and Need [73 Kb]
1.4 Market Analysis [5327 Kb]
1.5 Agency Participation [231 Kb]
1.6 Tribal and SHPO Consultation [27 Kb]
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2.1 Overview of the Proposed Project [8002 Kb]
2.2 Description of Reasonable Alternatives [6679 Kb]

Volume 2: Chapter 3

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3.3 Water Resources [3963 Kb]
3.4 Wetlands [3090 Kb]
3.5 Terrestrial Vegetation [3984 Kb]
3.6 Wildlife [1613 Kb]
3.7 Fisheries [767 Kb]

3.8 Threatened and Endangered Species [1334 Kb]
3.9 Land Use, Recreation, and Visual Resources [742 Kb]
3.10 Socioeconomics [4215 Kb]
3.11 Cultural Resources [1090 Kb]
3.12 Air Quality and Noise [651 Kb]
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4.6 Wildlife [414 Kb]
4.7 Fisheries [402 Kb]
4.8 Threatened and Endangered Species [1017 Kb]
4.9 Land Use, Recreation, and Visual Resources [878 Kb]
4.10 Socioeconomics [2236 Kb]
4.11 Cultural Resources [477 Kb]
4.12 Air Quality and Noise [1474 Kb]
4.13 Potential Releases [2016 Kb]
4.14 Greenhouse Gases and Climate Change [2528 Kb]
4.15 Cumulative Effects Assessment and Extraterritorial Concerns [5503 Kb]
4.16 Summary of Impacts [217 Kb]

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Volume VI Comments and Responses Part 2 [4979 Kb]

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#2

H.C.D. July 6 2015

PROJECT INFORMATION

Final Environmental Impact Statement (FEIS)

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Archived Documents

FEIS - Errata Sheet [259 Kb]
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United States Department of State
Final Environmental Impact Statement

For the

KEYSTONE XL PROJECT

Applicant for Presidential Permit:
TransCanada Keystone Pipeline, LP

Alexander Yuan, NEPA Contact & Project Manager
United States Department of State
Bureau of Oceans and International Environmental
and Scientific Affairs, Room 2657
Washington, DC 20520

Cooperating Agencies

U.S. Army Corps of Engineers (USACE)
U.S. Department of Agriculture – Farm Service Agency (FSA)
U.S. Department of Agriculture – Natural Resource Conservation Service (NRCS)
U.S. Department of Agriculture – Rural Utilities Service (RUS)
U.S. Department of Energy – Office of Policy and International Affairs (PI)
U.S. Department of Energy – Western Area Power Administration (Western)
U.S. Department of Interior – Bureau of Land Management (BLM)
U.S. Department of Interior – National Park Service (NPS)
U.S. Department of Interior – U.S. Fish and Wildlife Service (USFWS)
U.S. Department of Transportation – Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (PHMSA)
U.S. Environmental Protection Agency (EPA)
Montana Department of Environmental Quality (MDEQ)

Assisting Agencies

U.S. Department of Interior – Bureau of Reclamation (Reclamation)
Filmore, Greeley, Holt, Merrick, Nance, Saline, and Wheeler counties, Nebraska
Lower Big Blue Natural Resources and Upper Elkhorn Natural Resources districts, Nebraska

August 26, 2011

United States Department of State
Bureau of Oceans and International
Environmental and Scientific Affairs

#3

1 of 2
H.18.14

Final Supplemental Environmental Impact Statement

for the

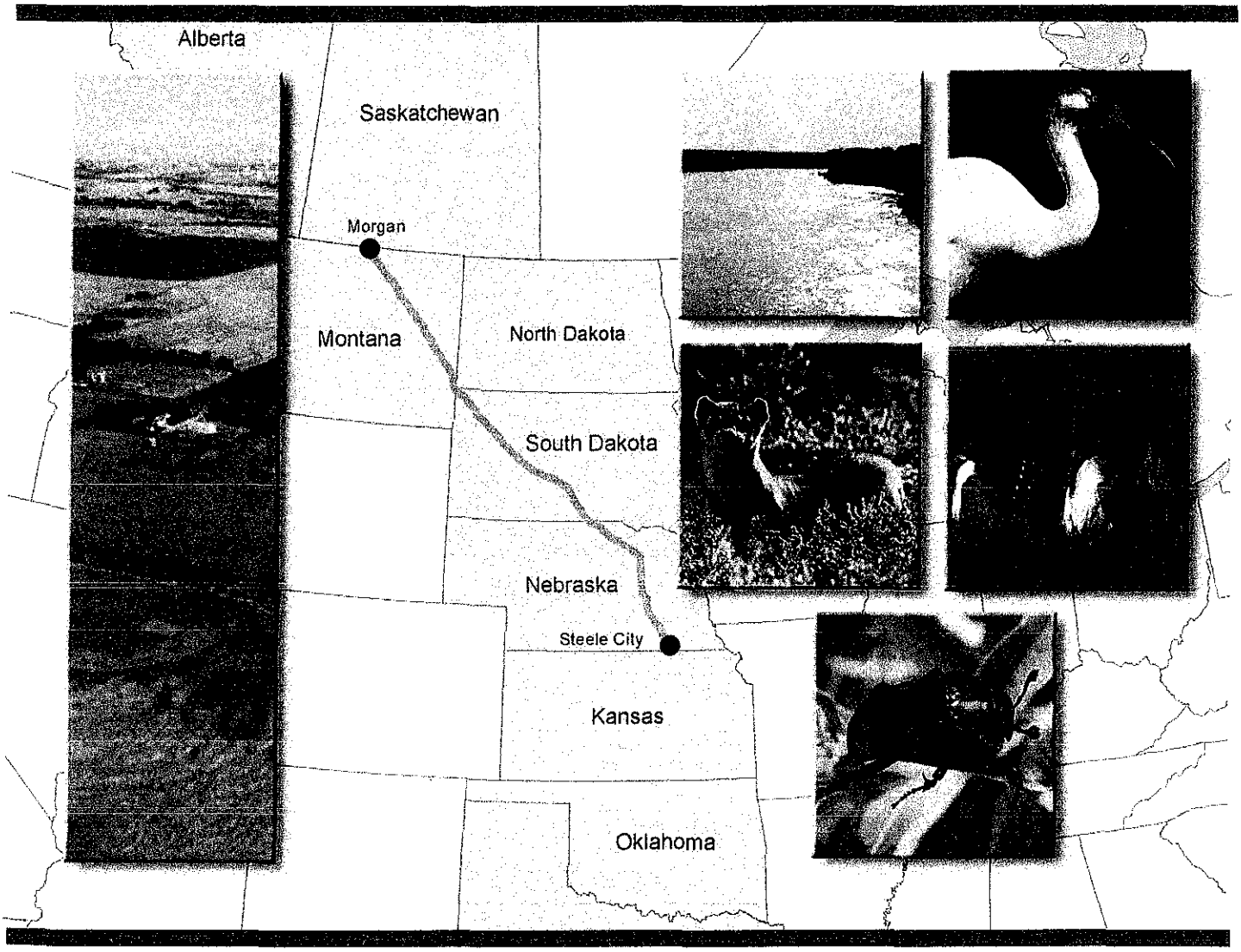
Keystone XL Project

Executive Summary

see page ES-3

January 2014

Applicant for Presidential Permit: TransCanada Keystone Pipeline, LP



Front cover photo sources in order of appearance top to bottom:

Whooping crane
Hagerty, Ryan. 2012. *Endangered Whooping Crane (Grus Americana).* Photograph. U.S. Fish and Wildlife Service. 23 February 2012. Website: http://www.flickr.com/photos/usfwshq/6777481034/.

Black-footed ferret
U.S. Fish & Wildlife Service. 2012. *Black-footed ferret.* Photograph. USFWS Headquarters. 3 July 2012. Website: http://www.flickr.com/photos/usfwshq/7013874797/in/photolist-9Z7MXd-bFMWBP-bsoAvk-9DoXKC-bZh2uu/.

Sage grouse
Rush, Kenneth. No Date. *Male Greater Sage Grouse Strutting at Hat Six Lek near Casper, Wyoming.* Photograph. Shutterstock, Image ID: 52631191. Website: http://www.shutterstock.com/pic-52631191/stock-photo-male-greater-sage-grouse-strutting-at-hat-six-lek-near-casper-wyoming.html.

American burying beetle
Backlund, Doug. No date. *Untitled [American Burying Beetle].* Photograph. U.S Fish & Wildlife Service – South Dakota Field Office. Website: http://www.fws.gov/southdakotafieldoffice/BEETLE.HTM.

United States Department of State
Final Supplemental Environmental Impact Statement

For the

KEYSTONE XL PROJECT

Applicant for Presidential Permit:
TransCanada Keystone Pipeline, LP

Executive Summary

Genevieve Walker
Project Manager
United States Department of State
Bureau of Oceans and International Environmental and Scientific Affairs
2201 C Street NW, Room 2726
Washington, DC 20520

Cooperating Agencies

U.S. Army Corps of Engineers (USACE)
U.S. Department of Agriculture—Farm Service Agency (FSA)
U.S. Department of Agriculture—Natural Resource Conservation Service (NRCS)
U.S. Department of Agriculture—Rural Utilities Service (RUS)
U.S. Department of Energy (DOE)
U.S. Department of Interior—Bureau of Land Management (BLM)
U.S. Department of Interior—National Park Service (NPS)
U.S. Department of Interior—U.S. Fish and Wildlife Service (USFWS)
U.S. Department of Transportation—Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (PHMSA)
U.S. Environmental Protection Agency (USEPA)

Assisting Agencies

U.S. Department of the Interior, Bureau of Reclamation (BOR)
Nebraska Department of Environmental Quality (NDEQ)
Various State and Local Agencies in Montana, South Dakota, Nebraska, and Kansas

January 2014

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2.0 Description of the Proposed Project and Alternatives

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3.0 Affected Environment

Volume III

4.0 Environmental Consequences

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6.0 List of Preparers
7.0 Distribution List—Final Supplemental EIS or Executive Summary
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ES.1.0 OVERVIEW OF REVIEW PROCESS

The Keystone XL Pipeline (the proposed Project) is a proposed 875-mile pipeline project that would extend from Morgan, Montana, to Steele City, Nebraska. The pipeline would allow delivery of up to 830,000 barrels per day (bpd) of crude oil from the Western Canadian Sedimentary Basin (WCSB) in Canada and the Bakken Shale Formation in the United States to Steele City, Nebraska, for onward delivery to refineries in the Gulf Coast area (see Figure ES-1). TransCanada Keystone Pipeline, LP (Keystone) has applied for a Presidential Permit that, if granted, would authorize the proposed pipeline to cross the United States-Canadian border at Morgan, Montana.

The proposed route differs from the route analyzed in the 2011 Final Environmental Impact Statement (2011 Final EIS) in that it would avoid the environmentally sensitive Nebraska Department of Environmental Quality (NDEQ)-identified Sand Hills Region and no longer includes a southern segment from Cushing, Oklahoma, to the Gulf Coast area.

The U.S. Department of State (the Department) prepared this Final Supplemental Environmental Impact Statement (the Supplemental EIS) to assess the potential impacts associated with the proposed Project and its alternatives. The Supplemental EIS takes into consideration over 400,000 comments received during the scoping period and 1.5 million comments received on the Draft Supplemental EIS issued in March 2013. Notable changes since the Draft Supplemental EIS include:

- Expanded analysis of potential oil releases;
- Expanded climate change analysis;
- Updated oil market analysis incorporating new economic modeling; and
- Expanded analysis of rail transport as part of the No Action Alternative scenarios.

ES.1.1 Presidential Permit Process

For proposed petroleum pipelines that cross international borders of the United States, the President, through Executive Order (EO) 13337, directs the Secretary of State to decide whether a project serves the national interest before granting a Presidential Permit.

To make this decision (i.e., the National Interest Determination), the Secretary of State, through the Department, considers many factors, including energy security; environmental, cultural, and economic impacts; foreign policy; and compliance with relevant state and federal regulations. This Supplemental EIS was produced consistent with the National Environmental Policy Act (NEPA) and will help inform that determination. Before making such a decision, the Department also asks for the views of eight federal agencies identified in EO 13337: the Departments of Energy, Defense, Transportation, Homeland Security, Justice, Interior, and Commerce, as well as the U.S. Environmental Protection Agency (USEPA).

If the proposed Project is determined to serve the national interest, it will be granted a Presidential Permit that authorizes the construction, connection, operation, and maintenance of the facilities at the border between the United States and Canada. The applicant would be required to abide by certain conditions listed in this Supplemental EIS and the Presidential Permit. The Department's primary role is to make a National Interest Determination. Its jurisdiction does not include selection of specific pipeline routes within the United States.

In addition, the Department acts consistent with the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA) as part of its comprehensive NEPA consistent review.

ES.1.2 Background

Keystone's first application for the Keystone XL pipeline was submitted on September 19, 2008, and a Final EIS was published on August 26, 2011. The route proposed included the same U.S.-Canada border crossing as the currently proposed Project but a different pipeline route in the United States. The 2011 Final EIS route traversed a substantial portion of the Sand Hills Region of Nebraska, as identified by the NDEQ. Moreover, the 2011 Final EIS route went from Montana to Steele City, Nebraska, and then from Cushing, Oklahoma, to the Gulf Coast area.

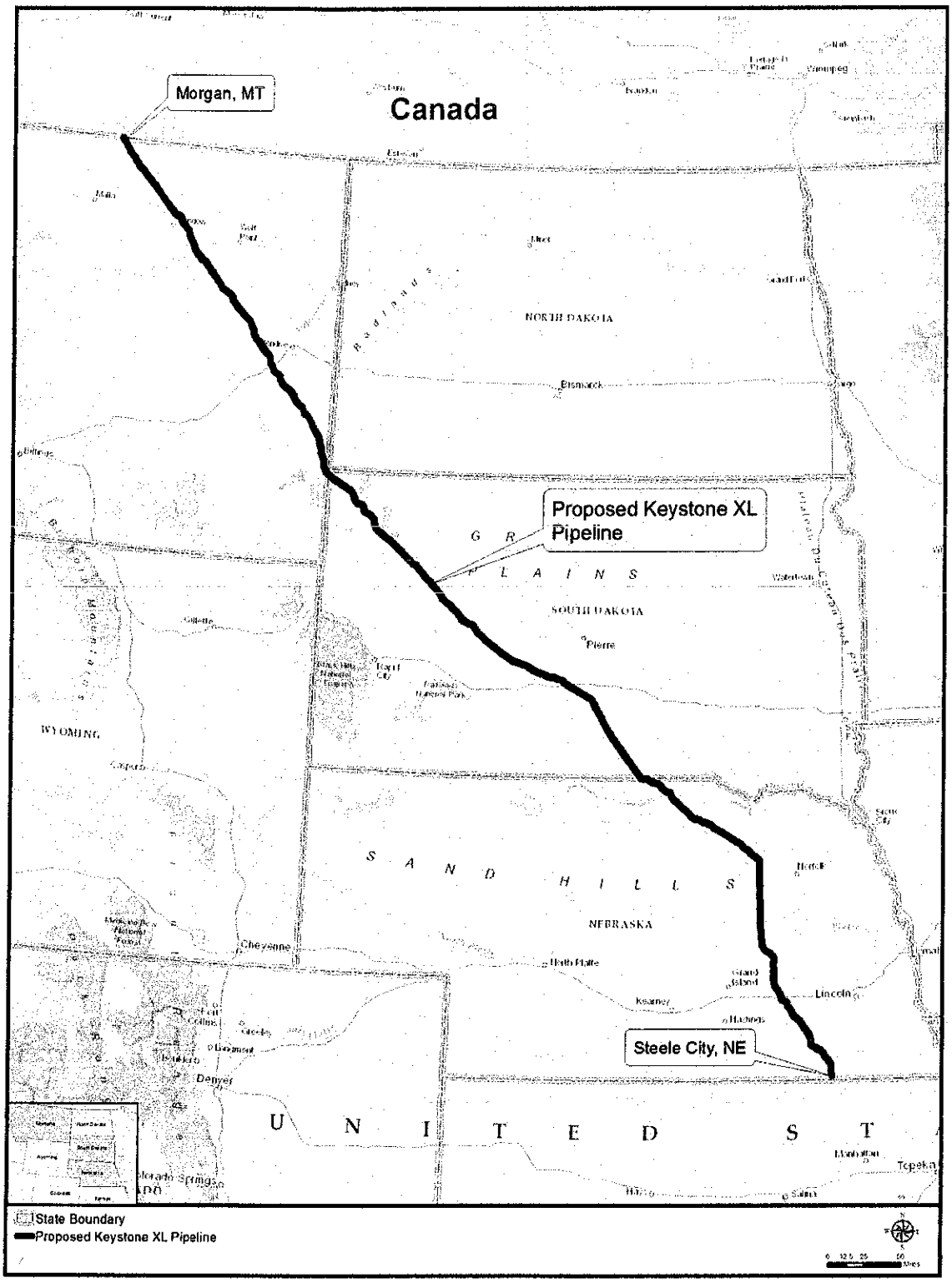


Figure ES-1 Proposed Keystone XL Project Route

In November 2011, the Department determined that additional information was needed to fully evaluate the application—in particular, information about alternative routes within Nebraska that would avoid the NDEQ-identified Sand Hills Region. In late December 2011, Congress adopted a provision of the Temporary Payroll Tax Cut Continuation Act that sought to require the President to make a decision on the Presidential Permit for the 2011 Final EIS route within 60 days. That deadline did not allow sufficient time to prepare a rigorous, transparent, and objective review of an alternative route through Nebraska. As such, the Presidential Permit was denied.

In February 2012, Keystone informed the Department that it considered the Gulf Coast portion of the originally proposed pipeline project (from Cushing, Oklahoma, to the Gulf Coast area) to have independent economic utility, and indicated that it intended to proceed with construction of that pipeline as a separate project, the Gulf Coast Project (see Figure ES-2). The Gulf Coast Project did not require a Presidential Permit because it does not cross an international border. Construction on the Gulf Coast Project was recently completed.

On May 4, 2012, Keystone filed a new Presidential Permit application for the Keystone XL Project. The proposed Project has a new route and a new stated purpose and need. The new proposed route differs from the 2011 Final EIS Route in two significant ways: 1) it would avoid the environmentally sensitive NDEQ-identified Sand Hills Region and 2) it would terminate at Steele City, Nebraska. From Steele City, existing pipelines would transport the crude oil to the Gulf Coast area. In other words, the proposed Project no longer includes a southern segment and instead runs from Montana to Steele City, Nebraska.

In addition to the NDEQ-identified Sand Hills Region, the proposed Project route would avoid other areas in Nebraska (including portions of Keya Paha County) that have been identified by the NDEQ as having soil and topographic characteristics similar to the Sand Hills Region. The proposed Project route would also avoid or move further away from water wellhead protection areas for the villages of Clarks and Western, Nebraska. Figure ES-3 compares the 2011 Final EIS route and the proposed Project route.

The proposed route in Montana and South Dakota is largely unchanged from the route analyzed in the 2011 Final EIS except for minor modifications that Keystone made to improve constructability and in response to landowner requests (see Figure ES-3).

The Department, after discussions with the USEPA and the Council on Environmental Quality (CEQ), determined consistent with NEPA that issuance of the new Presidential Permit would constitute a major federal action that may have significant environmental impact, and that it would prepare a supplement to the 2011 Final EIS for the new application. This Supplemental EIS provides a thorough analysis of the environmental impacts from the proposed Project; it has been revised, expanded, and updated to include a comprehensive review of the new route in Nebraska as well as any significant new circumstances or information that is now available and relevant to the overall proposed Project.

To assist in preparing this Supplemental EIS, the Department retained an environmental consulting firm, Environmental Resources Management (ERM). ERM was selected pursuant to the Department's interim guidance on the selection of independent third-party contractors. This guidance is designed to ensure that no conflicts of interest exist between the contractor and the applicant and that any perceived conflicts that would impair the public's confidence in the integrity of the work are mitigated or removed. ERM works at the sole and exclusive instruction of the Department and is not permitted to communicate with Keystone unless specifically directed to do so by Department officials.

On June 15, 2012, through a Notice of Intent, the Department solicited public comments for consideration in establishing the scope and content of this Supplemental EIS. The scoping period extended from June 15 to July 30, 2012. In total, an estimated 406,712 letters, cards, emails, e-comments, or telephone conversation records (henceforth referred to as submissions) were received from the public, agencies, and other interested groups and stakeholders during the scoping period. In March 2013, the Department issued a Draft Supplemental EIS that included new analysis and analysis built upon the work completed in the 2011 Final EIS, as well as the estimated 406,712 submissions mentioned above that were received during the 2012 scoping process.

