3.13 RELIABILITY AND SAFETY

Transportation of crude oil by pipeline involves some risk to the public and the environment in the event of an accident or an unauthorized action, and subsequent release of oil. Spills of crude oil from the proposed Keystone pipeline and appurtenant facilities would have a finite rate of occurrence, would affect the environment to varying degrees, and would be a concern to all of stakeholders. This section includes a summary of:

- Safety standards,
- Safety history,
- Risk assessment,
- Impacts, and
- Mitigation.

Appendix L provides a detailed discussion of the reliability and safety issues summarized in this section.

3.13.1 Safety Standards

This section summarizes the regulatory and industry standards to which the proposed crude oil pipeline would be designed, constructed, operated, and maintained. Details related to safety standards are provided in Appendix L.

3.13.1.1 U.S. Department of Transportation Standards

DOT is mandated to provide pipeline safety under 49 USC Chapter 601. OPS administers the national regulatory program to ensure the safe transportation of hazardous liquids, including crude oil, by pipeline. It develops safety regulations and other approaches to risk management that mandate safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The Pipeline and Hazardous Materials Safety Administration (PHMSA) ensures that people and the environment are protected from the risk of pipeline incidents.

The rules governing pipeline safety are included in 49 USC Chapter 601. Of those, Parts 190, 194, 195, 198, and 199 are relevant to hazardous liquid (including crude oil) pipelines. The following is a brief summary of the more important parts of 49 USC Chapter 601 with regard to the Keystone Project.

- Part 190 describes the procedures used by OPS in carrying out their regulatory duties, including inspection of pipelines and enforcement of the regulations.
- Part 194 contains requirements for oil spill response plans intended to reduce the environmental impact of oil discharged from onshore oil pipelines.
- Part 195 prescribes the safety standards and reporting requirements for hazardous liquid pipelines, including detailed requirements on a broad spectrum of areas related to the safety and environmental protection of hazardous liquid pipelines.
- Part 198 prescribes regulations governing grants-in-aid for state pipeline safety compliance programs.

- Part 199 requires operators of gas and hazardous liquid pipelines to establish programs for preventing alcohol misuse and to test employees for the presence of alcohol and prohibited drugs; it also provides the procedures and conditions for this testing.

Parts 194 and 195 specifically require Keystone to develop a comprehensive ERP for the pipeline, to be reviewed and approved by OPS prior to operation (the draft ERP is included as Appendix C). OPS also would conduct periodic inspections of the pipeline during operation, and would review and approve the pipeline Integrity Management Plan for high consequence areas (HCAs) that Keystone would be required to prepare. HCAs are defined as:

(1) A commercially navigable waterway, which means a waterway where a substantial likelihood of commercial navigation exists;

(2) A high population area, which means an urbanized area—as defined and delineated by the Census Bureau—that contains 50,000 or more people and has a population density of at least 1,000 people per square mile;

(3) Another populated area, which means a place—as defined and delineated by the Census Bureau—that contains a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area; and

(4) An unusually sensitive area—explicitly defined in 49 CFR Part 195.6 as drinking water or ecological resource areas that are unusually sensitive to environmental damage from hazardous liquid pipeline releases.

The HCA regulation requires that new hazardous liquid pipelines identify HCAs prior to operation and that a written integrity management program be in place within 1 year after the start of operation including baseline assessments by the date that pipeline operation begins. Depending on the findings of the assessment, the operator must take preventive and mitigating measures to protect the HCA from the consequences of a pipeline failure. These measures include conducting a risk analysis of the pipeline segment to identify additional actions to enhance public safety or for environmental protection.

Keystone has submitted a Risk Assessment and Environmental Consequence Analysis (ENSR 2006b) and a Frequency-Volume Study (DNV 2006); these serve as the risk analysis required for HCAs. The Risk Assessment and Environmental Consequence Analysis (ENSR 2006b) includes Table 4-13, which summarizes Keystone’s estimate of pipeline miles within various types of HCAs. Keystone estimates that approximately 170 miles of the Keystone Mainline Project and 71 miles of the Cushing Extension would be within HCAs. Keystone will submit to OPS an Integrity Management Plan for HCAs prior to pipeline operation. The Keystone Risk Assessment and Environmental Consequence Analysis and the Frequency-Volume Study are discussed in more detail in Appendix L.

3.13.1.2 Standards and Regulations for Affected States

OPS is responsible for oversight and inspections of interstate pipelines such as the proposed Keystone pipeline; in states where OPS and the state have a special agreement in place, the state may carry out these functions. OPS regulates, inspects, and enforces interstate liquid pipeline safety requirements in all the states that would be crossed by the proposed Keystone pipeline.

States may adopt regulations with requirements that supplement or exceed federal requirements. All the states that would be crossed by the proposed pipeline have adopted state One-Call systems to reduce the potential for third-party damage to utilities during projects that involve excavations or soil borings. The laws and regulations of each state that would be affected by the Keystone Project contain no other requirements exceeding federal requirements, except for Administrative Code 165, Chapter 20 in the State of Oklahoma that regulates gas and hazardous liquid pipeline safety. Oklahoma assesses an annual fee on pipeline operators, has reporting requirements, and requires notices prior to construction.