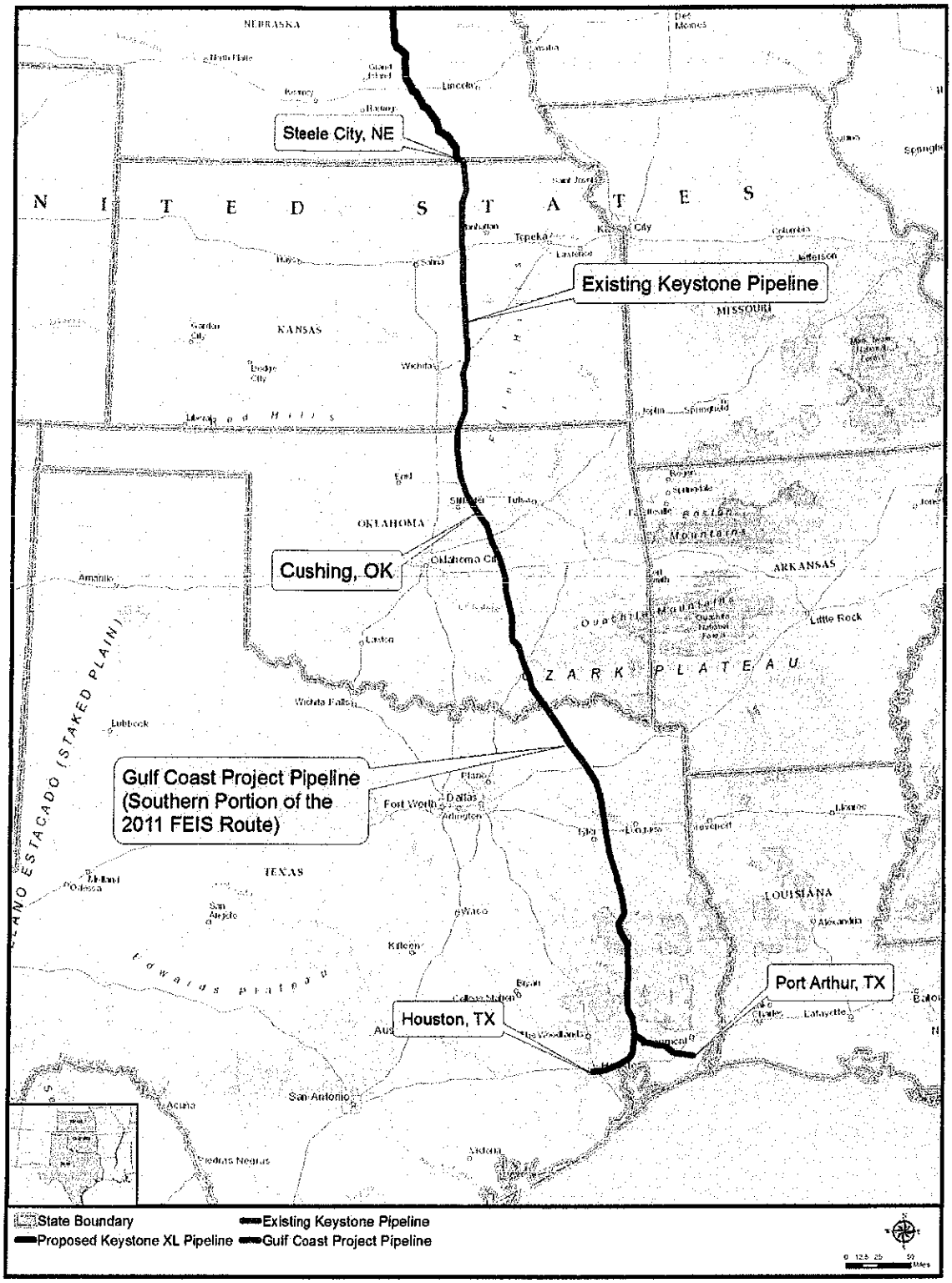
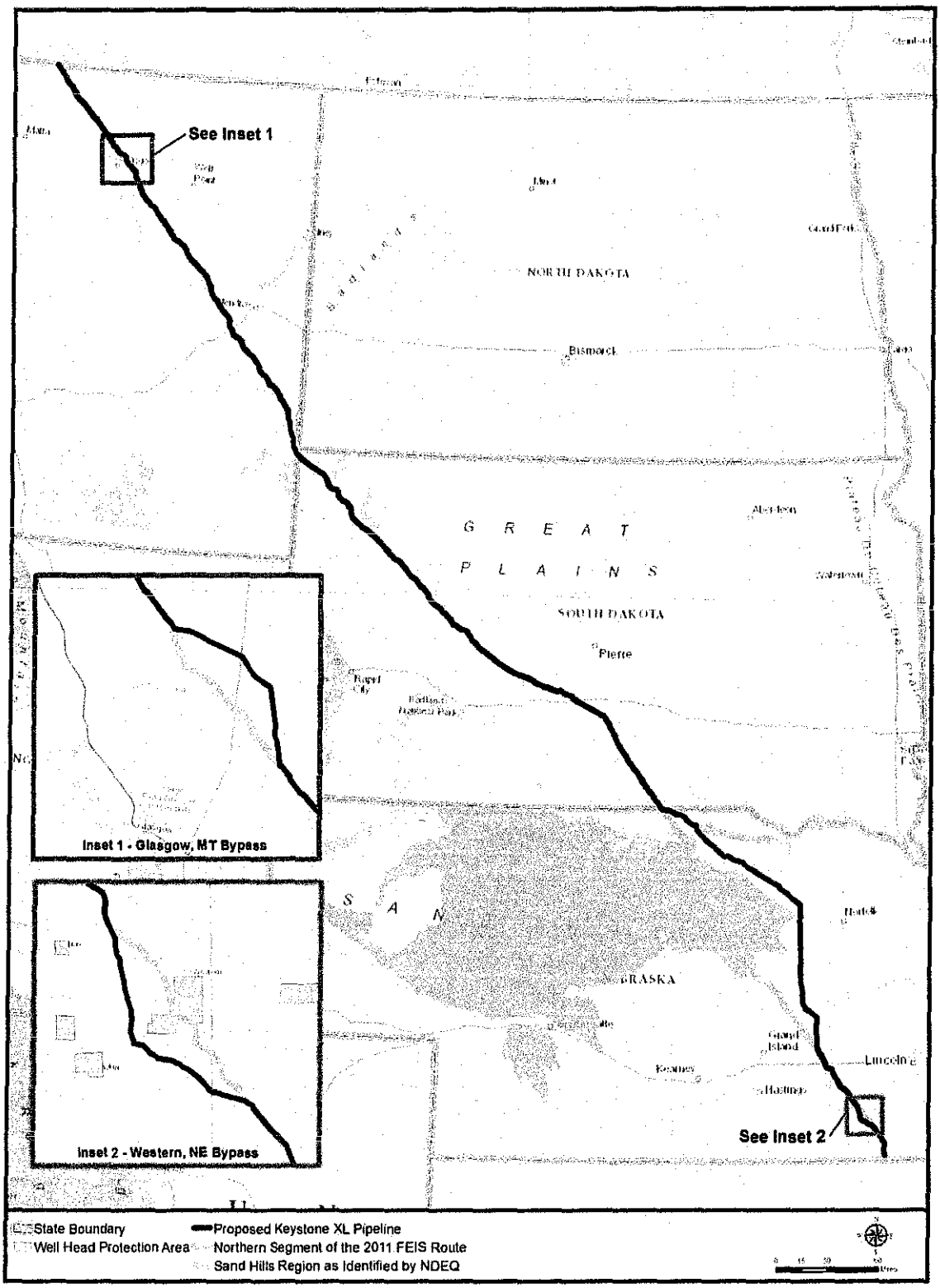


Figure ES-2 Gulf Coast Project Route



Note: The 2011 Final EIS route is also referred to in this Final Supplemental EIS as the 2011 Steele City Segment Alternative.

Figure ES-3 Comparison of Proposed Project to 2011 Final EIS Route

ES.1.3 Public Comments Received Regarding the Draft Supplemental EIS

Following publication of the 2013 Draft Supplemental EIS, the Department invited the public to comment on the document. Electronic versions were made available for download, and hard copies were made available in public libraries along the proposed pipeline route. Hard and electronic copies of the Draft Supplemental EIS were sent to interested Indian tribes, agencies, elected and appointed officials, non-governmental organizations (NGOs), and other parties. The Department also solicited input at a public meeting held on April 18, 2013 in Grand Island, Nebraska. In total, the Department received an estimated 1,513,249 submissions during the public comment period for the Draft Supplemental EIS. Submissions were made by federal, state, and local representatives, members of the public, government agencies, Indian tribes, NGOs, and other interested groups and stakeholders. Submissions made by the public on the Draft Supplemental EIS were posted on www.regulations.gov.

Of this total number of submissions, an estimated 1,496,396 submissions (99 percent of the total) were form letters sponsored by NGOs. The remaining 16,853 submissions were identified as unique submissions. All submissions were evaluated and addressed, as appropriate, in this Supplemental EIS. Some of the most frequent comment topics included:

- Concerns that the 2013 Draft Supplemental EIS did not adequately address the greenhouse gas (GHG) and climate change effects of the extraction, processing, and use of the crude oil that the proposed Project would carry;
- Concerns that potential releases from the proposed Project (i.e., spills) could pollute major groundwater resources such as the Ogallala Aquifer;
- Concerns that the 2013 Draft Supplemental EIS did not adequately address the impacts of bitumen extraction in Canada;
- Concerns about the contractor and subcontractor selection process for preparing this Supplemental EIS;
- Concerns that the crude oil transportation market was not adequately analyzed;
- Suggestions that the existing Keystone Pipeline right-of-way (ROW) be considered in lieu of the currently proposed pipeline route; and
- Questions about the accuracy of job creation estimates for construction and operation of the proposed Project, as well as the types, locations, and hiring preferences of those jobs.

ES.1.4 About the Final Supplemental EIS

This Supplemental EIS for the proposed Keystone XL pipeline project builds on the analysis provided in the 2011 Final EIS and the 2013 Draft Supplemental EIS and is now available for download by the public. Moreover, this Supplemental EIS has been distributed to participating federal and state agencies, elected officials, media organizations, Indian tribes, private landowners, and other interested parties. Printed copies have also been distributed to public libraries along the proposed pipeline route.

In completing this Supplemental EIS, the Department took into consideration the over 1.5 million submissions received. In response to these comments, the Department has revised the text from the 2013 Draft Supplemental EIS for the proposed Project. This Final Supplemental EIS includes the latest available information on the proposed Project resulting from ongoing discussions with federal, state, and local agencies. It also describes updated analysis of the potential effects (including direct, indirect, and cumulative effects) of the proposed Project and alternatives on various resources. The analysis reflects inputs from other U.S. government agencies and was reviewed through an interagency process.

ES.2.0 OVERVIEW OF PROPOSED PROJECT

ES.2.1 Proposed Project Purpose and Need

According to the application submitted by Keystone, the primary purpose of the proposed Project is to provide the infrastructure to transport crude oil from the border with Canada to delivery points in the United States (primarily to the Gulf Coast area) by connecting to existing pipeline facilities near Steele City, Nebraska. The proposed Project is meant to respond to the market demand of refineries for crude oil of the kind found in Western Canada (often called *heavy* crude oil). The proposed Project would also provide transportation for the kind of crude oil found within the Bakken formation of North Dakota and Montana (often called *light* crude oil).

The proposed Project would have the capacity to deliver up to 830,000 bpd, of which 730,000 bpd of capacity has been set aside for WCSB crude oil and the remaining 100,000 bpd of capacity set aside for Williston Basin (Bakken) crude oil. Keystone has

represented that it has firm commitments to transport approximately 555,000 bpd of heavy crude oil from producers in the WCSB, as well as 65,000 bpd of crude oil from the Bakken. The ultimate mixture and quantity of crude oils transported by the proposed Project over its lifetime would be determined by market demand.

There is existing demand for crude oil—particularly heavy crude oil—at refiners in the Gulf Coast area, but the ultimate disposition of crude oil that would be transported by the proposed Project, as well as any refined products produced from that crude oil, would also be determined by market demand and applicable law.

ES.2.2 Proposed Project Description

The proposed Project would consist of approximately 875 miles of new 36-inch-diameter pipeline and related facilities for transport of WCSB and Bakken crude oil, the latter from an oil terminal near Baker, Montana. Crude oil carried in the proposed Project would be delivered to existing pipeline facilities near Steele City, Nebraska, for onward delivery to refineries in the Gulf Coast area. The proposed Project would also include two pump stations (one new and one expanded) along the existing Keystone Pipeline in Kansas (see Figure ES-5).

Construction of the proposed Project would include the pipeline itself plus various aboveground ancillary facilities (e.g., access roads, pump stations, and construction camps) and connected actions. Figure ES-4 illustrates the construction sequence that would be followed for the proposed Project.

Construction of the proposed Project would generally require a 110-foot-wide temporary ROW and is expected to last 1 to 2 years. After construction, the proposed Project would generally maintain a 50-foot-wide permanent ROW easement over the pipeline in Montana (approximately 285 miles), South Dakota (approximately 316 miles), and Nebraska (approximately 274 miles).

Keystone would have access to property within the easement, but property owners would retain the ability to farm and conduct other limited activities within the easement. The permanent aboveground ancillary facilities would include electrically operated pump stations, mainline valves, and permanent access roads.

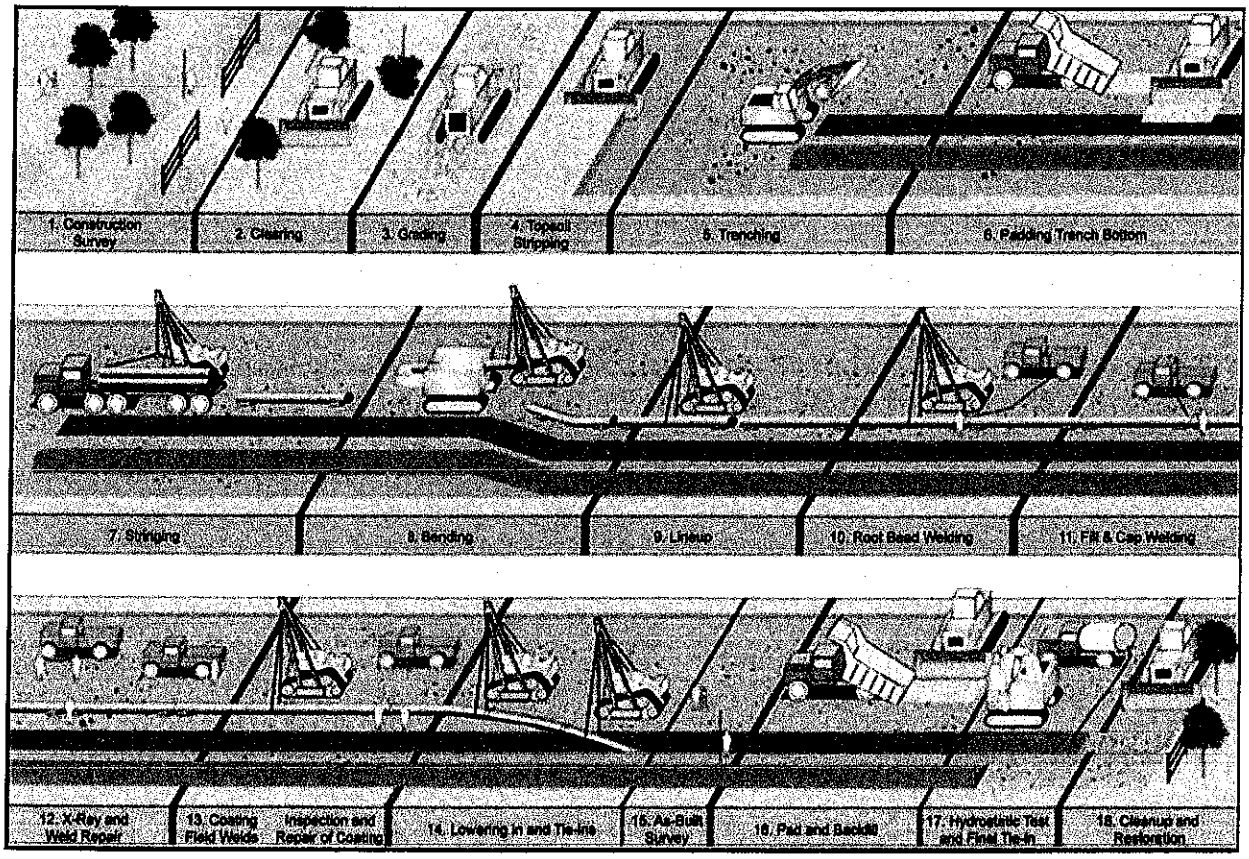


Figure ES-4 Keystone XL, Typical Pipeline Construction Sequence

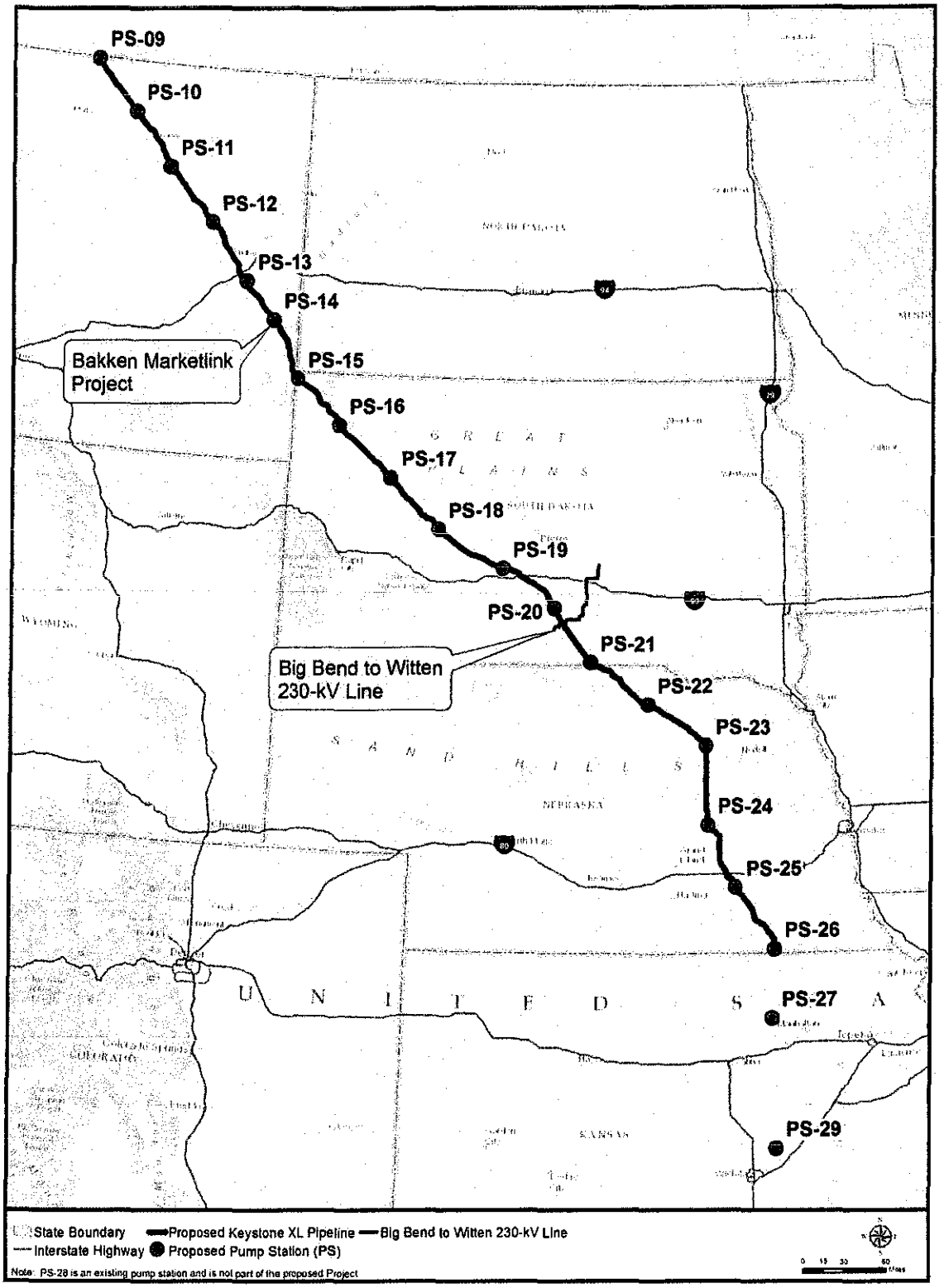


Figure ES-5 Proposed Project Overview

The U.S. portion of the proposed Project is estimated to cost approximately $3.3 billion, and would be paid for by Keystone. If permitted, the pipeline would begin operation approximately 2 years after final approvals were received, with the actual in-service date dependent on construction as well as obtaining any additional permits, approvals, and authorizations necessary before operations can commence.

ES.2.2.1 The Bakken Marketlink Project

Keystone Marketlink, LLC, a wholly owned subsidiary of TransCanada Pipelines Limited, would construct and operate the Bakken Marketlink Project. This project would include a 5-mile pipeline, pumps, meters, and storage tanks to supply Bakken crude oil to the proposed pipeline from the Bakken Marketlink pipeline system in North Dakota and Montana. Two crude oil storage tanks would be built near Baker, Montana, as part of this project. This project would be able to deliver up to 100,000 bpd of crude oil, and has commitments for approximately 65,000 bpd.

ES.2.2.2 Big Bend to Witten 230-kV Electrical Transmission Line

The Western Area Power Administration (Western) has determined that providing reliable electricity for operation of the proposed Project requires the construction of a new 230-kilovolt (kV) transmission line originating at the Fort Thompson/Big Bend Dam area in South Dakota and extending south to the existing Witten Substation, near Pump Stations 20 and 21. To meet these demands, Western would repurpose existing transmission infrastructure and construct new infrastructure between the Big Bend Dam and a proposed Big Bend Substation. The Basin Electric Power Cooperative would construct a new 76-mile, 230-kV transmission line from the Big Bend Substation to the existing Witten Substation, and would operate both the transmission line and the Big Bend Substation.

ES.2.2.3 Electrical Distribution Lines and Substations

Electrical power for the proposed Project would be obtained from local power providers. These power providers would construct the necessary substations and transformers, and would either use existing service lines or construct new service lines to deliver electrical power to the specified point of use (e.g., pump stations and mainline valves), which would be located at intervals along the proposed Project route.

ES.3.0 OVERVIEW OF PETROLEUM MARKETS

The scope and content of the market analysis in this Supplemental EIS were informed by public and interagency comments as well as new information that was not previously available. Among the notable updates to this analysis are revised modeling to incorporate evolving market conditions, more extensive information on the logistics and economics of crude by rail, and a more detailed analysis of supply costs to inform conclusions about production implications.

The updated market analysis in this Supplemental EIS—similar to the market analysis sections in the 2011 Final EIS and 2013 Draft Supplemental EIS—concludes that the proposed Project is unlikely to significantly affect the rate of extraction in oil sands areas (based on expected oil prices, oil-sands supply costs, transport costs, and supply-demand scenarios). The Department conducted this analysis, drawing on a wide variety of data and leveraging external expertise.

ES.3.1 Summary of Market Analysis

The 2011 Final EIS was developed contemporaneously with the start of strong growth in domestic light crude oil supply from so-called *tight* oil formations, such as those formations found in North Dakota's Bakken region. Domestic production of crude oil has increased significantly, from approximately 5.5 million bpd in 2010 to 6.5 million bpd in 2012 and 7.5 million bpd by mid-2013. Rising domestic crude production is predominantly light crude, and it has replaced foreign imports of light crude oil. However, demand persists for imported heavy crude by U.S. refineries that are optimized to process that kind of oil. Meanwhile, Canadian production of bitumen from the oil sands continues to grow, the vast majority of which is currently exported to the United States to be processed by U.S. refineries that want heavy crude oil. North American production growth and logistics constraints have contributed to significant discounts on the price of landlocked crude and have led to growing volumes of crude shipped by rail in the United States and, more recently, Canada.

Both the 2011 Final EIS and the Draft Supplemental EIS published in March 2013 discussed the transportation of Canadian crude by rail as a possibility. Due to market developments since then, this Supplemental EIS notes that the transportation of Canadian crude by rail is already occurring in substantial volumes. It is estimated that approximately 180,000 bpd of Canadian crude oil is already traveling by rail (see Figure ES-6).

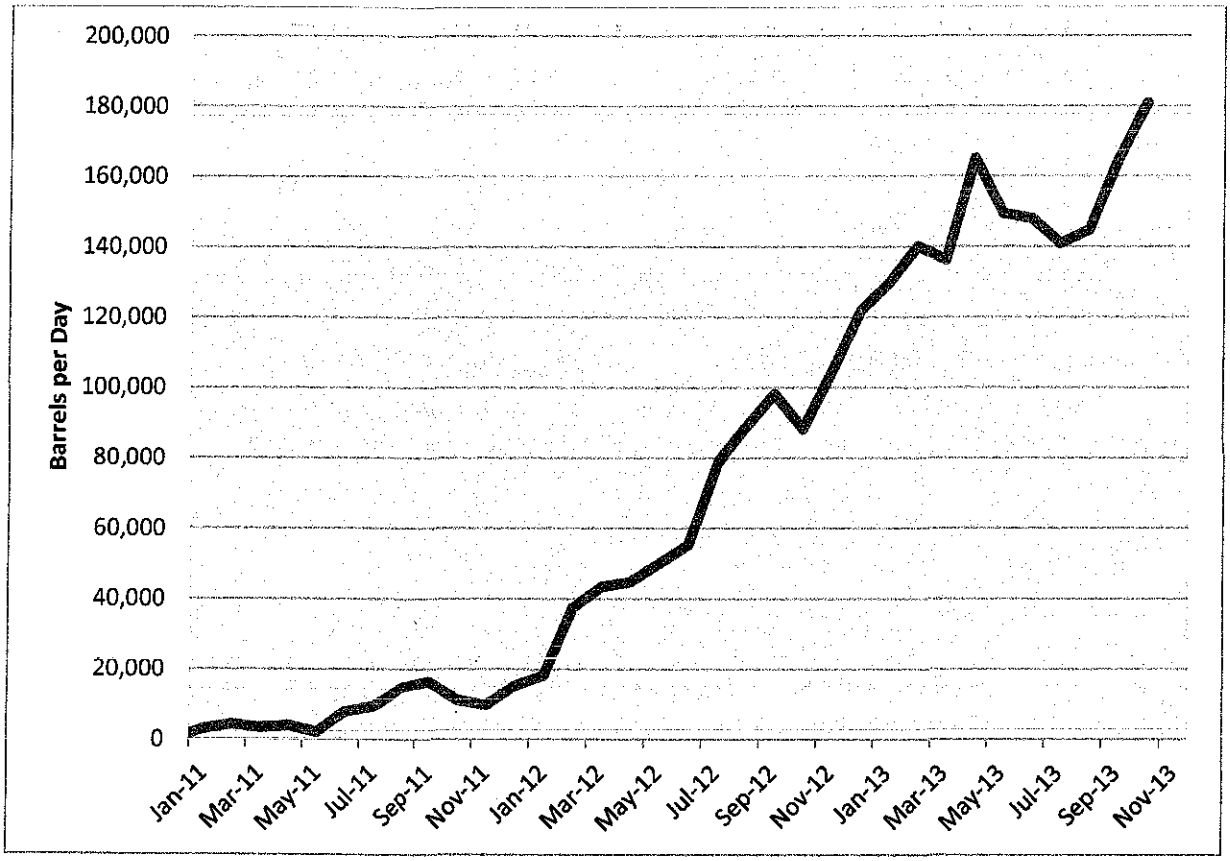
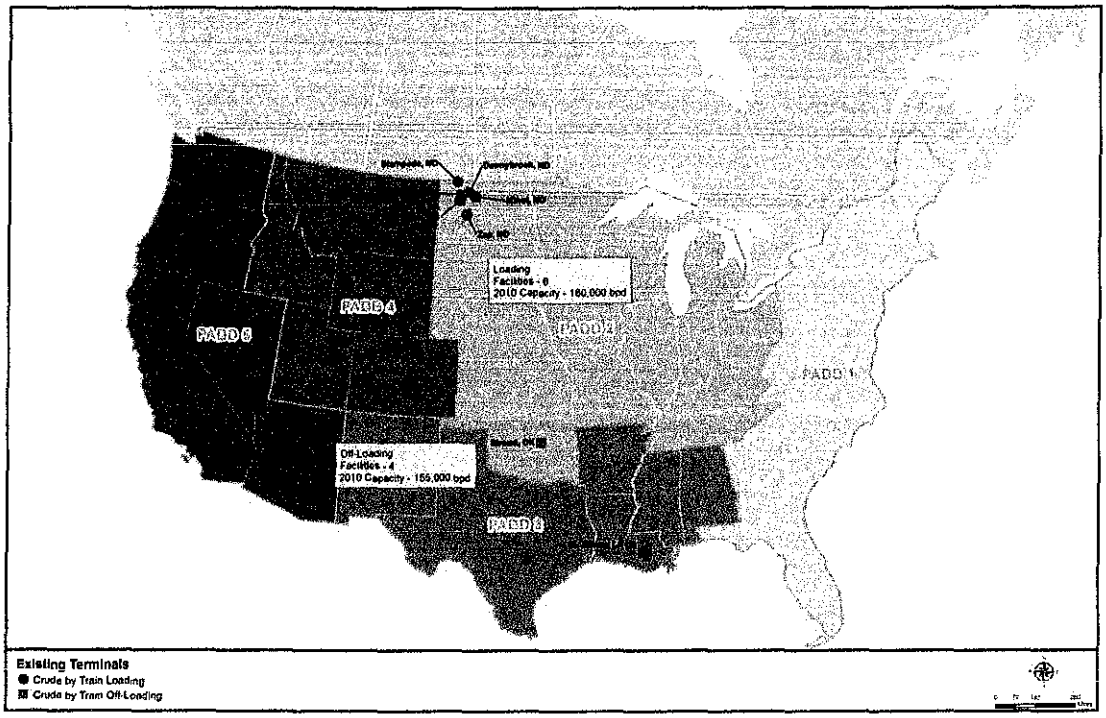


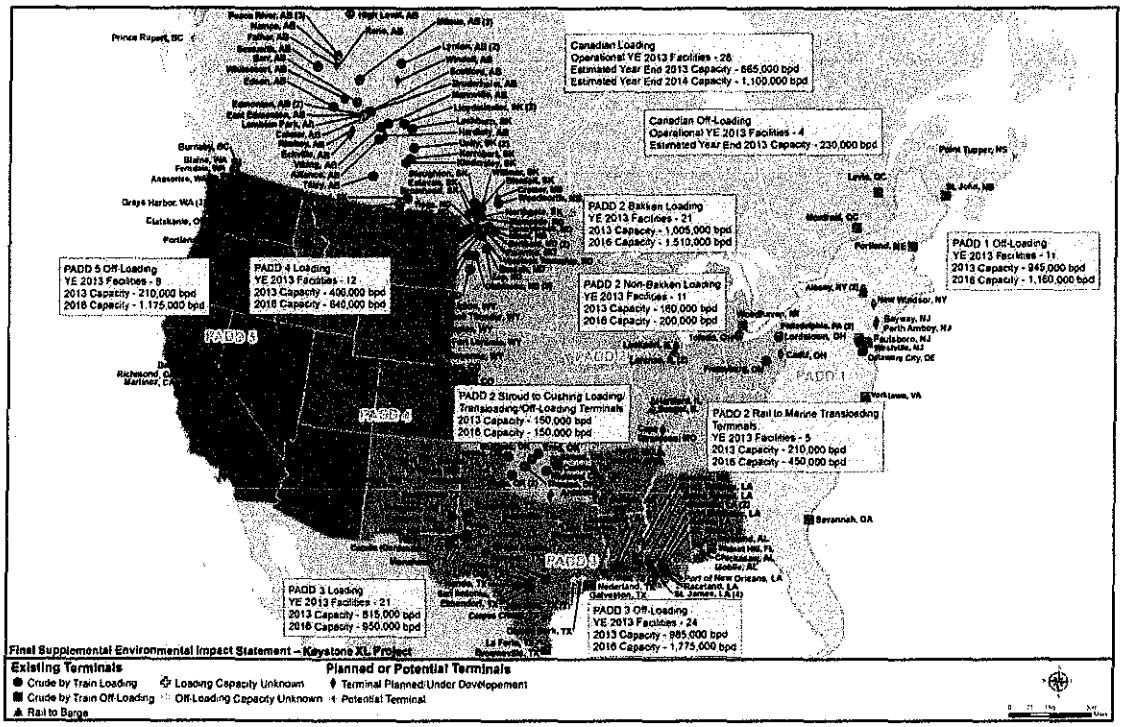
Figure ES-6 Estimated Crude Oil Transported by Rail from WCSB, bpd

The industry has been making significant investments in increasing rail transport capacity for crude oil out of the WCSB. Figure ES-7 illustrates the increase in rail loading and unloading terminals between 2010 and 2013. Rail loading facilities in the WCSB are estimated to have a capacity of approximately 700,000 bpd of crude oil, and by the end of 2014 this will likely increase to more than 1.1 million bpd. Most of this capacity (approximately 900,000 to 1 million bpd) is in areas that produce primarily heavy crude oil (both conventional and oil sands), or is being connected by pipelines to those oil production areas.

Various uncertainties underlie the projections upon which this Supplemental EIS partially relies. In recognition of the uncertainty of future market conditions, the analysis included updated modeling about the sensitivity of the market to some of these elements.

Updated information on rail transportation and oil market trends, particularly rising U.S. oil production, was incorporated in oil market modeling. This modeling was developed in response to comments received on the Draft Supplemental EIS. To help account for key uncertainties about oil production, consumption, and transportation, the modeling examined 16 different scenarios that combine various supply-demand assumptions and pipeline constraints. Modeled cases test supply and demand projections based on the official energy forecasts of independent U.S. Energy Information Administration's (EIA) 2013 Annual Energy Outlook that correspond to uncertainties raised in public comments, including potential higher-than-expected U.S. supply, lower-than-expected U.S. demand, and higher-than-expected oil production in Latin America.





Note: These estimates do not include a facility being constructed in Edmonton, Canada, with a design capacity of 250,000 bpd (100,000 bpd expected to be operational by the end of 2014) that was announced shortly before this Supplemental EIS was completed. In addition, Altex Energy has plans for a 55,000 bpd loading facility in Vermillion, Alberta.

Figure ES-7 Crude by Train Loading and Off-Loading Facilities in 2010 (top map) and 2013 (bottom map)

The supply-demand cases were paired with four pipeline configuration scenarios: an unconstrained scenario that allows pipelines to be built without restrictions; a scenario in which no new cross-border pipeline capacity to U.S. markets is permitted, but pipelines from the WSCB to Canada's east and west coasts are built; a scenario where new cross-border capacity between the United States and Canada is permitted, but Canadian authorities do not permit new east-west pipelines; and a constrained scenario that assumes no new or expanded pipelines carrying WCSB crude are built in any direction.

Updated model results indicated that cross-border pipeline constraints have a limited impact on crude flows and prices. If additional east-west pipelines were built to the Canadian coasts, such pipelines would be heavily utilized to export oil sands crude due to relatively low shipping costs to reach growing Asian markets. If new east-west and cross-border pipelines were both completely constrained, oil sands crude could reach U.S. and Canadian refineries by rail.

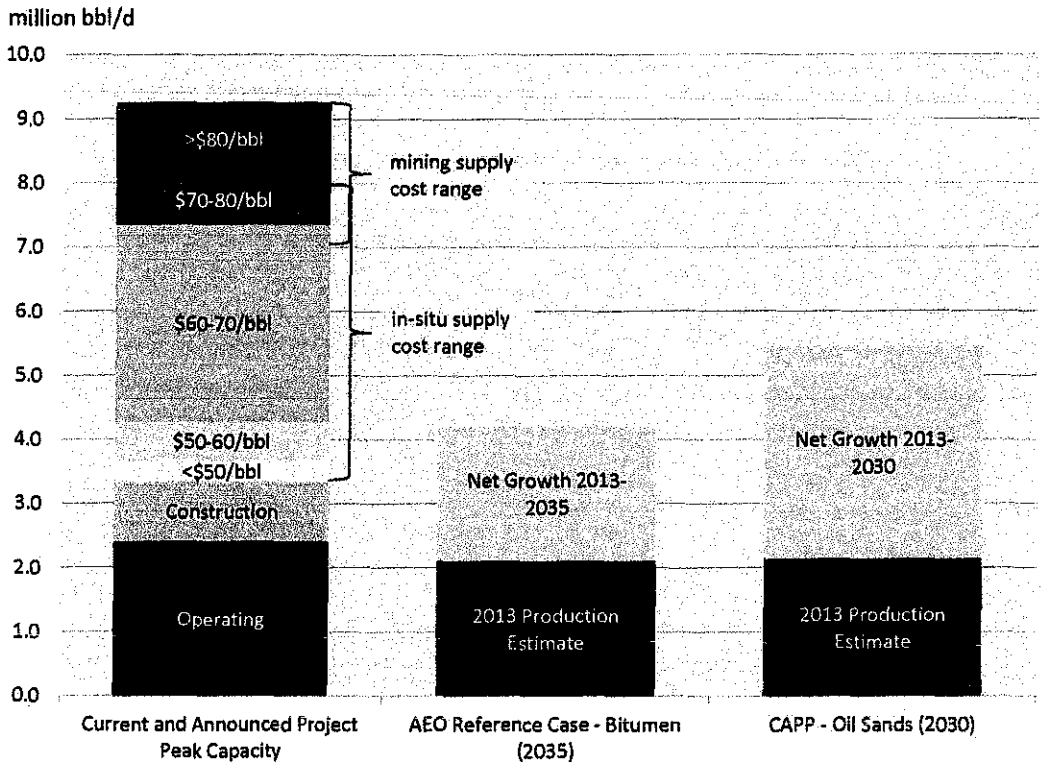
Varying pipeline availability has little impact on the prices that U.S. consumers pay for refined products such as gasoline or for heavy crude demand in the Gulf Coast. When this demand is not met by heavy Canadian supplies in the model results, it is met by heavy crude from Latin America and the Middle East.

Conclusions about the potential effects of pipeline constraints on production levels were informed by comparing modeled oil prices to the prices that would be required to support expected levels of oil sands capacity growth. Figure ES-8 illustrates existing oil sands capacity, the estimated supply costs of announced capacity, and the capacity growth that will be required to meet EIA and Canadian Association of Petroleum Producers production projections. Projected prices generally exceed supply costs for the projects responsible for future oil sands production growth. Modeling results indicate that severe pipeline constraints reduce the prices received by bitumen producers by up to $8/bbl, but not enough to curtail most oil sands growth plans or to shut-in existing production (based on expected oil prices, oil-sands supply costs, transport costs, and supply-demand scenarios). These conclusions are based on conservative assumptions about rail costs, which likely overstate the cost penalty producers pay for shipping by rail if more economic methods currently under consideration to ship bitumen by rail are utilized.

Several analysts and financial institutions have stated that denying the proposed Project would have significant impacts on oil sands production. To the extent that other assessments appear to differ from the analysis in this report, they typically do so because they have different focuses, near-term time scales, or production expectations, and/or include less detailed data and analysis about rail than this report. While short-term physical transportation constraints introduce uncertainty to industry outlooks over the next decade, new data and analysis in Section 1.4, Market Analysis, indicate that rail will likely be able to accommodate new production if new pipelines are delayed or not constructed.

Over the long term, lower-than-expected oil prices could affect the outlook for oil sands production, and in certain scenarios higher transportation costs resulting from pipeline constraints could exacerbate the impacts of low prices. The primary assumptions required to create conditions under which production growth would slow due to transportation constraints include: 1) that prices persist below current or most projected levels in the long run; and 2) that all new and expanded Canadian and cross-border pipeline capacity, beyond just the proposed Project, is not constructed.

Above approximately $75 per barrel for West Texas Intermediate (WTI)-equivalent oil, revenues to oil sands producers are likely to remain above the long-run supply costs of most projects responsible for expected levels of oil sands production growth. Transport penalties could reduce the returns to producers and, as with any increase in supply costs, potentially affect investment decisions about individual projects on the margins. However, at these prices, enough relatively low-cost *in situ* projects are under development that baseline production projections would likely be met even with constraints on new pipeline capacity. Oil sands production is expected to be most sensitive to increased transport costs in a range of prices around $65 to $75 per barrel. Assuming prices fell in this range, higher transportation costs could have a substantial impact on oil sands production levels—possibly in excess of the capacity of the proposed Project—because many *in situ* projects are estimated to break even around these levels. Prices below this range would challenge the supply costs of many projects, regardless of pipeline constraints, but higher transport costs could further curtail production.



Note: The green shaded areas in the *Current and Announced Project Peak Capacity* represent the capacity of projects that are operating or already under construction, which are expected to continue producing and/or remain under development as long as oil prices are above operating costs. The purple shaded areas represent the capacity of potential projects that would likely only go forward with oil prices above the stated ranges.

Figure ES-8 Oil Sands Supply Costs (West Texas Intermediate-Equivalent Dollars per Barrel), Project Capacity, and Production Projections

Oil prices are volatile, particularly over the short-term. In addition, long-term trends, which drive investment decisions, are difficult to predict. Specific supply cost thresholds, Canadian production growth forecasts, and the amount of new capacity needed to meet them are uncertain. As a result, the price threshold above which pipeline constraints are likely to have a limited impact on future production levels could change if supply costs or production expectations prove different than estimated in this analysis.

The dominant drivers of oil sands development are more global than any single infrastructure project. Oil sands production and investment could slow or accelerate depending on oil price trends, regulations, and technological developments, but the potential effects of those factors on the industry's rate of expansion should not be conflated with the more limited effects of individual pipelines.

ES.4.0 ENVIRONMENTAL ANALYSIS OF THE PROPOSED PROJECT

The Department evaluated the potential construction and operational impacts of the proposed Project and alternatives across a wide range of environmental resources. The analysis discusses public and agency interests and concerns as reflected in the submissions received during the scoping period and on the 2013 Draft Supplemental EIS, and includes:

- Climate change, including lifecycle (well-to-wheels [WTW]) GHG emissions associated with oil sands development, refining, and consumption;
- Potential releases or spills of oil;
- Socioeconomics, including the potential job and revenue benefits of the proposed Project, as well as concerns about environmental justice;
- Water resources, including potential effects on groundwater aquifers (e.g., Ogallala Aquifer) and surface waters;
- Wetlands;
- Threatened and endangered species;
- Potential effects on geology, soils, other biological resources (e.g., vegetation, fish, and wildlife), air quality, noise, land use, recreation, and visual resources; and
- Cultural resources, including tribal consultation.

ES.4.1 Climate Change

Changes to the Earth's climate have been observed over the past century with a global temperature increase of 1.5 degrees Fahrenheit between 1880 and 2012. This warming has coincided with increased levels of GHGs in the atmosphere. In order for the Earth's heat and energy to remain at a steady state, the solar energy that is incoming must equal the energy that is radiated into space (see Figure ES-9). GHGs contribute to trapping outbound radiation within the troposphere (the layer of the atmosphere closest to the Earth's surface), and this is called the greenhouse effect.

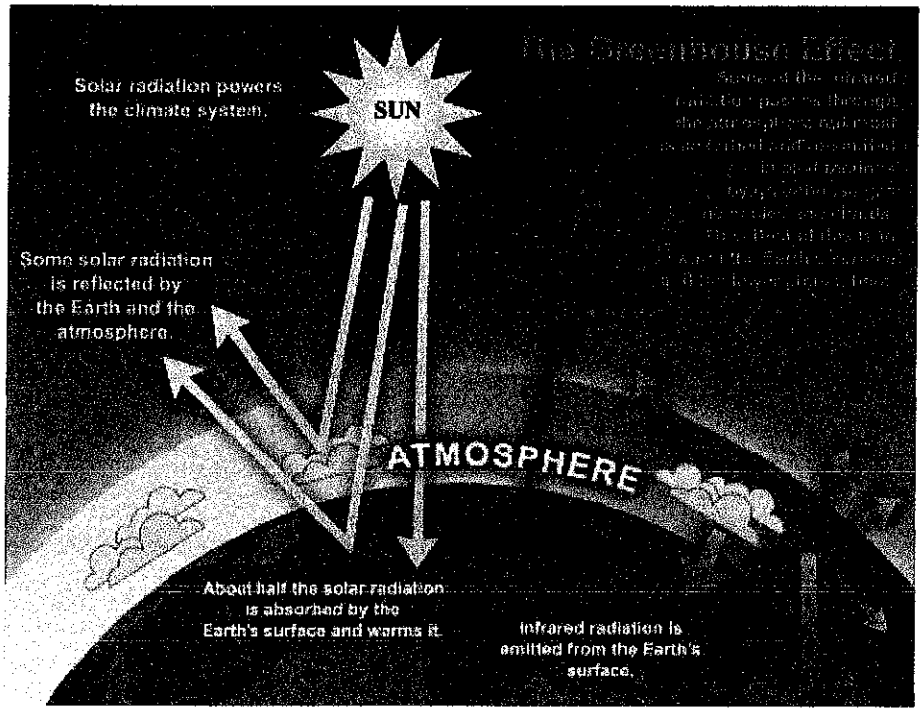


Figure ES-9 The Greenhouse Effect

Since the beginning of the Industrial Revolution, the rate and amount of GHGs have increased as a result of human activity. The additional GHGs intensify the greenhouse effect, resulting in a greater amount of heat being trapped within the atmosphere. The Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries around the world, in its Fifth Assessment Report concludes that global warming in the climate system is unequivocal based on measured increases in temperature, decrease in snow cover, and higher sea levels.

This Supplemental EIS evaluates the relationship between the proposed Project with respect to GHG emissions and climate change from the following perspectives:

- The GHG emissions associated with the construction and operation of the proposed Project and its connected actions;
- The potential increase in indirect lifecycle (wells-to-wheels) GHG emissions associated with the WCSB crude oil that would be transported by the proposed Project;
- How the GHG emissions associated with the proposed Project cumulatively contribute to climate change; and
- An assessment of the effects that future projected climate change could have in the proposed Project area and on the proposed Project.

ES.4.1.1 Greenhouse Gas Emissions from the Proposed Project

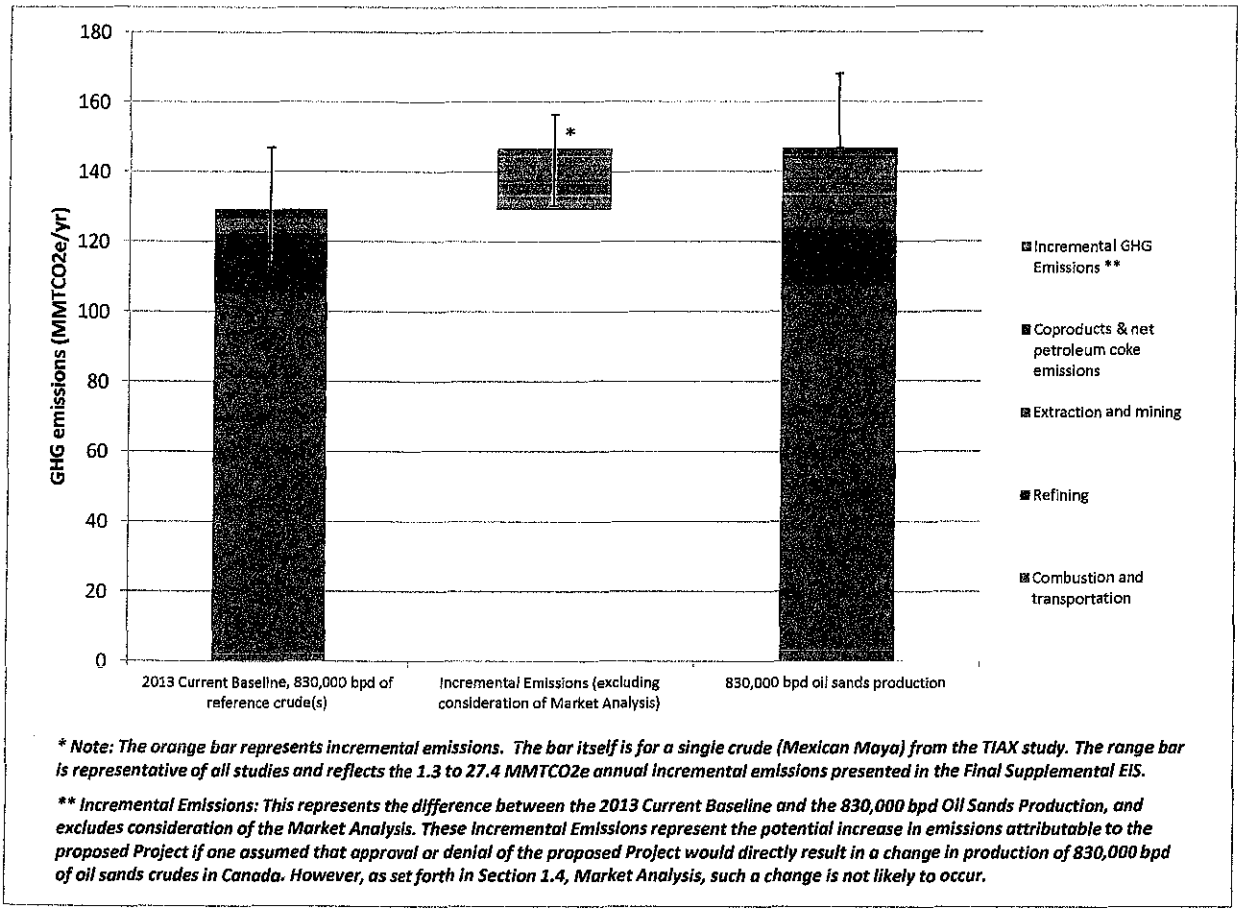
The proposed Project would emit approximately 0.24 million metric tons of carbon dioxide (CO_2) equivalents ($MMTCO_2e$) per year during the construction period. These emissions would be emitted directly through fuel use in construction vehicles and equipment, as well as, land clearing activities including open burning, and indirectly from electricity usage.

During operations, approximately 1.44 $MMTCO_2e$ would be emitted per year, largely attributable to electricity use for pump station power, fuel for vehicles and aircraft for maintenance and inspections, and fugitive methane emissions at connections. The 1.44 $MMTCO_2e$ emissions would be equivalent to GHG emissions from approximately 300,000 passenger vehicles operating for 1 year, or 71,928 homes using electricity for 1 year.

ES.4.1.2 Lifecycle Analysis

To enable a more comprehensive understanding of the potential indirect GHG impact of the proposed Project, it is important to also consider the wider GHG emissions associated with the crude oil being transported by the proposed Project. A lifecycle approach was used to evaluate the GHG implications of the WCSB crudes that would be transported by the proposed Project compared to other crude oils that would likely be replaced or displaced by those WCSB crudes in U.S. refineries. A lifecycle analysis is a technique used to evaluate the environmental aspects and impacts (in this case GHGs) that are associated with a product, process, or service from raw materials acquisition through production, use, and end-of-life. The lifecycle analysis considered wells-to-wheels GHG emissions, including extraction, processing, transportation, refining, and refined product use (such as combustion of gasoline in cars) of WCSB crudes compared to other reference heavy crudes. The lifecycle analysis also considered the implications associated with other generated products during the lifecycle stages (so-called *co-products*) such as petroleum coke. WCSB crudes are generally more GHG intensive than other heavy crudes they would replace or displace in U.S. refineries, and emit an estimated 17 percent more GHGs on a lifecycle basis than the average barrel of crude oil refined in the United States in 2005. The largest single source of GHG emissions in the lifecycle analysis is the finished-fuel combustion of refined petroleum fuel products, which is consistent for different crude oils, as shown in Figure ES-10.

The total lifecycle emissions associated with production, refining, and combustion of 830,000 bpd of oil sands crude oil transported through the proposed Project is approximately 147 to 168 $MMTCO_2e$ per year. The annual lifecycle GHG emissions from 830,000 bpd of the four reference crudes examined in this Supplemental EIS are estimated to be 124 to 159 $MMTCO_2e$. The range of incremental GHG emissions for crude oil that would be transported by the proposed Project is estimated to be 1.3 to 27.4 $MMTCO_2e$ annually. The estimated range of potential emissions is large because there are many variables such as which reference crude is used for the comparison and which study is used for the comparison.



Note: See Figure 4.14.3-7 in Section 4.14.3.5, Incremental GHG Emissions, for a full description of the information presented in this figure.

Figure ES-10 Incremental Well-to-Wheels GHG Emissions from WCSB Oil Sands Crudes Compared to Well-to-Wheels GHG Emissions from Displacing Reference Crudes

The above estimates represent the total incremental emissions associated with production and consumption of 830,000 bpd of oil sands crude compared to the reference crudes. These estimates represent the potential increase in emissions attributable to the proposed Project if one assumed that approval or denial of the proposed Project would directly result in a change in production of 830,000 bpd of oil sands crudes in Canada (See Section 4.14.4.2, Emissions and Impacts in Context, for additional information on emissions associated with increases in oil sands production). However, as set forth in Section 1.4, Market Analysis, such a change is not likely to occur under expected market conditions. Section 1.4 notes that approval or denial of any one crude oil transport project, including the proposed Project, is unlikely to significantly impact the rate of extraction in the oil sands or the continued demand for heavy crude oil at refineries in the United States based on expected oil prices, oil-sands supply costs, transport costs, and supply-demand scenarios.

The 2013 Draft Supplemental EIS estimated how oil sands production would be affected by long-term constraints on pipeline capacity (if such constraints resulted in higher transportation costs) if long-term WTI-equivalent oil prices were less than $100 per barrel. The Draft Supplemental EIS also estimated a change in GHG emissions associated with such changes in production. The additional data and analysis included in this Supplemental EIS provide greater insights into supply costs and the range of prices in which pipeline constraints would be most likely to impact production. If WTI-equivalent prices fell to around approximately $65 to $75 per barrel, if there were long-term constraints on any new pipeline capacity, and if such constraints resulted in higher transportation costs, then there could be a substantial impact on oil sands

production levels. As noted in E.S.3.1, Summary of Market Analysis, this estimated price threshold could change if supply costs or production expectations prove different than estimated in this analysis. This is discussed in Section 1.4.5.4, Implications for Production.

ES.4.1.3 Climate Change Effects

The total direct and indirect emissions associated with the proposed Project would contribute to cumulative global GHG emissions. However, emissions associated with the proposed Project are only one source of relevant GHG emissions. In that way, GHG emissions differ from other impact categories discussed in this Supplemental EIS in that all GHG emissions of the same magnitude contribute to global climate change equally, regardless of the source or geographic location where they are emitted.

As part of this Supplemental EIS, future climate change scenarios and projections developed by the Intergovernmental Panel on Climate Change and peer-reviewed downscaled models were used to evaluate the effects that climate change could have on the proposed Project, as well as the environmental consequences from the proposed Project.

Assuming construction of the proposed Project were to occur in the next few years, climate conditions during the construction period would not differ substantially from current conditions. However, during the subsequent operational time period, the following climate changes are anticipated to occur regardless of any potential effects from the proposed Project:

- Warmer winter temperatures;
- A shorter cool season;
- A longer duration of frost-free periods;
- More freeze-thaw cycles per year (which could lead to an increased number of episodes of soil contraction and expansion);
- Warmer summer temperatures;
- Increased number of hot days and consecutive hot days; and
- Longer summers (which could lead to impacts associated with heat stress and wildfire risks).

This Supplemental EIS assessed whether the projected changes in the climate could further influence the impacts and effects attributable to the proposed Project. Elevated effects due to projected climate change could occur to water resources, wetlands, terrestrial vegetation, fisheries, and endangered species, and could also contribute to air quality impacts. In addition, the statistical risk of a pipeline spill could be increased by secondary effects brought on by climatic change such as increased flooding and drought. However, this increased risk would still be much less than the risk of spills from other causes (such as third-party damage). Climate change could have an effect on the severity of a spill such that it could be reduced in drought conditions but increased during periods of increased precipitation and flooding.

ES.4.2 Potential Releases

The proposed Project would include processes, procedures, and systems to prevent, detect, and mitigate potential oil spills.

Many commenters raised concerns regarding the potential environmental effects of a pipeline release, leak, and/or spill. Impacts from potential releases from the proposed Project were evaluated by analyzing historical spill data. The analysis identified the types of pipeline system components that historically have been the source of spills, the sizes of those spills, and the distances those spills would likely travel. The resulting potential impacts to natural resources, such as surface waters and groundwater, were also evaluated as well as planned mitigation measures designed to prevent, minimize, and respond to spills.

ES.4.2.1 Historical Pipeline Performance

In response to numerous comments regarding pipeline performance, the Department analyzed historical incident data within the PHMSA and National Response Center incident databases to understand what has occurred with respect to crude oil pipelines and the existing Keystone Pipeline system.

Table ES-1 summarizes hazardous liquid pipeline incidents reported to the PHMSA across the United States from January 2002 through July 2012 and shows the breakdown of incidents by pipeline component. A total of 1,692 incidents occurred, of which 321 were pipe incidents and 1,027 were involving different equipment components such as tanks, valves, or pumps.

Table ES-1 Summary of PHMSA Database Incidents[a] (January 2002 to July 2012)

Incident Category	Incidents	Incident Sub-Category	Incidents
Crude oil pipeline	1,692	Crude oil mainline pipe incidents	321
		Crude oil pipeline, equipment incidents (not mainline pipe)	1,027
		Crude oil pipeline system, unspecified elements	344
Crude oil mainline pipe	321	16-inch or greater diameter	71
		8-inch or 15-inch diameter	154
		Less than 8-inch diameter	52
		Diameter not provided	44
Crude oil pipeline, equipment (not mainline pipe)	1,027	Tanks	93
		Valves	25
		Other discrete elements (pumps, fittings, etc.)	909

[a] *Incident* as used in the Final Supplemental EIS is in reference to a PHMSA and/or a National Response Center record of a reportable spill or accident found within their respective databases.

To assess the likelihood of releases from the proposed Project, risk assessments were conducted addressing both the potential frequency of releases and the potential crude oil spill volumes associated with the releases. The assessments used three hypothetical spill volumes (small, medium, and large scenarios) to represent the range of reported spills in the PHMSA's spills database. Table ES-2 shows these spill volumes and the probabilities of such volumes.

Most spills are small. Of the 1,692 incidents between 2002 and 2012 (shown in Table ES-1), 79 percent of the incidents were in the small (zero to 50 bbl) range, equivalent to a spill of up to 2,100 gallons (see Table ES-2). Four percent of the incidents were in the large (greater than 1,000 bbl) range.

ES.4.2.1.1 Small and Medium Spills

The potential impacts from small spills of oil would typically be confined to soil immediately surrounding the spill, and would have little effect on nearby natural resources. These types of spills would generally be detected by maintenance or operations personnel and addressed through repair of the leak and remediation of the impacted area by removal of impacted soil and cleaning of stained concrete or containment areas.

With medium spills, a release could occur as a subsurface or surface event depending upon the cause. Similar to a small spill, a slow subsurface leak could potentially reach a groundwater resource and, if the leak is faster than the soil can absorb the oil, could seep to the ground surface. Once the migrating oil leaves the release site, impacts to soil, vegetation, wildlife, and surface water along the flow path would occur. Depending on how quickly it is remediated, some of the oil might tend to pool in low areas and potentially infiltrate back into the soil and to groundwater depending on the depth to groundwater.

ES.4.2.1.2 Large Spills

With a large spill, the majority of the spill volume would migrate away from the release site. The potential impacts from a large spill would be similar to the impacts from the medium-sized spill, but on a much larger scale. More oil would seep into the soil over a larger area and could infiltrate deeper into the soil. Once the spill reaches the surface, the oil would flow following topographic gradient or lows (e.g., gullies, roadside drainage ditches, culverts, or storm sewers) and eventually to surface water features.

Table ES-2 Spill Scenarios Evaluated in Supplemental EIS

Spill Volume Scenario	Frequency[a]
Small: Less than 50 bbl (2,100 gallons)	79%
Medium: 50–1,000 bbl (2,100–42,000 gallons)	17%
Large: >1,000 bbl (>42,000 gallons)	4%

[a] Indicates the share of all releases reported in the PHMSA database that fit each spill volume scenario.

If the release enters flowing water or other surface water features, the extent of the release could become very large, potentially affecting soil, wildlife, and vegetation along miles of river and shoreline. As has been seen in recent large spills, sinking oil can be deposited in river or stream bottoms and become a continual source of oil release over time.

ES.4.2.2 Prevention and Mitigation

In order to reduce the risk of spills, if permitted Keystone has agreed to incorporate additional mitigation measures in the design, construction, and operation of the proposed Keystone XL Project, in some instances above what is normally required, including:

- 59 Special Conditions recommended by PHMSA;
- 25 mitigation measures recommended in the Battelle and E^{x}ponent risk reports; and
- 11 additional mitigation measures.

Many of these mitigation measures relate to reductions in the likelihood of a release occurring. Other measures provide mitigation that reduces the consequences and impact of a spill should such an event occur. Mitigation measures are compiled in Appendix Z, Compiled Mitigation Measures, of this Supplemental EIS. Mitigation measures are actions that, if the proposed Project is determined to be in the national interest, Keystone would comply with as conditions of a Presidential Permit.

If a spill occurred, the degree of impact to water, people, livestock, soil, and other natural resources would depend on the distance from the spill source. A large spill of 20,000 bbl, for example, could have a combined overland and groundwater spreading of up to 2,264 feet (or 0.42 miles) from a release point. Oil could spread on flat ground up to 1,214 feet from the proposed pipeline, depending on the volume spilled. If oil reached groundwater, components in the oil, such as benzene, could spread in groundwater up to an additional 1,050 feet downgradient (essentially, downhill underground and on land) of the spill point.

The proposed Project would, if permitted, include processes, procedures, and systems to prevent, detect, and mitigate potential oil spills that could occur during construction and operation of the pipeline. These would include a Spill Prevention, Control, and Countermeasure Plan as well as a Construction, Mitigation, and Reclamation Plan (CMRP). In the event of a large leak, Supervisory Control and Data Acquisition sensors would automatically detect noticeable changes in pipeline pressure and flow rates. Leaks and spills could also be identified during routine aerial surveillance along the pipeline ROW. In addition, Keystone would be required, if permitted, to prepare an Emergency Response Plan that would contain further detail on response procedures and would be reviewed by the PHMSA prior to granting permission to operate the proposed pipeline. Keystone would incorporate into these plans lessons learned from past spills such as the pipeline rupture in 2010 that affected the Kalamazoo River (Marshall, Michigan). For example, Keystone would, if permitted, procure equipment required to respond to sunken and submerged oil and ensure personnel are appropriately trained.

ES.4.3 Socioeconomics

ES.4.3.1 Economic Activity Overview

During construction, proposed Project spending would support approximately 42,100 jobs (direct, indirect, and induced), and approximately $2 billion in earnings throughout the United States. Of these jobs, approximately 3,900 would be direct construction jobs in the proposed Project area in Montana, South Dakota, Nebraska, and Kansas (3,900 over 1 year of construction, or 1,950 per year if construction took 2 years). Construction of the proposed Project would contribute approximately $3.4 billion (or 0.02 percent) to the U.S. gross domestic product (GDP). The proposed Project would generate approximately 50 jobs during operations. Property tax revenue during operations would be substantial for many counties, with an increase of 10 percent or more in 17 of the 27 counties with proposed Project facilities.

The jobs and earnings analysis recognizes three distinct components of economic activity and job creation: direct, indirect, and induced.

- Direct economic activity associated with construction includes all jobs and earnings at firms that are awarded contracts for goods and services, including construction, directly by Keystone.
- Indirect economic activity includes all goods and services purchased by these construction contractors in the conduct of their services to the proposed Project. Examples of these types of activities related to pipeline construction include the goods and services purchased to produce inputs such as concrete, fuel, surveying, welding materials, and earth-moving equipment.
- Induced economic activity includes the spending of earnings received by employees working for either the construction contractor or for any supplier of goods and services required in the construction process. Examples of induced activities include

spending by access road construction crews, welders, employees of pipe manufacturers, and ranchers providing beef for restaurants and construction camps.

ES.4.3.2 Pipeline Geography, Population

Of the land area near the proposed pipeline route, approximately 17 percent intersects areas with low-income or minority populations, including Indian tribes. Such populations could potentially be disproportionately affected by the proposed Project.

The proposed pipeline route would go through 27 counties: six in Montana, nine in South Dakota, and 12 in Nebraska. These counties are referred to as the *pipeline corridor counties* and would be expected to experience most of the direct socioeconomic effects of the proposed Project.

The 27 pipeline corridor counties are predominantly rural and sparsely populated, with a total population of approximately 263,300 (2010 Census). Population density (number of persons per square mile) is low.

ES.4.3.3 Economic Activity During Construction

Construction contracts, materials, and support purchased in the United States would total approximately $3.1 billion. Another approximately $233 million would be spent on construction camps for workers in remote locations of Montana, South Dakota, and northern Nebraska.

Construction of the proposed Project would contribute approximately $3.4 billion to the U.S. GDP. This figure includes not only earnings by workers, but all other income earned by businesses and individuals engaged in the production of goods and services demanded by the proposed Project, such as profits, rent, interest, and dividends. When compared with the GDP in 2012, the proposed Project's contribution represents approximately 0.02 percent of annual economic activity across the nation.

Construction spending would support a combined total of approximately 42,100 jobs throughout the United States for the up to 2-year construction period. A *job* consists of one position that is filled for one year. The term *support* means jobs ranging from new jobs (i.e., not previously existing) to the continuity of existing jobs in current or new locations. The specific number of jobs at any location would result from the individual decisions of employers across the country affected by the proposed Project based on their labor needs, work backlog, and local hiring conditions. Of these jobs, approximately 16,100 would be direct jobs at firms that are awarded contracts for goods and services, including construction, by Keystone. The other approximately 26,000 jobs would result from indirect and induced spending; this would consist of goods and services purchased by the construction contractors and spending by employees working for either the construction contractor or for any supplier of goods and services required in the construction process.

About 12,000 jobs, or 29 percent of the total 42,100 jobs, would be supported in Montana, South Dakota, Nebraska, and Kansas. Also, of the 42,100 jobs, approximately 3,900 (or 1,950 per year if construction took 2 years) would comprise a direct, temporary, construction workforce in the proposed Project area.

Employment supported by construction of the proposed Project would translate to approximately $2.05 billion in employee earnings. Of this, approximately 20 percent ($405 million in earnings) would be allocated to workers in the proposed Project area states. The remaining 80 percent, or $1.6 billion, would occur in other locations around the country.

ES.4.3.4 Economic Activity During Operations

Once the proposed Project enters service, operations would require approximately 50 total employees in the United States: 35 permanent employees and 15 temporary contractors. This small number would result in negligible impacts on population, housing, and public services in the proposed Project area.

The total estimated property tax from the proposed Project in the first full year of operations would be approximately $55.6 million spread across 27 counties in three states. This impact to local property tax revenue receipts would be substantial for many counties, constituting a property tax revenue benefit of 10 percent or more in 17 of these 27 counties. Operation of the proposed Project is not expected to have an impact on residential or agricultural property values.

ES.4.4 Environmental Justice

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* directs federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. Environmental justice refers to the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA 2007). The CEQ has provided guidance for addressing environmental justice.

Within the socioeconomic analysis area identified for the proposed Project, 16 census groupings contain minority populations that are meaningfully greater (equal or greater than 120 percent) than the share in the surrounding state, and five census tracts have larger shares of low-income populations. Four of these areas contain meaningfully greater populations of both minority and low income residents. Two minority populations are located on Indian lands: the Cheyenne River Indian Reservation and the Rosebud Indian Reservation.

Impacts during construction could include exposure to construction dust and noise, disruption to traffic patterns, and increased competition for medical or health services. Typical proposed Project operations are unlikely to disproportionately adversely impact the environmental justice populations present. Because the risk of a potential release is roughly equal at all points along the pipeline, the risks associated with such releases would not be disproportionately borne by minority or low-income populations. However, such populations could be more vulnerable should a release occur.

If permitted, Keystone has agreed to avoidance and mitigation measures to minimize negative impacts to all populations in the proposed Project area. Specific mitigation for environmental justice communities during construction would involve ensuring that adequate communication in the form of public awareness materials regarding the construction schedule and construction activities is provided.

ES.4.5 Water Resources

The proposed Project route would avoid surface water whenever possible, but would cross approximately 1,073 surface waterbodies including 56 perennial rivers and streams as well as approximately 24 miles of mapped floodplains. If permitted, Keystone would drill underneath major rivers to mitigate construction impacts as described below and in Section 4.3, Water Resources.

The proposed pipeline would cross important aquifers such as the Northern High Plains Aquifer (NHPAQ) (which includes the Ogallala Aquifer) and the Great Plains Aquifer (GPA). Modeling indicates that aquifer characteristics would inhibit the spread of released oil, and impacts from a release on water quality would be limited.

Nevertheless, within 1 mile of the proposed Project route are 2,537 wells, including 39 public water supply wells. Wells that are in the vicinity could be affected by a release from the proposed Project.

ES.4.5.1 Surface Water

ES.4.5.1.1 Construction

Construction of the proposed Project could result in temporary and permanent impacts such as:

- Stream sedimentation;
- Changes in stream channel morphology (shape) and stability;
- Temporary reduction in stream flow; and
- Potential for hazardous material spills.

Open-cut methods would be used at most waterbody crossings. However, impacts to surface waterbodies would be mitigated through various means. Horizontal directional drill (HDD) methods would be used at 14 major and sensitive waterbody crossings (see Figure ES-11). Waterbody banks would be restored to preconstruction contours or to a stable slope. Seeding, erosion control fabric, and other erosion control measures would be installed, as specified in the CMRP and permit documents.

ES.4.5.1.2 Operations

Surface water impacts associated with potential releases of crude oil and other hazardous liquid spills are addressed in detail in the Potential Releases section. Other potential impacts during the operations phase would include:

- Channel migration or streambed degradation that exposes the pipeline;
- Channel incision that increases bank heights to the point where slopes are destabilized, ultimately widening the stream; and
- Sedimentation within a channel that triggers lateral bank erosion.

Mitigation measures to address these impacts would include those specified in the CMRP. The proposed pipeline would be at least 5 feet below the bottom of waterbodies and at least 3 to 4 feet below the bottom of waterbodies in rocky areas, and that depth would be maintained at least 15 feet from either waterbody edge.

Where an HDD method is used, the crossing depth would be up to 55 feet below the stream bed. Potential bank protection measures could include installing rock, wood, or other materials keyed into the bank to provide protection from further erosion or regrading the banks to reduce the bank slope.

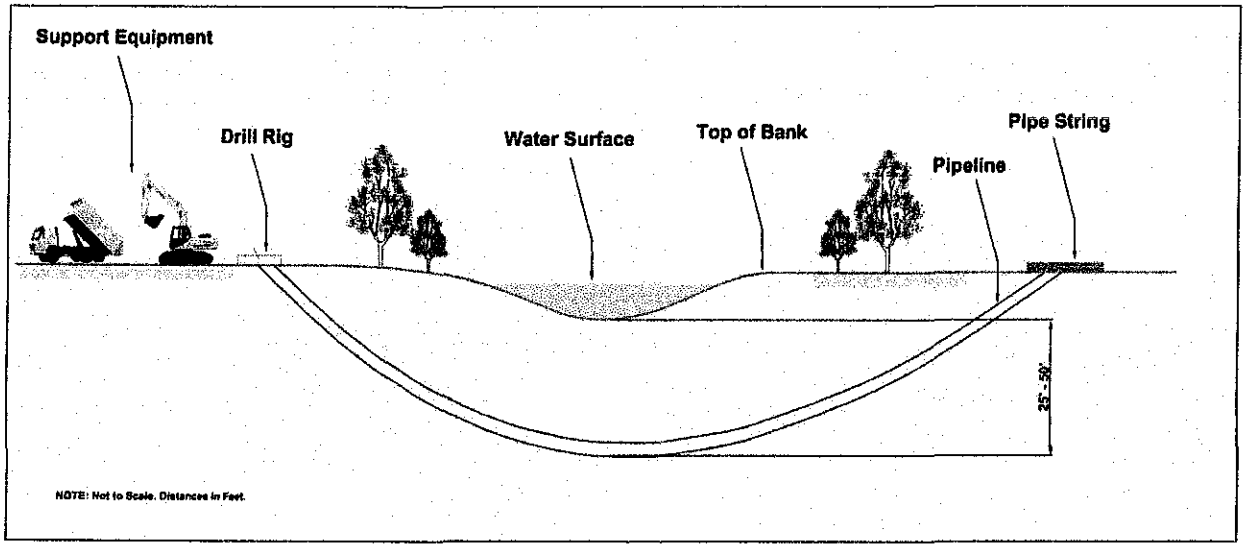


Figure ES-11 Cross Section of the Horizontal Directional Drilling Method

ES.4.5.2 Floodplains

The proposed pipeline would cross mapped and unmapped floodplains in Montana, South Dakota, and Nebraska. In floodplain areas adjacent to waterbody crossings, contours would be restored to as close to previously existing contours as practical, and the disturbed area would be revegetated during construction of the ROW in accordance with the CMRP. After construction, the proposed pipeline would not obstruct flows over designated floodplains, and any changes to topography would be minimal and thus would not affect local flood elevations.

ES.4.5.3 Groundwater

The primary source of groundwater impacts from the proposed Project would be potential releases of petroleum during pipeline operation and, to a lesser extent, from fuel spills from equipment. Any petroleum releases from construction or operation could potentially impact groundwater where the overlying soils are permeable and/or the depth to groundwater is shallow. Table ES-3 summarizes the anticipated effects of potential releases from the proposed Project on aquifers along the proposed Project route.

ES.4.6 Wetlands

The proposed Project would affect approximately 383 acres of wetlands. Potential impacts include:

- Impacts to wetland functions and values;
- Conversion from one wetland type to another; and
- Permanent loss of wetlands due to fill for permanent project-related facilities.

An estimated 2 acres of permanent wetland loss is anticipated. Remaining wetlands affected by the proposed Project would remain as functioning wetlands, provided that impact minimization and restoration efforts described in the CMRP are successful.

Wetlands are regulated primarily by Section 404 of the Clean Water Act, but other regulations could apply if, for example, a wetland area provides important habitat for federally listed species and species protected by the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. Section 404 requires that wetland impacts are avoided, minimized, and mitigated to the greatest practicable extent possible. Keystone has made route modifications to avoid wetland areas (such as the NDEQ-identified Sand Hills Region) and has prepared a CMRP that summarizes the proposed wetland avoidance, minimization, and mitigation measures. In addition, various agencies, such as U.S. Army Corps of Engineers, could require additional mitigation in accordance with American Indian tribal, local, state, and federal permits and regulations.

Table ES-3 Effects of Potential Releases on Aquifers

Aquifer	Effects
Alluvial Aquifers and Northern High Plains Aquifer (NHPAQ), including the Ogallala Aquifer	Aquifer conditions in the NHPAQ in the proposed Project area indicate that shallow groundwater generally discharges to local surface waterbodies, and typically does not flow downward in significant amounts or flow horizontally over long distances. Analysis of historic spills and groundwater modeling indicate that contaminant plumes from a large-scale release that reaches groundwater in the NHPAQ and alluvial aquifers could be expected to affect groundwater quality up to approximately 1,000 feet downgradient of the source. This localized effect indicates that petroleum releases from the proposed Project is unlikely to extensively affect water quality in this aquifer group.
Great Plains Aquifer (GPA)	Across most of the proposed pipeline area where the GPA is present, it is very unlikely that any releases from the proposed pipeline would affect groundwater quality in the aquifer because the aquifer is typically deeply buried beneath younger, water-bearing sediments and/or aquitard units. The exception is in southern Nebraska, where the aquifer is closer to the surface. Water quality in the GPA could be affected by releases in this area, but groundwater flow patterns in the vicinity of the proposed Project route make such effects unlikely. Overall, it is very unlikely that the proposed pipeline area would affect water quality in the GPA due to weak downward gradients (downward groundwater flows) in the aquifers overlying the GPA.
Northern Great Plains Aquifer System (NGPAS)	As with the GPA, petroleum releases from the proposed Project would only affect water quality in portions of the NGPAS near the ground surface. In the case of a large-scale release, these impacts would typically be limited to within several hundred feet of the source, and would not affect groundwater within areas that provide groundwater recharge to large portions of the NGPAS.
Western Interior Plains Aquifer	The depth to this aquifer is several hundred feet below the ground surface in the proposed Project area; therefore, there is an extremely low probability that a petroleum release from the proposed Project would affect water quality in this aquifer.
Shallow Groundwater and Water Wells	There are 2,537 wells within 1 mile of the proposed Project, including 39 public water supply wells and 20 private wells within 100 feet of the pipeline ROW. The majority of these wells are in Nebraska. Those wells that are in the vicinity of a petroleum release from the proposed Project may be affected.

ES.4.7 Threatened and Endangered Species

Consultation and coordination with the U.S. Fish and Wildlife Service (USFWS) identified 14 federally protected, proposed, and candidate species that could be affected by the proposed Project: 11 federally-listed threatened or endangered species, as defined under the ESA, one proposed species for listing as endangered, and two candidate species for listing as threatened or endangered. Of the federally listed, proposed, and candidate species, the endangered American buying beetle (*Nicrophorus americanus*) is the only species that is likely to be adversely affected by the proposed Project (see Figure ES-12). Other species could potentially be affected by the proposed Project; among these are whooping cranes (*Grus americana*), greater sage-grouse (*Centrocercus urophasianus*), and Western prairie fringed orchids (*Platanthera praeclara*).

In consultation with the USFWS, the Department prepared a Biological Assessment to evaluate the proposed Project's potential impacts to federally listed and candidate species and designated critical habitat. In addition, USFWS has developed a Biological Opinion for the proposed Project, which includes recommended conservation measures and compensatory mitigation for unavoidable impacts that were assessed during the formal consultation process. The Biological Opinion is attached in Appendix H, 2012 Biological Assessment, 2013 USFWS Biological Opinion, and Associated Documents.

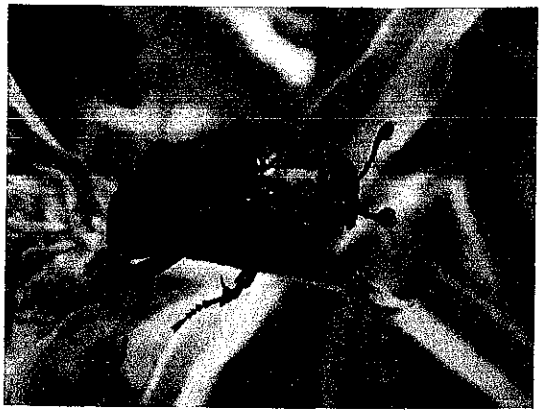


Figure ES-12 American Burying Beetle

Approximately 83 miles of the proposed Project Route in South Dakota and Nebraska would affect suitable American burying beetle habitat. Consultation between the Department and USFWS resulted in development of conservation measures and compensatory mitigation, such as trapping and relocating beetles, special lighting restrictions (the beetles are attracted to light), and establishment of a habitat conservation trust.

Even with these measures, the proposed Project would be likely to adversely affect the American burying beetle, resulting in incidental take (such as unintended death or harm of individual beetles) during construction or operation. The combination of Keystone's American burying beetle monitoring program and Reclamation Performance Bond would provide assurances that the acres disturbed by the proposed Project would be restored appropriately. The USFWS concluded in the 2013 USFWS Biological Opinion that the proposed Project is not likely to jeopardize the continued existence of the American burying beetle.

ES.4.8 Geology and Soils

The proposed route extends through relatively flat and stable areas, and the potential for seismic hazards (earthquakes), landslides, or subsidence (sink holes), is low. The pipeline would not cross any known active faults. During construction, land clearing could increase the risk of landslides and erosion. Keystone would, if permitted, construct temporary erosion control systems and restore the ROW after construction.

The proposed Project route would avoid the NDEQ-identified Sand Hills Region, where soils are particularly susceptible to damage from pipeline construction. Potential impacts to soils resources in other areas associated with construction or operation of the proposed Project and connected actions could include soil erosion, loss of topsoil, soil compaction, an increase in the proportion of large rocks in the topsoil, soil mixing, soil contamination, and related reductions in the productivity of desirable vegetation or crops. Construction also could result in damage to existing tile drainage systems (an agriculture practice that removes excess water from soil subsurface), irrigation systems, and shelterbelts.

To mitigate and minimize these impacts, Keystone would, if permitted, put in place procedures for construction and operation that are designed to reduce the likelihood and severity of proposed Project impacts to soils and sediments, including topsoil segregation methods, and to mitigate impacts to the extent practicable. After construction, areas of erosion or settling would be monitored.

ES.4.9 Terrestrial Vegetation

Potential construction- and operations-related impacts to general terrestrial vegetation resources associated with the proposed Project include impacts to cultivated crops, developed land, grassland/pasture, upland forest, open water, forested wetlands, emergent herbaceous wetlands, and shrub-scrub communities. In addition, the proposed Project route would result in impacts to biologically unique landscapes and vegetation communities of conservation concern.

Keystone would, if permitted, restore topsoil, slopes, contours, and drainage patterns to preconstruction conditions as practicable and to reseed disturbed areas to restore vegetation cover, prevent erosion, and control noxious weeds. Because disturbed prairie areas are difficult to restore to existing (pre-disturbance) conditions, Keystone would, if permitted, use specific best management practices and procedures to minimize and mitigate the potential impacts to native prairie areas and coordinate with appropriate agencies as necessary to monitor progress.

ES.4.10 Wildlife

Potential impacts to wildlife associated with construction of the proposed Project could include habitat loss, alteration, and fragmentation; direct mortality during construction and operation (e.g., vehicle collisions, power line/power pole collisions, etc.); indirect mortality because of stress or avoidance of feeding due to exposure to construction and operations noise, low-level helicopter or airplane monitoring overflights, and from increased human activity; reduced breeding success from exposure to construction and operations noise and from increased human activity; reduced survival or reproduction due to decreased availability of edible plants, reduced cover, and increased exotics and invasives; and increased predation (i.e., nest parasitism, creation of predator travel corridors, and poaching).

To reduce potential construction- and operations-related effects where habitat is crossed, Keystone would, if permitted, implement measures to minimize adverse effects to wildlife habitats, including shelterbelts, windbreaks, and living snow fences. Pipeline construction would be conducted in accordance with required permits.

ES.4.11 Fisheries

The proposed route would cross rivers and streams, including perennial streams that support recreational or commercial fisheries. Most potential impacts to fisheries resources would occur during construction and would be temporary or short term. Potential impacts from construction of stream crossings include siltation, sedimentation, bank erosion, sediment deposition, short-term delays in movements of fish, and transport and spread of aquatic invasive animals and plants. Keystone would, if permitted, minimize vehicle contact with surface waters and clean equipment to prevent transportation of aquatic invasive animals and plants. Impacts associated with potential releases of oil are described in Section 4.13, Potential Releases.

Most streams would be crossed using one of several open-cut (trenching) methods. Most stream crossings would be completed in less than 2 days, grading and disturbance to waterbody banks would be minimized, and crossings would be timed to avoid sensitive spawning periods, such that resulting steam bed disturbance and sediment impacts would be temporary and minimized.

Most large rivers would be crossed using HDD methods, which would install the pipeline well below the active river bed. As a result, direct disturbance to the river bed, fish, aquatic animals and plants, and river banks would be avoided. If permitted, Keystone has agreed to develop site-specific contingency plans to address unintended releases of drilling fluids that include preventative measures and a spill response plan.

ES.4.12 Land Use

Construction of the proposed Project would disturb approximately 15,427 acres of land. Approximately 90 percent of that land is privately owned while the remaining is owned by federal, state, or local governments. Rangeland (approximately 9,695 acres) and agriculture (approximately 4,975 acres) comprise the vast majority of land use types that would be affected by construction.

After construction, approximately 5,569 acres would be retained within permanent easements or acquired for operation of the proposed Project; this includes the pipeline ROW and aboveground facilities. Nearly all agricultural land and rangeland along the ROW would be allowed to return to production with little impact on production levels in the long term. However, there would be restrictions on growing woody vegetation and installing structures within the 50-foot-wide permanent ROW. Keystone has agreed to compensate landowners for crop losses on a case-by-case basis.

Keystone would if permitted use construction measures designed to reduce impacts to existing land uses such as topsoil protection, avoiding interference with irrigation systems, repairing or restoring drain tiles, assisting with livestock access and safety, and restoring disturbed areas with custom native seed mixes.

ES.4.13 Air Quality and Noise

Dust and emissions from construction equipment would impact air quality. Construction emissions typically would be localized, intermittent, and temporary since proposed pipeline construction would move through an area relatively quickly. Mitigation measures would be employed and enforced by an environmental inspector assigned to each construction spread.

All pump stations would be electrically powered by local utility providers. As a result, during normal operation there would be only minor emissions from valves and pumping equipment at the pump stations. The proposed Project would not be expected to cause or contribute to a violation of any federal, state, or local air quality standards, and it would not require a Clean Air Act Title V operating permit.

Construction activities would result in intermittent, temporary, and localized increases in noise levels. To reduce construction noise impacts, Keystone would, if permitted, limit the hours during which activities with high-decibel noise levels are conducted in residential areas, require noise mitigation procedures, monitor sound levels, and develop site-specific mitigation plans to comply with regulations.

ES.4.14 Cultural Resources

The proposed Project route would cross various private, state, and federal lands in Montana, South Dakota, and Nebraska where cultural resources would be encountered. Literature searches were conducted to locate previously identified cultural resources within the designated area of potential effects. Field studies were conducted between 2008 and 2013 to identify cultural resources and assess archaeological resources (i.e., sites), historic resources (i.e., buildings, structures, objects, and districts), and properties of religious and cultural significance, including traditional cultural properties.

As of December 2013, most of the proposed Project area has been surveyed for cultural resources. The proposed Project area of potential effects is approximately 39,500 acres, of which approximately 1,038 acres remain unsurveyed and are the subject of ongoing field studies. As part of this Supplemental EIS route evaluation process, consistent with the National Historic Preservation Act, the Programmatic Agreement (PA) that was signed in 2011 has been amended, finalized, and re-signed. Signatory parties to this agreement were the Department, Advisory Council on Historic Preservation, Bureau of Land Management, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, National Park Service, Western, Rural Utilities Service, Natural Resources Conservation Service, Farm Service Agency, Bureau of Indian Affairs, and the State Historic Preservation Offices of Montana, South Dakota, Nebraska, and Kansas. Invited signatories included the Montana Department of Natural Resources and Conservation, Montana Department of Environmental Quality, and Keystone. Indian tribes that participated in consultation were asked in 2013 to sign as Concurring Parties, consistent with 36 Code of Federal Regulations §§ 800.2(c)(2) and 800.6(c)(3).

Pursuant to the stipulations outlined in the PA, Keystone is required to complete cultural resources surveys on all areas that would be potentially impacted by the proposed Project, make recommendations on National Register of Historic Places eligibility, provide information on potential effects of the proposed Project, and provide adequate mitigation in consultation with the Department, state and federal agencies, and Indian tribes. Construction would not be allowed to commence on any areas of the proposed Project until these stipulations are met. The PA, therefore, would ensure that appropriate consultation procedures are followed and that cultural resources surveys would be completed prior to construction. If unanticipated cultural materials or human remains were encountered during the construction phase of the proposed Project, Keystone would implement Unanticipated Discovery Plans pursuant to the PA.

ES.4.14.1 Tribal Consultation

Upon receiving a new application, the Department reached out directly to 84 Indian tribes throughout the United States with potential interest in the cultural resources potentially affected by the proposed Project (see Figure ES-13). Of the 84 Indian tribes, 67 tribes notified the Department that they would like to consult or were undecided as to whether they would become consulting parties. All Indian tribes that participated in consultation were asked in 2013 to sign the amended PA.

The Department has conducted a broad range of tribal consultations, ranging from group meetings involving many Indian tribes and discussion topics to individual discussions on specific topics via letter, phone, and email. In addition to communication by phone, email, and letter, high-level Department officials travelled to areas near the proposed Project route to hold four face-to-face consultations, to which all Indian tribes were invited and whose participation was funded by Keystone, and one teleconference. Tribal meetings were held in October 2012 (three meetings), May 2013 (one meeting), and July 2013 (teleconference). Face-to-face meetings were held in four locations: Billings, Montana; Pierre, South Dakota; Rapid City, South Dakota; and Lincoln, Nebraska.

The Department engaged in discussions with the tribes and Tribal Historic Preservation Officers on issues relating to cultural resources. Consultations included discussions of cultural resources, in general, as well as cultural resources surveys, Traditional Cultural Properties surveys, effects to cultural resources, and mitigation. The Department has continued government-to-government consultations to build on previous work, to ensure that tribal issues of concern are addressed in the consultation process, and to amend and incorporate comments and modifications to the PA, as appropriate, in consultation with the tribes to conclude the Section 106 consistent process for the proposed Project. Additionally, tribes were provided proposed Project cultural resources survey reports and opportunities to conduct Traditional Cultural Property surveys funded by Keystone.

ES.4.15 Cumulative Effects

The cumulative effects analysis evaluates the way that the proposed Project's impacts interact with the impact of other past, present, or reasonably foreseeable future actions or projects. The goal of the cumulative impacts analysis is to identify situations where sets of comparatively small individual impacts, taken together, constitute a larger collective impact.

Cumulative impacts associated with the proposed Project and connected actions vary among individual environmental resources and locations. Generally, where long-term or permanent impacts from the proposed Project are absent, the potential for additive cumulative effects with other past, present, and reasonably foreseeable future projects is negligible.

Keystone's CMRP and planned mitigation measures, individual federal and state agency permitting conditions, and/or existing laws and regulations would, if permitted, work to control potential impacts and reduce the proposed Project's contribution to cumulative effects.

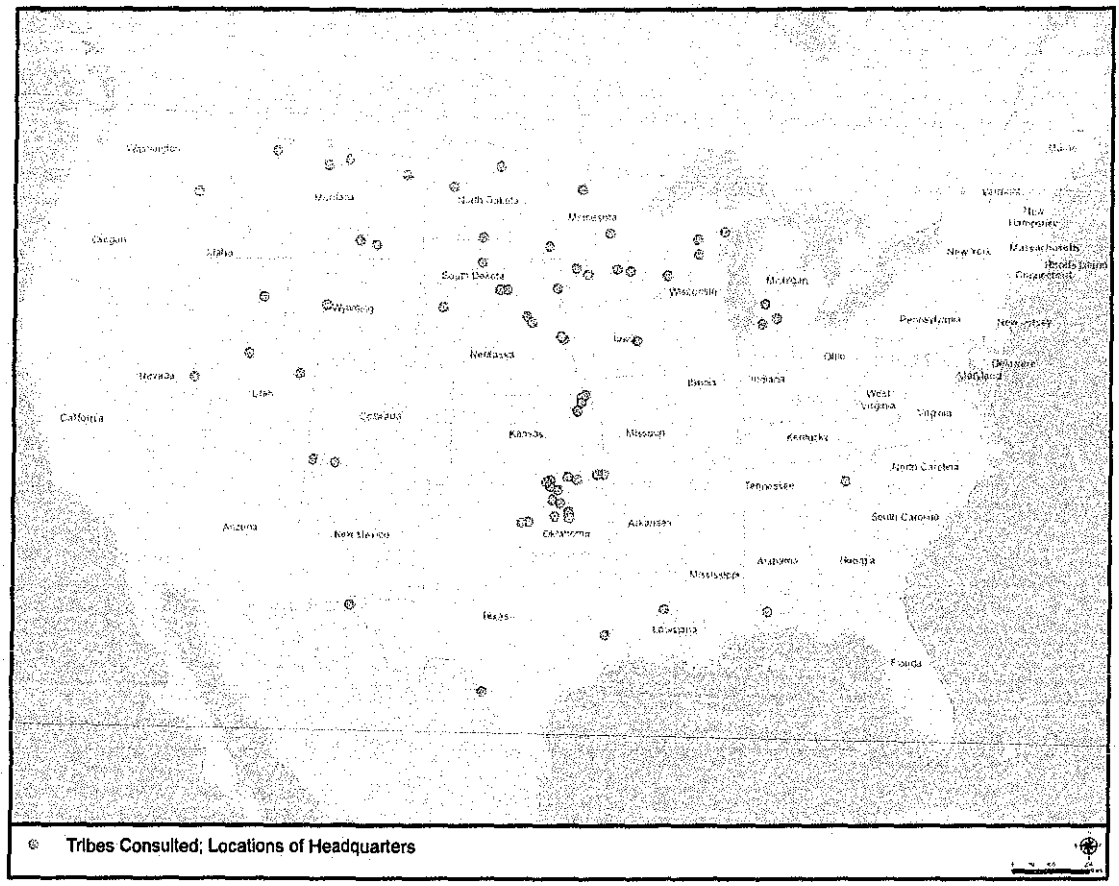


Figure ES-13 Indian Tribes Consulted

ES.4.16 Environmental Impacts in Canada

While the proposed Project analyzed in this Supplemental EIS begins at the international boundary where the pipeline would exit at Saskatchewan, Canada, and enter the United States through Montana, the origination point of the pipeline system would be in Alberta, Canada. In addition to the environmental analysis of the proposed Project in the United States, the Department monitored and obtained information from the environmental analysis of the Canadian portion of the proposed Project. The Canadian government, not the Department, conducted an environmental review of the portion of the proposed Project within Canada. However, the Department has included information from the Canadian government's assessment in this Supplemental EIS and has continued to monitor information from Canada as it becomes available.

On March 11, 2010, the Canadian National Energy Board issued its 168-page Reasons for Decision granting Keystone's application to build the Canadian portion of the proposed Project. This document provided a rationale for the approval of the pipeline by Canadian regulatory authorities and a description of the National Energy Board's analysis of the following topics: economic feasibility, commercial impacts, tolls and tariffs, engineering, land matters, public consultation, aboriginal consultation, and environmental and socioeconomic matters.

Moreover, analysis and mitigation of environmental impacts in Canada more generally are ongoing by Canadian officials. For example, on September 1, 2012, the Government of Alberta's development plan for the Lower Athabascan oil sands region became effective. The plan requires cancellation of about 10 oil sands leases, sets aside nearly 20,000 square kilometers (7,700 square miles) for conservation, and sets new environmental standards for the region in an effort to protect sensitive habitat, wildlife, and forest land.

ES.5.0 ALTERNATIVES

Detailed analysis was conducted on three broad categories of alternatives to the proposed Project, consistent with NEPA:

- No Action Alternative—which addresses potential market responses that could result if the Presidential Permit is denied or the proposed Project is not otherwise implemented;
- Major Route Alternatives—which includes other potential pipeline routes for transporting WCSB and Bakken crude oil to Steele City, Nebraska; and
- Other Alternatives—which include minor route variations, alternative pipeline designs, and alternative sites for aboveground facilities.

Several alternatives exist for the transport of WCSB and Bakken crude oil to Gulf Coast refineries, including many that were not carried forward for detailed analysis. This Supplemental EIS provides a detailed description of the categories of alternatives, the alternative screening process, and the detailed alternatives identified for further evaluation.

ES.5.1 No Action Alternative

The No Action Alternative analysis considers what would likely happen if the Presidential Permit is denied or the proposed Project is not otherwise implemented. It includes the Status Quo Baseline, which serves as a benchmark against which other alternatives are evaluated. Under the Status Quo Baseline, the proposed Project would not be constructed and the resulting direct, indirect, and cumulative impacts that are described in this Supplemental EIS would not occur. The Status Quo Baseline is a snapshot of the crude oil production and delivery systems at current levels – in other words, no change at all – irrespective of likely alternative transport scenarios to transport WCSB and Bakken crude.

The No Action Alternative includes analysis of three alternative transport scenarios that, based on the findings of the market analysis, are believed to meet the proposed Project's purpose (i.e., providing WCSB and Bakken crude oil to meet refinery demand in the Gulf Coast area) if the Presidential Permit for the proposed Project were denied, or if the pipeline were otherwise not constructed. Under the alternative transport scenarios, other environmental impacts would occur in lieu of the proposed Project. This Supplemental EIS includes analysis of various combinations of transportation modes for oil, including truck, barge, tanker, and rail. These scenarios are considered representative of the crude oil transport alternatives with which the market would respond in absence of the Keystone XL pipeline. These three alternative transport scenarios (i.e., the Rail and Pipeline Scenario, Rail and Tanker Scenario, and Rail Direct to the Gulf Coast Scenario) are described below and illustrated on Figure ES-14.

ES.5.1.1 Rail and Pipeline Scenario

Under this scenario, WCSB and Bakken crude oil (in the form of dilbit or synbit) would be shipped via rail from Lloydminster, Saskatchewan (the nearest rail terminal served by two Class I rail companies), to Stroud, Oklahoma, where it would be temporarily stored and then transported via existing and expanded pipelines approximately 17 miles to Cushing, Oklahoma, where the crude oil would interconnect with the interstate oil pipeline system.

This scenario would require the construction of two new or expanded rail loading terminals in Lloydminster, Saskatchewan (the possible loading point for WCSB crude oil), one new terminal in Epping, North Dakota (the representative loading point for Bakken crude oil), seven new terminals in Stroud, and up to 14 unit trains (consisting of approximately 100 cars carrying the same material and destined for the same delivery location) per day (12 from Lloydminster and two from Epping) to transport the equivalent volume of crude oil as would be transported by the proposed Project.

ES.5.1.2 Rail and Tanker Scenario

The second transportation scenario assumes crude oil (as dilbit or synbit) would be transported by rail from Lloydminster to a western Canada port (assumed to be Prince Rupert, British Columbia), where it would be loaded onto Suezmax tankers (capable of carrying approximately 986,000 barrels of WCSB crude oil) for transport to the U.S. Gulf Coast (Houston and/or Port Arthur) via the Panama Canal. Bakken crude would be shipped from Epping to Stroud via BNSF Railway or Union Pacific rail lines, similar to the method described under the Rail and Pipeline Scenario. This scenario would require up to 12 unit trains per day between Lloydminster and Prince Rupert, and up to two unit trains per day between Epping and Stroud. This scenario would require the construction of two new or expanded rail loading facilities in Lloydminster with other existing terminals in the area handling the majority of the WCSB for shipping to Prince Rupert. Facilities in Prince Rupert would include a new rail unloading and storage facility and a new marine terminal encompassing approximately 4,200 acres and capable of accommodating two Suezmax tankers. For the Bakken crude portion of this Scenario, one new rail terminal would be necessary in both Epping, North Dakota, and Stroud, Nebraska.

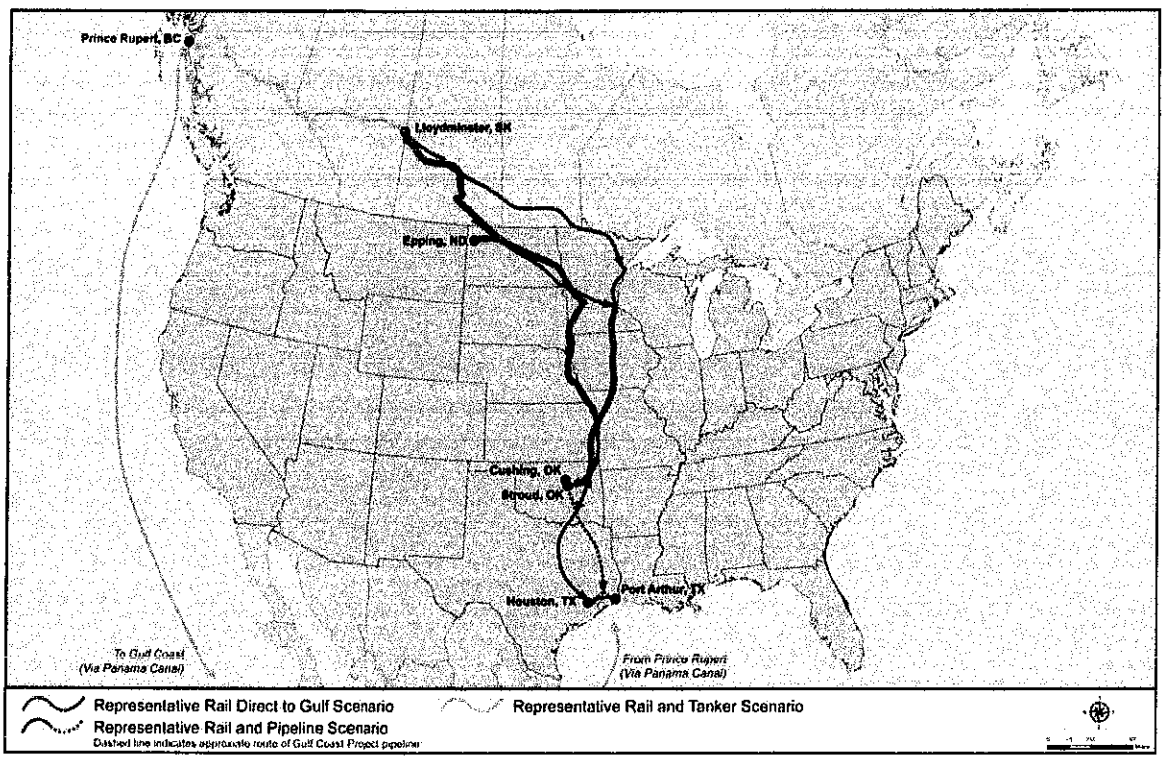


Figure ES-14 Representative No Action Alternative Scenarios

ES.5.1.3 Rail Direct to the Gulf Coast Scenario

The third transportation scenario assumes that WCSB and Bakken crude oil (as dilbit) would be shipped by rail from Lloydminster, Saskatchewan, and Epping, North Dakota, directly to existing rail facilities in the Gulf Coast region capable of off-loading up to 14 unit trains per day. These existing facilities would then either ship the crude oil by pipeline or barge the short distance to nearby refineries. It would largely rely on existing rail terminals in Lloydminster, but would likely require construction of up to two new or expanded terminals to accommodate the additional WCSB shipments out of Canada. One new rail loading terminal would be needed in Epping to ship Bakken crude oil. Sufficient off-loading rail facilities currently exist or are proposed in the Gulf Coast area such that no new terminals would need to be built under this scenario.

ES.5.2 Major Pipeline Route Alternatives

The Department considered potential alternative pipeline routes to assess whether or not route alternatives could avoid or reduce impacts to environmentally sensitive resources while also meeting the proposed Project's purpose. Consistent with NEPA, a two-phase screening process was used to evaluate prospective alternatives using a set of criteria to determine their technical, environmental, and economic viability. Alternatives that failed to meet the screening criteria were not brought forward for detailed analysis in this Supplemental EIS. The initial (Phase I) screening of other major route alternatives considered the following criteria:

- Meeting the proposed Project's purpose and need, including whether the alternative would require additional infrastructure such as a pipeline to access Bakken crude oil;
- Availability;
- Reliability;
- Length within the United States;
- Total length of the pipeline, including both the United States and Canada;
- Estimated number of aboveground facilities;
- Length co-located within an existing corridor;
- Acres of land directly affected during construction; and
- Acres of land directly affected permanently.

Pipeline length was used as an important screening criterion because it has a relatively direct relationship with:

- System reliability, in that the longer the pipeline the greater risk that some portion may become inoperable at some point, thereby delaying shipments.
- Environmental impacts, including:
  - Risk of spills and leaks, which represent the greatest potential threat to water and aquatic resources;
  - Temporary construction-related disturbance to natural habitat (e.g., wetlands, forests, native prairie); and
  - Permanent habitat fragmentation.
- Construction and operational costs, which generally increase in proportion to overall pipeline length.

All other factors being equal, longer pipelines are less desirable because they represent greater risks to system reliability, environmental impacts, and project costs.

As a result of this Phase I screening process, the following alternatives were eliminated because they would not meet the project purpose and/or were significantly longer than other viable options (see Figure ES-15):

- Western Alternative (to Cushing);
- Express Platte Alternative; and
- Existing Keystone Corridor
  - Option 1: Proposed Border Crossing (near Morgan, Montana)
  - Option 2: Existing Keystone Pipeline Border Crossing (at Pembina, North Dakota).

Several commenters recommended that the proposed Project parallel the existing Keystone Pipeline rather than the proposed route. The Department considered these comments, but ultimately concluded that the existing Keystone Pipeline Route was not a reasonable alternative because it would not meet the proposed Project's purpose and need (i.e., would not meet Keystone's contractual obligations to transport 100,000 bpd of Bakken crude oil). Further, the existing Keystone Pipeline Corridor would be longer (taking into consideration pipeline length in both Canada and the United States), which represents an increased spill risk. The 2011 Steele City Segment, the I-90 Corridor, and the Steele City Segment A1A alternatives, however, were retained for further screening.

The Phase II screening used a desktop data review of key environmental and other features (e.g., wetlands and waterbodies crossed, total acreage affected). After this Phase II screening, the Steele City Segment A1A Alternative was eliminated because this route would be longer with an associated increased risk for spills and leaks, would cross more miles of principal aquifer and wetlands, and would require a second major crossing of the Missouri River, relative to the proposed Project. For these reasons, the Steele City A1A Alternative would not offer any offsetting environmental advantages relative to the proposed Project to warrant further consideration. However, both the 2011 Steele City Segment and I-90 Corridor alternatives were considered reasonable alternatives and were retained for full evaluation in this Supplemental EIS. These two route alternatives are described below and depicted in Figure ES-15. Table ES-4 summarizes key aspects of the major pipeline route alternatives.

Table ES-4 Summary of Major Pipeline Route Alternatives

	Proposed Project	2011 Steele City Segment Alternative	I-90 Corridor Alternative
New Pipeline Length (miles)	875	854	927
Number of Aboveground Facilities[a]	73	71	77
Length Co-Located with Existing Keystone Pipeline (miles)	0	0	254
NDEQ-Identified Sand Hills Region Crossed (miles)	0	89	0
Highly Erodible Soil (Wind) Crossed (miles)	73	116	36
Perennial Waterbody Crossings	56	53	61
Wetlands Affected during Construction (acres)	262	544	223
Average Annual Employment During Construction	3,900	3,900	4,100
Property Tax Revenues (millions)	$55.6	$53.7	$59.3
Construction Land Area Affected (acres)	11,593	11,387	12,360
Operations (Permanent) Land Area Required (acres)	5,569	5,176	4,818

[a] Does not include 2 pump stations for the Cushing Extension in Kansas

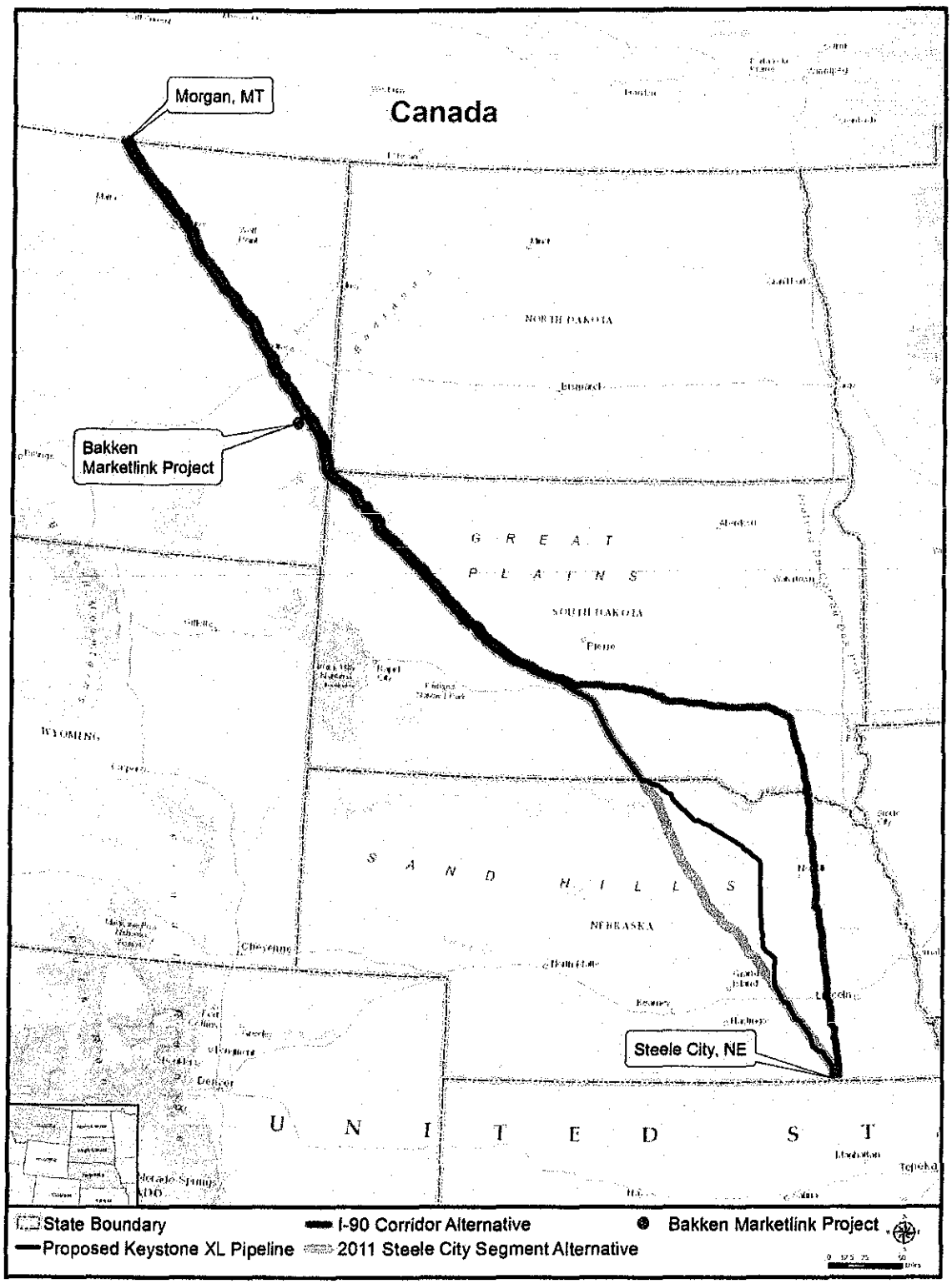


Figure ES-15 Preliminary Pipeline Route Alternatives

ES.5.2.1 Keystone XL 2011 Steele City Segment Alternative

The Keystone XL 2011 Steele City Segment Alternative evaluates the impacts of constructing the route proposed in the 2011 Final EIS as a comparison against which other route alternatives, including the proposed Project, can be made. This alternative would follow Keystone's proposed Project route from the Canadian border, designated Milepost (MP) 0, south to approximately MP 204, where it would connect with the Bakken Marketlink Project onramp at the same location as the proposed Project and continue to approximately MP 615 in northern Nebraska near the South Dakota state line. At that location, the Keystone XL 2011 Steele City Segment Alternative would divert from the current proposed Project and would continue southeasterly for another 240 miles to the southern terminus at Steele City, Nebraska. For approximately 89 miles, the Keystone XL 2011 Steele City Segment Alternative would cross the NDEQ-identified Sand Hills Region.

ES.5.2.2 I-90 Corridor Alternative

Keystone's proposed Project route starts at the Canadian Border (MP 0) and stretches south through Montana and into South Dakota to approximately MP 516, where the proposed pipeline route intersects Interstate 90 (I-90). From this point, this alternative pipeline route would diverge from the proposed Project route, following the ROW of I-90 and State Highway 262 for 157 miles, where it would then intersect and follow the ROW of the existing Keystone pipeline to Steele City, Nebraska.

The I-90 Corridor would avoid crossing the NDEQ-identified Sand Hills Region, and would reduce the length of pipeline crossing the NHPAQ system, which includes the Ogallala Aquifer.

ES.5.3 Other Alternatives Considered

In addition to the major route alternatives, the Department reviewed proposed variations—relatively short deviations—to the proposed route that were designed to avoid or minimize construction impacts to specific resources (e.g., cultural resource sites, wetlands, recreational lands, residences) or that minimize constructability issues (e.g., shallow bedrock, difficult waterbody crossings, steep terrain).

The Department also considered two alternative pipeline designs in response to public comments: an aboveground pipeline and an alternative using a smaller-diameter pipe. The Department determined that both alternative designs were not reasonable alternatives for the proposed Project because they would not meet the proposed Project purpose and need and/or because of safety and security reasons; therefore, they were not considered further in this Supplemental EIS.

This Supplemental EIS considered renewable energy sources and energy conservation as alternatives to the proposed Project. As noted in Section 1.4, Market Analysis, the crude oil would be used largely for transportation fuels and, therefore, any alternatives to the crude oil would need to fulfill the same purpose. The analysis found that even with renewable energy and conservation, there would still be a demand for oil sands-derived crude oil. Based on this evaluation, these alternatives were not carried forward for further analysis as alternatives to the proposed Project.

ES.5.4 Comparison of Alternatives

Consistent with NEPA and the CEQ regulations, the Department compared the proposed Project with the alternatives that met the proposed Project's purpose and need, and that were carried forward for detailed analysis in this Supplemental EIS. The alternatives carried forward for detailed analysis were: the 2011 Steele City Segment Alternative, the I-90 Corridor Alternative, and the three identified No Action Alternative scenarios (i.e., the Rail and Pipeline Scenario, the Rail and Tanker Scenario, and the Rail Direct to the Gulf Coast Scenario).

The two pipeline alternatives compare different routes that meet the purpose and need of the proposed Project, and the No Action Alternative scenarios describe the likely potential impacts associated with transport of crude oil from the WCSB and the Bakken formations if the Presidential Permit is denied or if the proposed Project is not otherwise implemented. The comparison focuses on three categories of impacts: physical disturbance, GHG emissions, and potential releases.

ES.5.4.1 Physical Disturbance Impacts Alternatives Comparison

The primary differences between the proposed Project and the alternatives related to physical disturbance are summarized in Table ES-5.

Table ES-5 Physical Disturbance Impacts Associated with New Construction and Operations for the Proposed Project and Alternatives

	Status Quo Baseline	Proposed Project	2011 Steele City Segment Alternative	I-90 Corridor Alternative	No Action Rail/Pipeline Scenario	No Action Rail/Tanker Scenario	No Action Rail Direct to the Gulf Coast Scenario
New Pipeline Length (miles)	0	875	854	927	17	32	0
Number of New Aboveground Facilities	0	73	71	77	33	33	19
Length Co-located with Existing Keystone Pipeline (miles)	0	0	0	254	NA	NA	NA
NDEQ-Identified Sand Hills Region Crossed (miles)	0	0	89	0	0	0	0
New Highly Erodible Soil (Wind) Crossed (miles)	0	73	116	36	0	0	0
Perennial Waterbody Crossings	0	56	53	61	1,216	330	711
Major Water Crossings[a]	0	62	60	61	42	14	40
Number of Shallow Wells in Proximity [b]	0	113	97	42	NA	NA	NA
New NHPAQ Crossed (miles)	0	294	247	145	NA	NA	NA
Wetland Affected during Construction (acres)	0	262	544	223	193	351	NQ[c]
Communities within 2 Miles	0	17	16	37	350	182	669
Construction (Temporary) Land Area Affected (acres)	0	11,599	11,387	12,360	5,227	6,427	1,500
Operations (Permanent) Land Area Required (acres)	0	5,309	5,176	4,818	5,103	6,303	1,500

Notes: This table does not include Canadian impacts for pipeline alternatives.
NA = not applicable
NQ = not quantified; insufficient design data
NDEQ = Nebraska Department of Environmental Quality
NHPAQ = Northern High Plains Aquifer
[a] This is defined as channel crossings of waterbodies that delineate U.S. Geological Survey National Hydrography Dataset Level 4 (HUC4) Hydrologic Unit watershed basins.
[b] A shallow well is defined as a well with a depth of 50 feet or less, but does not include wells with zero depth; proximity is defined as within ¼ mile of the centerline.
[c] Specific facility footprints for this scenario are not known at this time. However, impacts would be generally similar to the other rail scenarios.

ES.5.4.2 Greenhouse Gas Emissions Alternatives Comparison

To facilitate comparison of GHG emissions across all alternatives for operational GHG emissions, an assessment was made for all alternatives along the entire route from Hardisty, Alberta, to the Gulf Coast (including pipelines in Canada and from Steele City to the Gulf Coast). GHG emissions from the two pipeline route alternatives would be similar in scale to those of the proposed Project. The direct emissions during the operation phase of the 2011 Steele City Segment Alternative would be essentially the same as those generated by the proposed Project because they would have the same number of pump stations (20). The I-90 Corridor Alternative is expected to have similar but slightly higher GHG emissions because it would have one more pump station than the proposed Project and could generate slightly higher amounts of indirect GHG emissions from electricity consumption.

During operation of all No Action rail scenarios, the increased number of unit trains along the scenario routes would result in GHG emissions from both diesel fuel combustion and electricity generation to support rail terminal operations (as well as for pump station operations for the Rail/Pipeline Scenario). The total annual GHG emissions (direct and indirect) attributed to the No Action scenarios range from 28 to 42 percent greater than for the proposed Project (see Table ES-6).

The indirect GHG emissions over the lifecycle of oil sands crude oil production, transportation, refining, and product use are compared between the proposed Project and the evaluated alternatives in Section ES.4.1.2, Lifecycle Analysis.

Table ES-6 Annual Greenhouse Gas Emissions from Crude Transport (from Hardisty/Lloydminster, Alberta, to the Gulf Coast Area) Associated with the Proposed Project and Alternatives (per 100,000 bpd)

	Overall Proposed Project Route[a]	Overall 2011 Steele City Segment Alternative Route[b]	Overall I-90 Corridor Alternative Route[c]	No Action Rail/Pipeline Scenario	No Action Rail/Tanker Scenario	No Action Rail Direct to the Gulf Coast Scenario
Operation (direct and indirect)—Transportation, Not Extraction						
$MTCO_2e$/Year per 830,000 bpd	3,123,859	3,123,844	3,211,946	4,428,902	4,364,611	3,991,472
$MTCO_2e$/Year per 100,000 bpd	376,369	376,367	386,981	533,603	525,857	480,900
% Difference from Proposed Project	NA	0.0%	2.8%	41.8%	39.7%	27.8%

[a] Canadian, Proposed Project, and Gulf Coast
[b] Canadian, Steele City Segment, and Gulf Coast
[c] Canadian, I-90, and Gulf Coast
Notes: The emissions shown for the overall proposed Project differ from those shown for the proposed Project in Section ES.4.1.1, Greenhouse Gas Emissions from the Proposed Project, in order to present a full comparison of the overall proposed Project route to the other alternatives. All data include train emissions for return trips as well.
$MTCO_2e$ = metric tons of CO_2 equivalents
NA = not applicable
bpd = barrels per day

ES.5.4.3 Potential Spill Risk Alternatives Comparison

Similar to the GHG emissions comparison, potential spill risk was evaluated for alternatives along the entire route from Hardisty, Alberta, to the Gulf Coast (including portions of the route in Canada and including existing pipelines from Steele City to the Gulf Coast). Table ES-7 provides a summary of calculated potential release impacts for the various alternatives analyzed in terms of the number of potential releases per year and the potential volume of oil released per year.

Both of the major route alternatives would begin at the same border crossing as the proposed Project (near Morgan, Montana) and end at the same location as the proposed Project (near Steele City, Nebraska); as such, the pipelines in Canada north of the border crossing and the pipelines south of Steele City down to the Gulf Coast would be identical for all three overall pipeline routes. Compared to the proposed Project, the two major pipeline route alternatives would have similar potential spill risks (see Table ES-7). In addition, both of these major route alternatives would require aboveground facilities that are similar to those for the proposed Project; therefore, potential releases impact areas would be similar. Because the I-90 Corridor Alternative is slightly longer than the proposed Project, it would carry a slightly higher spill risk (with an estimated 533 bbl released per year compared to 518 annual bbl released for the proposed Project).

The three No Action Alternative scenarios differ from the proposed Project in that they would use alternative modes of transportation to deliver crude oil to refinery markets in the Gulf Coast rather than just a pipeline (although one of the three scenarios includes a pipeline as a significant part of its delivery system). Potential spill risks for these alternative modes differ from the proposed Project in terms of both average spill frequency and average spill size.

Volume of crude oil transportation by rail in the No Action Alternative scenarios would generally be limited to the volume contained within individual railcars. This volume constrains the total volume of crude oil that could potentially impact groundwater relative to the proposed Project in the event of a release. This constraint is offset by the increased statistical likelihood of spills associated with these alternative modes of crude oil transport relative to pipelines.

Historical rail incident data were analyzed to evaluate potential releases associated with rail transport in the United States. The results help provide insight into what could potentially occur with respect to spill volume, incident cause, and incident frequency for the No Action Alternative scenarios that involve rail transport. In addition, rail incident frequencies were compared to frequencies for other modes of transport (i.e., pipeline, marine tanker). Although the product to be transported by the proposed Project is crude oil, incidents for petroleum products were also analyzed to provide a comparison to a larger dataset. In order to make comparisons between the modes of transportation, the statistics regarding releases are expressed in terms of *ton-miles* (1 ton-mile is transporting 1 ton of product 1 mile; to calculate total ton-miles in a given year, one multiplies the total tons transported by the total number of miles transported).

The rates of releases and average size of releases vary between modes of transportation. For instance, rail transport has more reported releases of crude oil per ton-mile than pipeline or marine transport but, overall, pipeline transport has the highest number of barrels released per ton-mile. Comprehensive data from 2010 to 2013 are not yet available and therefore this analysis does not include incidents subsequent to 2009 such as the 2013 Lac-Mégantic rail tragedy or the Tesoro Logistics pipeline incident. The number of barrels released per year for the No Action scenarios is higher than what is projected for the proposed Project or the other pipeline alternatives (as detailed in Table ES-7) because of the alternate modes of transport in the No Action scenarios.

There is also a greater potential for injuries and fatalities associated with rail transport relative to pipelines. Adding 830,000 bpd to the yearly transport mode volume would result in an estimated 49 additional injuries and six additional fatalities for the No Action rail scenarios compared to one additional injury and no fatalities for the proposed Project on an annual basis.

Table ES-7 Potential Releases Impacts (Full Pathway) Associated with the Proposed Project and Alternatives

	Overall Proposed Project Route[a]	Overall 2011 Steele City Segment Alternative Route[b]	Overall I-90 Corridor Alternative Route[c]	No Action Rail/Pipeline Scenario	No Action Rail/Tanker Scenario	No Action Rail Direct to the Gulf Coast Scenario	
						Option 1[g]	Option 2[g]
Miles for Transport (Overall Route)	1,938	1,917	1,990	3,902	14,014	4,624	5,375
Releases per Year[d,e]	0.46	0.46	0.48	294	276	383	455
Barrels Released per Year[f]	518	513	533	1,227	4,633	1,335	1,606

[a] Canadian, Proposed Project, and Gulf Coast
[b] Canadian, Steele City Segment, and Gulf Coast
[c] Canadian, I-90, and Gulf Coast
[d] Releases per year frequency was calculated using databases from the U.S. Department of Transportation covering U.S. transportation in the years 2002 to 2009. The pipeline spill frequency was based on a 16-inch diameter crude oil pipeline.
[e] Releases per Year = (16-inch U.S. crude pipeline spill frequency * total pipeline ton-miles) + (U.S. rail spill frequency * total rail ton-miles) + (U.S. marine spill frequency * total rail ton-miles) + (U.S. truck spill frequency * total truck ton-miles).
[f] Barrels Released per Year = (average 16-inch U.S. crude pipeline barrels (bbl) released * total pipeline ton-miles) + (average rail bbl released * total rail ton-miles) + (average marine bbl) released * total rail ton-miles) + (average truck bbl released * total truck ton-miles).
[g] The Option 1 route goes through Lloydminster while Option 2 routes through Fort McMurray.

ES.6.0 GUIDE TO READING THE SUPPLEMENTAL EIS

The Supplemental EIS consists of 11 volumes and is available electronically for viewing or download at www.keystonepipeline-xl.state.gov. Various sections of this document contain bibliographies with full lists of references and citations. A list of where to find printed copies of the complete Supplemental EIS can be found at www.keystonepipeline-xl.state.gov or by mail inquiry to:

U.S. Department of State
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Room 2726
Washington D.C. 20520

ES.7.0 SUPPLEMENTAL EIS CONTENTS

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#4

Held

Nancy Held July 6, 2015

CEPA

Canadian Energy Pipeline Association

Association canadienne de pipelines d'énergie

Pipeline Abandonment Assumptions

Technical and Environmental considerations for development of Pipeline Abandonment strategies

Prepared for the Terminal Negative Salvage Task Force of the Canadian Energy Pipeline Association

September 2006 – April 2007

Does not include Appendix

Disclaimer

This report was prepared by the Terminal Negative Salvage Technical Working Group, a subcommittee of the Terminal Negative Salvage Steering Committee of the Canadian Energy Pipeline Association (CEPA). The working group included representatives of CEPA member companies. While every means was taken to ensure the accuracy of the information contained in this report, CEPA does not guarantee its accuracy.

The use of this report will be at the user's sole risk, regardless of any fault or negligence of CEPA.

Executive Summary

Companies that own and operate oil and gas pipelines in Canada recognize the need to develop guidelines to safely and viably abandon pipelines and other related facilities when they reach the end of their economic lives. Technical guidelines were drawn up by industry groups 10 years ago to help companies plan abandonment strategies. The basic assumptions made in a 1996 discussion paper on pipeline abandonment (Pipeline Abandonment – A Discussion Paper on Technical and Environmental Issues – see Appendix C) are still appropriate. Land use is the most important factor used to determine abandonment strategies and specific site assessments must be conducted for every potential abandonment.

This report documents CEPA's review of those assumptions to today's technical standards and regulatory environment. The pipeline abandonment matrix developed for this report allows pipeline owners to plot variables, including land use and pipeline properties (i.e. diameter) to guide decision making about removal, abandoning in place or abandoning with special treatment is the most appropriate abandonment strategy. A risk-based, comprehensive site specific assessment is needed to validate the chosen abandonment strategy for specific pipelines.

For major abandonment projects, it is expected that a combination of treatments will be used, based on site specific assessments. Most common issues are dealt with in this report including regulatory requirements, environmental considerations, land use, ground subsidence, remediation, pipe cleanliness, water crossings, erosion, water conduits, rail, road or utility crossings, and post-abandonment responsibilities, providing companies with the technical background to make appropriate abandonment decisions.

This report is a preliminary and broad based look at technical abandonment assumptions and requires discussions with appropriate parties supported by detailed analysis of historical case studies and issue-specific research. It is recognized that further effort is required to develop a risk based decision process to support the required site specific assessments. Also, some of the assumptions contained within this report and the earlier works are too broad and/or require validation (An example of an issue identified as candidate for further specific attention is pipeline cleanliness to provide further understanding and guidance about "how clean is clean).

Abbreviations

AENV	Alberta Environment
AEPEA	Alberta Environmental Protection and Enhancement Act
C&R	Conservation and Reclamation
CAPP	Canadian Association of Petroleum Producers
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Energy Pipeline Association
DOT	U.S. Department of Transportation
EUB	Alberta Energy and Utilities Board
FERC	U.S. Federal Energy Regulatory Commission
km	kilometre
mm	millimetre
NEB	National Energy Board
NORMs	Naturally occurring radioactive materials
O.D.	Outside diameter
OPS (PHMSA)	U.S. Office of Pipeline Safety (Pipeline Hazardous Materials Safety Administration)
PCB	Polychlorinated biphenyl
TNS	Terminal Negative Salvage

Table of Contents

1. Introduction

The energy pipeline grid in Canada has been growing for many decades. This pipeline infrastructure is fundamental to the safe, reliable, and efficient delivery of hydrocarbon fluids from producing areas to domestic and U.S. markets.

While the energy industry is expected to remain robust well into the future, it must be recognized that the necessity to abandon pipeline facilities may be triggered by changing supply and demand patterns, both at the local and macro levels. Changing technologies and other economic influences may also affect pipeline lifecycles.

In April 2005, the Canadian Energy Pipeline Association (CEPA) formed a Task Force to study the issues relating to Terminal Negative Salvage (TNS) for pipeline systems. Simply put, TNS is the cost associated with all activities involved in the eventual permanent abandonment of the pipeline facilities. Before one can begin the process of estimating these costs it is necessary to start discussing some of the technical assumptions for abandonment and retirement of these facilities.

A Steering Committee was formed to direct the study of various TNS sub-committees. As part of this initiative, a technical subcommittee of the Steering Committee (Technical Working Group), comprised of representatives from several CEPA member pipeline companies, was formed to update pipeline [technical] abandonment assumptions. This report is the result of the work of this subcommittee.

From a technical standpoint, and in light of cost and land use considerations, decisions have to be made by pipeline companies concerning the appropriate retirement of pipeline facilities, whether above or below ground. As a general proposition, the recognized practice is to dismantle and remove above-ground facilities. The appropriate method to use for abandonment of buried pipe is not quite so straightforward. Options range from abandonment in place, complete removal, or some intermediate option.

For any large-scale abandonment project, it is unlikely that any one abandonment technique will be employed. Rather, a project will likely involve a combination of pipe removal and abandonment in place along the length of the pipeline. A key factor influencing the choice between the two options is present and future land use.

No matter what abandonment techniques are used, it is reasonable to expect that the associated costs will outweigh any proceeds which may be realized from the sale of removed pipe for scrap or other use. Terminal negative salvage costs are those which are net of salvage proceeds recovered.

To provide a framework for the development of abandonment plans, this report sets forth technical abandonment assumptions. The information contained in this report builds on the information contained in the 1996 discussion paper. In most cases the 1996 information is still appropriate and the information was not copied into the main body of

this report. The 1996 report is included in Appendix C in order to provide a more complete reference collection of relevant information

In essence, the report seeks to provide guidance in terms of the appropriate retirement of pipeline facilities. Importantly, this report includes a pipeline abandonment options matrix by pipeline diameter and land use category for general reference.

This report forms the basis for further discussion and development. Notwithstanding the abandonment methodology noted in the matrix, it is recognized that any specific abandonment plan should be developed on the basis of comprehensive site-specific assessments, company specific considerations, landowner/stakeholder input and the various technical and environmental factors described in this report. A risk based decision process shall be developed for the site-specific assessments to support appropriate actions by an operator for a particular pipeline situation.

2. Past Initiatives

2.1 Overview

Pipeline abandonment and the funding of future abandonment projects, or TNS, have been discussed by energy producers, facility operators and regulatory agencies in Canada for over 20 years.

The first significant foray into this area resulted in the publication of a comprehensive background paper by National Energy Board (NEB) staff in 1985 (the 1985 NEB Staff Paper). The NEB issued a further guidance letter on TNS in February 1986 (the 1986 NEB Letter). In the mid-1990s, two major discussion papers were spawned by an intense collaborative review involving the NEB, the Alberta Energy Utilities Board (EUB), the Canadian Association of Petroleum Producers (CAPP) and CEPA. The first discussion paper was issued in 1996 and was entitled "Pipe Abandonment – A Discussion Paper on Technical and Environmental Issues" (the 1996 Discussion Paper). The second discussion paper was issued in 1997 and was entitled "Legal Issues Relating to Pipeline Abandonment: A Discussion Paper" (the 1997 Legal Paper). The subject was also further explored by CAPP in a 2002 paper entitled "Draft Guidelines for Pipeline Abandonment Applications in Alberta" (the 2002 CAPP Guidelines).

Taken together, these initiatives provided a solid starting point for this recent CEPA effort. For background and context, this chapter provides a synopsis of each of these initiatives.

2.2 The 1985 NEB Staff Paper

In 1984, at an NEB gas pipeline tolls hearing, several parties demonstrated an interest in addressing the issue of TNS related to pipeline abandonment. This provided the impetus

for a background paper on TNS to be prepared by NEB staff. This paper was issued in September 1985.

For ease of reference, the executive summary of the 1985 NEB Staff Paper has been reproduced as Appendix D to this report.

This discussion paper represented the first significant examination by a Canadian regulatory authority of the appropriate abandonment techniques for buried pipelines. Importantly, the paper acknowledged that abandonment in place is a viable option for smaller-diameter pipelines, and that such an approach might also be viable in certain situations for larger-diameter pipelines.

In so doing, the paper supports in many instances that pipelines may be abandoned in place. NEB staff pointed to the environmental disturbance that would be caused by removal in some circumstances, and the extreme costs that would be associated with removing all facilities.

The paper pointed to the various factors that should be considered in deciding the proper abandonment approach. These factors included land use and the potential for ground subsidence arising from the eventual deterioration of pipelines abandoned in place.

2.3 The 1996 and 1997 Discussion Papers

The twin matters of pipeline abandonment and TNS again came to the fore in the mid-1990s when the NEB, the EUB, CAPP, and CEPA embarked on a comprehensive collaborative review.

That particular initiative resulted in the issuance of a discussion paper on technical and environmental issues in November 1996, as well as a discussion on associated legal issues in May 1997. These papers were leading edge at the time and provided considerable guidance to stakeholders in the formulation of abandonment and decommissioning plans.

For ease of reference, the 1996 Discussion Paper on technical and environmental issues has been reproduced as Appendix C of this report.

The 1996 Discussion Paper canvassed many of the same issues that had been addressed in the 1985 NEB Staff Paper. In essence, the 1996 Discussion Paper took the 1985 NEB Staff Paper's initial analysis to the next level, and looked more closely at issues such as ground subsidence and pipe cleanliness. Specific studies on these issues were commissioned for purposes of completing the 1996 Discussion Paper and remain leading edge to this day. These studies entitled Identification and Assessment of Trace Contaminants Associated with Oil and Gas Pipelines Abandoned in Place, Preliminary Geotechnical Assessment of Pipeline Subsidence Phenomena and Environmental Issues

Concerning Pipeline Abandonment are referenced in Appendix E of this report. These studies are available for viewing at the NEB or EUB libraries or from CEPA.

Consistent with the 1985 NEB Staff Paper, the 1996 Discussion Paper acknowledged and confirmed that abandonment in place is a viable option in many circumstances. The 1996 Discussion Paper reconfirmed that any large-scale abandonment project would likely involve a combination of pipe removal and abandonment in place along the length of the pipeline.

Various technical and environmental factors were addressed at length in the 1996 Discussion Paper, with the paper recommending that comprehensive site-specific assessments be conducted in support of any abandonment plan.

The legal discussion paper that followed in May 1997, the 1997 Discussion Paper, examined a variety of legal issues, including liability issues relating to the discontinuation and abandonment of pipelines. Owing to the composition of the legal work group, the effort focused largely on pipelines subject to the jurisdiction of the NEB and the EUB.

2.4 The 2002 CAPP Draft Guidelines

Drafted six years after the 1996 Discussion Paper, the 2002 CAPP Draft Guidelines focused solely on Alberta, providing direction to pipeline owner/operators planning to abandon a pipeline within that province. These draft guidelines supported the 1996 Discussion Paper with regard to the management of technical and environmental issues affecting pipeline abandonment.

The 2002 CAPP Draft Guidelines also provided a thorough and expanded list of both operator and regulator responsibilities associated with the pipeline abandonment process.

2.5 Review of Recent Abandonment Case Studies

To help give context to abandonment planning strategies, the CEPA Technical Working Group looked for recent examples of medium to large scale pipeline abandonment projects that could be used as case studies to broaden the understanding of abandonment issues being studied in this report. A literature review was conducted in search of both Canadian and U.S. examples. The few documented case studies found in the public domain, are included in this section. It is hoped that future pipeline abandonment projects will be tracked as they occur to provide additional case studies.

2.5.1. Canadian Review

A literature search did not turn up any major pipeline abandonment projects in the public domain. To follow up, staff at the EUB and NEB were contacted to determine whether they were aware of any recent large-scale abandonment projects.

At the time, NEB staff were not aware of any major projects, only the abandonment of some discrete sections of pipe (Recently the abandonment of a major above-ground pipeline in the Yukon is providing some case history and a point of reference going forward). At the EUB, officials were aware of a number of pipeline abandonment projects in Alberta. For the most part, these projects involved the abandonment in place of small diameter pipelines in all types of land use categories.

During the development of the 1996 Discussion Paper, two pipeline abandonment case studies were reviewed. Both of these case studies supported abandonment in place strategy as a viable option for some pipelines. The case studies reviewed in the development of the 1996 Discussion Paper were:

1. Trans-Northern Pipelines Inc. (NPS 8 pipe abandoned in place)
2. Montreal Pipe Line Limited (NPS 12 pipe abandoned in place)

These pipeline companies were contacted to see if they had any new information to add to their case studies today.

In November 1995, Trans-Northern Pipelines submitted a case history to the 1996 Pipeline Abandonment Steering Committee for their eight-inch diameter pipeline referred to as the Ottawa Lateral. It was constructed in 1952 and abandoned in place in segments between 1968 and 1987. When contacted in October 2005, officials at Trans-Northern Pipelines said they did not have any new information to add to their original case study.

In January 1996, Montreal Pipe Line submitted a letter to the 1996 Pipeline Abandonment Steering Committee outlining its abandonment in place of a 12-inch diameter pipeline in 1984. When contacted in 2005, officials at Montreal Pipe Line Limited were unable to provide an update on their abandonment experience.

2.5.2. U.S. Review

Several companies in the U.S. have filed applications with the Federal Energy Regulatory Commission (FERC) to abandon older pipelines and a summary of these applications can be found at the FERC website at http://elibrary.ferc.gov/idmws/docket_search.asp and entering the Docket numbers stated below.

A summary of these applications and corresponding FERC decisions are:

1. El Paso Natural Gas, Docket No. CP04-423, Order approving abandonment plan
2. Northwest Pipeline Corporation, Docket No. CP05-32, Order authorizing abandonment and issuing certificate
3. Paiute Pipeline Company, Docket No. CP03-31, Order approving contested settlement, issuing certificate and authorizing abandonment

While these applications and FERC decisions discuss broad issues, they do not contain detailed technical information. They show that present and future land use, safety and

environmental considerations are important factors in determining a pipeline abandonment plan. They also demonstrate that site specific assessments are required in managing these factors.

To better understand these U.S. case studies, the next paragraph is a summary of the abandonment and decommissioning process for pipeline facilities subject to FERC jurisdiction (Section 7(b) of the Natural Gas Act, 15 U.S.C. 717f(b)(2005)) along with a summary of the environmental assessment requirements from each of the U.S. case studies reviewed.

Under the Natural Gas Act section 7(b), a natural gas pipeline company must seek approval from FERC to abandon/decommission any pipeline facilities. FERC considers whether the abandonment is in the public convenience or necessity. In this process FERC approves the plan for pipeline abandonment based on various factors, including consideration of State and/or local permitting requirements. In making its decision, FERC balances landowner claims of economic and environmental harm from leaving abandoned pipeline in the ground against the benefits of removing it, in its environmental assessment of the abandonment application. The Environmental Assessment addresses geology, soils, mineral resources, fisheries, threatened and endangered species, cultural resources, water resources, wetlands, land use, residential impacts, and alternatives. For each area that would be used or disturbed, each company must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area.

Case Study No. 1
El Paso Natural Gas
Docket No. CP04-423
Order Approving Abandonment (issued January 27, 2005)

El Paso sought to decommission sections of its 16-inch diameter Jal Lines by *using a combination of removal and abandonment in place*. The lines, which were originally constructed in 1929 and 1937, extended about 207 miles and 178 miles respectively. El Paso has been progressively decommissioning segments of these lines since the early 1990s. The Commission found that because the lines were old, obsolete and underutilized, the abandonment was in the public convenience and necessity. The Commission *approved El Paso's application* on the condition that the company implement the mitigation measures contained in its application.

Case Study No. 2
Northwest Pipeline Corporation
Docket No. CP05-32
Order Authorizing Abandonment and Issuing Certificate (issued September 13, 2005)

Northwest filed an application seeking approval of its Capacity Replacement Project in response to an order issued by the U.S. Department of Transportation's Office of Pipeline Safety after a series of pipeline failures. As part of the project, Northwest sought

permission to *abandon in place* 268 miles of 26-inch diameter pipeline between Sumas and Washougal, Washington, and to isolate the 26-inch pipeline from other system components. The Commission *approved* the application subject to Northwest meeting certain environmental conditions identified in the Environmental Assessment.

Case Study No. 3
Paiute Pipeline Company
Docket No. CP03-31
Order Approving Contested Settlement, Issuing Certificate, and Authorizing Abandonment (issued July 14, 2003)

Paiute Pipeline applied for authorization to abandon segments of deteriorating pipeline on its Carson Lateral in Nevada. Paiute planned to replace the deteriorating pipeline with a larger diameter pipeline, thus expanding its capacity overall. The Commission approved the *abandonment in place* of the 10-inch diameter pipeline and said the environmental conditions attached to the order would mitigate any impacts associated with this strategy. As well, Paiute must comply with the terms of the Environmental Assessment.

From the limited technical information found in these case studies it appears that FERC is receptive to abandonment in place strategies providing that the associated technical and environmental issues are appropriately managed.

It is important to note, that no U.S. case studies were found in the public domain that required the entire removal of a pipeline system once it was no longer required.

3. Guidelines and Assumptions

3.1 Overview

This section discusses the key issues involved in the safe, environmentally sound and financially viable abandonment of buried metallic hydrocarbon transmission pipeline facilities. These same issues were reviewed and discussed in the 1996 Discussion Paper and, where applicable, this section provides a current update to these issues. The content of the 1996 Discussion Paper remains valid and was not copied in the main body of this report. Rather it is contained in Appendix C and should be referenced. A key deliverable of this report is to produce an abandonment matrix that can be used to assist with planning pipeline abandonment projects.

3.2 Pipeline Abandonment Matrix

The origins of the matrix produced in this report are found in the pipeline abandonment matrix developed in the 1985 NEB Staff Paper. This matrix has been modified to provide an updated perspective on the primary pipeline abandonment options based on pipeline diameter and land use categories.

There are several broad assumptions that apply to the pipeline abandonment matrix for all diameter ranges and land use categories. These assumptions are as follows:

- The matrix in this report is applicable for all hydrocarbon pipelines.
- Cathodic protection will be discontinued in all cases.
- Site specific assessments may override any of the primary options recommended in the matrix. As part of a site specific assessment there may be legal or other considerations (easement agreements, landowner input, etc.) that may change the recommended option.

The horizontal axis of the matrix is organized by the following three outside diameter ranges:

- Small (2" to 12")
- Medium (14" to 24")
- Large (26" and greater)

Three diameter ranges were chosen because they provide an appropriate level of guidance for pipe abandonment options. Based on the CEPA review, it was found that iIncluding more diameter ranges would not necessarily enhance the matrix or provide more definitive guidance.

The most important consideration for any pipeline abandonment/removal project is the existing and potential land use. The vertical axis of the matrix is structured around three broad land use areas containing 10 land use categories. These categories are discussed in more detail in the upcoming sections:

- Agricultural
  - Cultivated
  - Cultivated with special features (deep tilling, tree farms, etc.)
  - Non-cultivated (pasture, prairie, etc.)
- Non-agricultural
  - Existing developed land
  - Prospective developed land
  - No future development (forest, Crown Lands, etc.)
- Other areas
  - Environmentally sensitive (wetlands, endangered species habitat, etc.)
  - Water crossings
  - Roads and railways
  - Utilities crossings

Table 1 – Pipeline Abandonment Matrix

Land Use		Pipe Diameter		
		60.3 to 323.9 mm (2" to 12")	355.6 to 610 mm (14" to 24")	> 660 mm (> 26")
Agricultural	**Cultivated**	A	A	A
	Cultivated with special features (depth of cover considerations)	R	R	R
	Non Cultivated (Native Prairie, Rangeland, Pasture)	A	A	A
Non-Agricultural	**Existing Developed Lands** (Commercial, Industrial, Residential)	A	A	A
	Prospective future development (Commercial, Industrial, Residential)	R	R	R
	No future development anticipated (eg, Forest Areas)	A	A	A
Other Areas	**Environmentally Sensitive Areas** (including Wetlands)	A	A	A
	Roads & Railways	A+	A+	A+
	Water Crossings	A	A	A
	Other Crossings (Utilities)	A	A+	A+

Each box in the matrix represents the primary option for pipeline abandonment for each of the land use categories. It is recognized that there will always be a certain amount of pipe that will be removed or abandoned in place for each of the categories based on site specific assessments, but the primary option is the one listed in the matrix. As well, it is recognized that further development is needed to further refine land use categories. This development will occur as part of the development of the risk based site specific assessment process.

The three recommended options available in the matrix are described in Table 2.

Table 2 – Primary Pipeline Abandonment Options

Abandonment Option	Description
A	pipeline is abandoned in place
A+	pipeline is abandoned in place with special treatment to prevent potential ground subsidence (e.g., fill pipe with concrete)
R	pipeline is removed

At the initial stages of any pipeline abandonment project, site specific assessments will be necessary and will probably determine that a combination of abandonment options be performed for the various land use categories. In doing so, pipeline companies may determine a percentage split between the primary option in the matrix and any potential secondary option. For example, the matrix recommends that all diameter ranges of pipelines be abandoned in place for a cultivated land use category. However, when the time arrives to initiate an actual abandonment project for this land use category, there is a reasonable likelihood that a small amount of pipe will require removal or abandon with special treatment after the completion of site specific assessments. A similar approach can be applied for the other land use categories.

3.2. Regulatory Requirements

The 1996 Discussion Paper included an appendix summarizing the regulatory requirements which prevailed for pipeline abandonment in Canada at that time.

An updated tabular summary of current regulatory requirements has been compiled and appears as Appendix B of this report.

Any proposed abandonment activity for NEB regulated pipelines has to be approved in advance by the NEB and other applicable regulatory agencies. Applications for such approvals have to include the rationale for the abandonment and the measures to be employed to carry out the abandonment.

Applicable provincial legislation and regulations are also included in the summary in Appendix B for information purposes.

3.3. Environmental Considerations

The following key fundamental assumptions from the 1996 Discussion Paper remain relevant and applicable:

- Pipe abandoned in place shall be emptied of service fluids, purged or appropriately cleaned or both; physically separated from any in-service piping; and capped, plugged, or otherwise effectively sealed.
- It is assumed that pipe can be cleaned to an acceptable level (applicable regulatory standards)
- It is assumed that all external pipe coatings are stable (environmental) and acceptable to remain in place
- A responsible approach to all pipe abandonment projects includes an assessment of potential environmental effects.

Although various provincial regulators consider environmental issues such as cleanliness of the pipe, environmental regulatory process requirements specific to the abandonment phase of a pipeline remain limited to those of Alberta Environment. At this time, no other provincial jurisdiction specifically deals with pipeline abandonment.

Under the *Alberta Environmental Protection and Enhancement Act*, an operator must obtain a Reclamation Certificate once the pipeline right-of-way has been reclaimed to the current standard. If the abandonment project includes pipe removal that meets the index of a Class I pipeline, then AEPEA approval is required to ensure appropriate conservation and reclamation. A Class I pipeline is defined as one with an index of 2960 or greater (index = outside diameter in millimetres times length in kilometres). Class II pipelines are subject to conservation and reclamation direction provided in AENV's *Environmental Protection Guidelines for Pipelines*. A Class II pipeline is defined as one with an index less than 2960.

Since the 1996 Discussion Paper was issued, there has been increasing regulatory interest in environmental issues such as contamination from both provincial and federal regulatory bodies. These issues exist for both removal and abandon in place options. For example, if the pipe is a potential source of polychlorinated biphenols (PCBs) or naturally occurring radioactive materials (NORMs), it will affect the removal operation and the ability to safely dispose of the pipe and contaminants. However, if the pipe is left in place, the PCBs or NORMs could flow along the pathway inside or alongside the pipe spreading contamination. In both cases, to ensure compliance companies need to have an understanding of allowable threshold criteria for specific contaminants and current regulatory requirements at the time of abandonment.

At this time revisions are being considered by Environment Canada under the Canadian Environmental Protection Act related to PCB regulation. Currently a multi-stakeholder group led by the EUB, is developing guidelines for disposal of NORMs. The abandonment matrix in this report is based on current requirements, which at this time does not include any specific regulations for NORMs.

3.4. Land Use Considerations

From a review of the technical and environmental issues, it is clear that existing and future land use is the most important factor to consider when determining whether pipe should be removed or abandoned in place.

The 1996 Discussion Paper also reached the same conclusion. For the purpose of this report, it is assumed that there are no existing easement agreements and Crown Land Authorizations that would affect the abandonment options in the matrix.

Abandonment in place is recommended for the following land uses because the disturbance caused by pipe removal would adversely affect sensitive areas or existing infrastructure:

- Environmentally Sensitive Areas (parks, wetlands, natural areas, species at risk habitat)
- Water crossings (streams, rivers, lakes, canals)
- Non-agricultural lands such as:
    - forested lands,
    - existing developed lands (commercial, industrial, residential)
- Non-cultivated lands (native prairie, rangeland)
- Roads and railways
- Other crossings (utilities, other pipelines)
- Cultivated (including those that are irrigated)

Removal is recommended for the following land uses because of the potential for the pipe to become a hindrance to ongoing land management activities:

- Prospective future development (commercial, industrial, residential)
- Cultivated with special features where depth of cover is of concern (tree farms, turf farms, deep-tilling operations)

Generally, the process should be to abandon in place until the land is to be developed to lessen the overall impact to the area.

3.5. Ground Subsidence

Wherever abandonment in place is recommended in the matrix, it is assumed that ground subsidence levels are within the tolerable range for the land use. Abandonment plans should consider site-specific conditions to evaluate the degree and tolerability of subsidence that might be expected.

The 1996 Discussion Paper concluded after significant study that even under the worst conditions of total structural collapse, ground subsidence would be negligible for pipelines with diameters of 12-inches and smaller. It went on to conclude that for pipelines with greater diameters, the degree of subsidence may be within tolerable ranges. Studies commissioned on corrosion observed that less then 1 % of the pipeline length

contain coating defects which may lead to corrosion. In layman's terms, this means that most abandoned pipelines would retain their overall structural integrity for decades, if not centuries. The risk-based comprehensive site specific assessment would validate the subsidence risks.

Subsidence is known to be highly dependant on pipeline diameter, depth of cover and local soil conditions. Consideration for safety, land-use and environmental factors should help determine if the land can tolerate subsidence. The matrix identifies the general acceptability of in-place abandonment through most land-use categories except lands with special features and prospective future development areas. It is recognized that a proportion of pipelines abandoned in-place may be in-filled with solid materials to reduce or eliminate long-term subsidence.

In the case of pipe removal, subsidence continues to be an issue. Ditch line subsidence resulting from the removal of pipelines is to be addressed on a site-specific basis. Considerations should include: soil volumes required for backfilling, sources of material, topsoil conditions, compaction and application of a roach.

For further reference, in Section 3.3 of the1996 Discussion Paper (Appendix C) there is a more thorough overview of potential ground subsidence issues. It is recognized that considerable work is needed to validate the risk of subsidence due to pipeline corrosion. This work could occur as part of the effort to define a risk-based assessment process.

3.6. Remediation Considerations

It is assumed that any residual contamination found on the right-of-way or company owned/leased properties will be remediated to the applicable standards and regulatory requirements prior to final abandonment, regardless of the abandonment strategy.

3.7. Pipe Cleanliness

It is assumed that any pipe abandoned in place will be cleaned to meet all applicable guidelines and regulatory requirements. The question noted in the 1996 Discussion Paper of "How clean is clean?" remains unclear. One way to address this question is to consider not just the condition inside the pipe, but the potential for migration of any materials out of the pipe and the sensitivity for degradation of the surrounding soil or water to that particular material.

Companies need to understand the current criteria for various contaminants for those particular mediums along with the potential for movement of any materials beyond the pipe. The Canadian Council of Ministers of the Environment (CCME) developed guidelines (as have several provinces through harmonization initiatives), "Canada-Wide Standards for Petroleum Hydrocarbons (PCH) in Soil, 2001" that sets acceptable levels of certain contaminants in soil based on land use. It may be reasonable to expect that if the potential for any material movement within the pipeline is eliminated and if the level of listed contaminants inside the pipe meets the defined criteria, then there is no potential for

contaminants that may migrate out of the pipe to result in unacceptable levels in the surrounding land or water. Thus the pipe could be considered 'clean'. The risk is that these criteria for acceptable conditions may change over time as new information arises and regulatory policies evolve.

In addition to potential contaminants inside the pipe, an operator should also consider the potential for concern with pipe coating degradation. The potential for degradation of certain coatings, for example asbestos coatings, needs to be balanced with the risk to human health by removing the coatings.

3.8. Water Crossings

Water crossings remain an environmentally sensitive location on a pipeline right-of-way. For the purposes of the abandonment matrix in this report, it is assumed that any pipe abandoned in place will be cleaned to meet current criteria and that intact coatings are in an acceptable condition to be left in place.

3.9. Erosion Considerations

The 1996 Discussion Paper fully captured the various aspects of erosion issues that should be considered when abandoning a pipeline and these remain unchanged. For ease of reference, 3.7 of the 1996 Discussion Paper can be found Appendix C. In summary, these considerations included:

- Special consideration should be made for pipelines in areas of slope instability. Over time, a pipeline may play a role in reinforcing and stabilizing a slope. This is a primary reason for the preferred option of abandoning a pipeline in place on a slope. Protective measures, including building berms, ditch plugs, sub-drains, etc., may be required when removing a pipeline on a slope, increasing the cost of the abandonment project.
- Forested areas are likely less susceptible to erosion than areas like native prairie or cultivated land.
- The erosion history of an area, starting with construction through the life of the pipeline, should be considered when developing an abandonment plan.
- Longer-term erosion issues are a key consideration for pipelines abandoned in place that may, over time, become exposed for developed or cultivated land categories.
- Post-abandonment responsibilities should include erosion monitoring and remediation. In the case of pipeline removal, the pipeline right-of-way should be monitored for re-vegetation, weed control and surface subsidence.
- Stakeholder input, which includes consultation with other pipeline operators in the immediate area and landowners, is an important factor in selecting an appropriate abandonment option in areas of erosion or slope instability concerns.

3.10. Water Conduits

The potential for a pipe abandoned in place to become a conduit for water movement was discussed in the 1996 Discussion Paper. In developing the pipeline abandonment matrix, it is assumed that the abandoned pipe would be segmented at appropriate locations to address this potential concern. In determining the appropriate locations for the segmentation, factors such as terrain and land use are considerations. The 1996 Discussion Paper provides specific locations where segmentation and plugs are recommended (Table 3-1 of that report) and these remain valid today. Impermeable materials such as concrete, polyurethane foam or soil are still reasonable materials to create plugs in the pipe.

3.11. Highway, Road, Railway and Utility Crossings

Ground subsidence is the primary consideration for determining the appropriate pipeline abandonment option for highways, roads and railways. To address this concern it is recommend for all diameter ranges in the matrix that pipelines be abandoned in place with special treatment. The special treatment part of this option includes filling the pipeline with a material to prevent future subsidence. A concrete slurry mixture is still the most cost effective material available today to inject into the pipeline.

In Section 3.8 of the 1996 Discussion Paper there is an outline of several considerations to be assessed in determining the appropriate abandonment option for the various types of utility crossings. In summary these include:

- type of utility crossing
- congestion of other utilities that may limit access to pipeline
- pipeline may provide support to other utilities located above
- burial depth of pipeline
- pipeline diameter and subsidence tolerance
- disruption of cathodic protections systems of other utilities

It is assumed in the pipeline abandonment matrix that the primary option is to abandon the pipeline in place for all types of utility crossings in order to avoid potential impacts to the stability of those facilities. For the medium and large diameter ranges it is assumed that the pipeline be filled with a concrete slurry mixture to prevent future ground subsidence.

3.12. Other Facilities

The 1996 Discussion Paper provides an overview of all the other ancillary and auxiliary facilities that are associated with a pipeline system.

In summary, the main types of facilities include:

- above ground piping (including in-line inspection barrels)
- valves
- cathodic protection equipment (rectifiers, ground beds, test leads)
- above and below ground tanks
- compression and metering facilities

- buildings
- telemetry equipment
- slope monitoring equipment
- foundations and supports

These types of facilities are not specifically included in the pipeline abandonment matrix. However, in general all above ground facilities should be cleaned to an acceptable standard and removed. Below ground ancillary and auxiliary equipment can be abandoned according to the applicable land use category in the matrix providing that all environmental and safety considerations are appropriately managed.

For compression/pump, metering and some valve facilities a pipeline company should consider developing an appropriate decommissioning standard. Often these facilities reside upon company owned property, which may lead to the decommissioning of these facilities and sites to a company specific standard. For example, some companies may choose an industrial standard for their own reasons rather than returning the site fully back to its original state. Regardless of the standard chosen, all environmental and safety consideration should be fully addressed.

3.13. Post Abandonment Responsibilities

Section 4.0 of the 1996 Discussion Paper presented a full discussion of post-abandonment responsibilities to be considered. That discussion and the responsibilities to be considered remain relevant today. Post abandonment responsibilities may include activities for addressing future depth of cover issues due to erosion and scour, line location of abandoned in place pipeline facilities for future encroachment and utility crossings and maintenance of right-of-way signage and markers. Companies may want to consider developing a checklist of post abandonment responsibilities to ensure future compliance to all pertinent regulatory requirements.

4. Path Forward

a) Industry should consider sponsoring collaborative research to develop innovative cost-effective technologies to address certain pipeline abandonment issues discussed in this report. The abandonment assumptions contained in this report are based on existing technologies and the development of new technologies could have the potential to change the recommended pipeline abandonment options in the matrix.

Areas for further advancement include:

- alternative to a concrete slurry fill material to prevent ground subsidence
- development of cleaning solvents to more effectively address potential environmental contaminants
- quantification of subsidence threat for large diameter pipelines
- algorithms to model structural collapse of the pipeline

- pipeline cleanliness specifications (how clean is clean for required land use?)

c) Future pipeline abandonment projects need to be based on site specific assessments, having regard to the factors and assumptions included in this report.

d) Pipeline abandonment assumptions should be reviewed by affected parties on a periodic basis. This review should incorporate new knowledge that may be gained from pipeline abandonment projects and other case studies along with incorporating any changes to applicable codes and regulations.