3.13.1.3 Industry Standards

Pipeline design would comply with pertinent industry standards, including:

- American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) Code B31.4, "Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols." This standard addresses requirements for materials of construction, welds, inspection, and testing for cross-country hazardous liquid pipelines. It requires a mainline block valve on the upstream side of major river crossings and public water supply reservoirs, and either a block valve or a check valve on the downstream side.
- American Petroleum Institute (API) 570 Piping Inspection Code, Inspection, Repair, Alteration, and Re-Rating of In-Service Piping Systems. This code was developed for the petroleum refining and chemical processing industries but may be used for any piping system.
- API RP 1102, Recommended Practices for Liquid Petroleum Pipelines Crossing Railroads and Highways. This recommended practice is a requirement of ASME/ANSI B31.4.
- API RP 1109, Recommended Practice for Marking Liquid Petroleum Pipeline Facilities. ASME/ANSI B31.4 advises that this API RP 1109 shall be used as a guide.
- NACERP 01-69, Control of External Corrosion on Underground or Submerged Metallic Piping Systems. ASME/ANSI B31.4 refers to sections of this recommended practice as a guide for an adequate level of cathodic protection.

3.13.2 Safety History

This section summarizes the safety history of onshore hazardous liquid pipeline operations in the United States, including specific hazardous liquid pipeline operating experience in the states that would be traversed by the proposed pipeline. A more detailed review is found in Appendix L.

3.13.2.1 PHMSA's Oil Pipeline Statistics

Spills are reported to PHMSA on standard forms, in accordance with 49 CFR Section 195.50. PHMSA maintains a database of pipeline incident reports (available online: <http://primis.phmsa.dot.gov/comm/reports/psi.html>, accessed in February 2007). Pipeline incident reports encompass onshore and offshore natural gas and hazardous liquid pipelines. In this section, the term "hazardous liquid pipelines" is used for information based on hazardous liquid pipeline data.

Hazardous liquid pipeline incidents include those that are categorized as "serious" or "significant." A "serious" hazardous liquid pipeline safety incident is one involving a fatality or an injury requiring in-patient hospitalization. "Significant" hazardous liquid pipeline safety incidents include spills releasing 2,100 gallons (50 bbls) or more; spills of 210 gallons (5 bbls) of highly volatile liquid; spills resulting in total costs of $50,000 or more (1984 dollars); or spills that include fire, explosion, injury, or death.

The PHMSA spill report data web site includes summary tables that provide overviews of serious incidents and significant incidents reported over the last 20 years, ending in 2005. Because the PHMSA data set is truncated on the lower end at the reporting limit of 50 bbls[1], the data understate the actual number of incidents and overstate the average spill volumes.

Table 3.13.2-1 shows the average number of serious incidents in a year for hazardous liquid pipeline operators. The summary data show a decreasing trend in serious pipeline incidents. The data include 113 serious incidents reported for 20 years (1986–2005).

TABLE 3.13.2-1
Nationwide Hazardous Liquid Pipeline Systems,
Annual Averages of Serious Incidents (1986–2005)

Time Period	Serious Incidents per Year
5-year average (2001–2005)	3
10-year average (1996–2005)	5
20-year average (1986–2005)	6

Source: PHMSA 2007.

Table 3.13.2-2 shows the number of significant incidents in a year for all hazardous liquid pipeline operators. The summary data show a decreasing trend in annual incident frequency, injuries, and spill volume. Table 3.13.2-3 is a summary of PHMSA significant pipeline safety incidents for hazardous liquid pipelines (by cause) for the 20-year period from 1986 through 2005. The dominant incident cause is an outside force that results from one or more of the following:

- Excavation damage from encroachment of mechanical equipment (22 percent);
- Natural force damage such as earth movements due to soil settlement, washouts, or geologic hazards (5 percent); and
- Other outside force damage (1 percent) (Table 3.13.2-3).

Older pipelines have a higher frequency of outside force incidents partly because their location is less likely to be precisely known or marked, and because their diameters are in aggregate disproportionately smaller and therefore more easily crushed or broken.

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[1] Of the 600 spills reported in the PHMSA database between 1996 and 2005, 16 percent were reported as less than 2,100 gallons (50 barrels).

TABLE 3.13.2-2
Nationwide Hazardous Liquid Pipeline Systems, Annual Averages for Significant Incidents (1986–2005)

Period	Number of Incidents	Fatalities	Injuries	Property Damage [a, b]	Gross Barrels Lost	Barrels Recovered	Net Barrels Lost
5-year average (2001–2005)	123	2	7	$73,426,467	99,526	35,724	63,802
10-year average (1996–2005)	138	2	8	$88,783,825	127,828	53,319	74,509
20-year average (1986–2005)	153	2	14	$62,509,194	160,347	64,460	95,888

Note:

Totals for the period from 1986 through 2005: 3,051 incidents; 44 fatalities; 272 injuries; $1,250,183,884 property damage; 3,206,945 barrels lost; 1,289,191 barrels recovered, and 1,917,754 net barrels lost.

[a] The costs shown in the tables are in 2005 dollars. Costs are adjusted via the Bureau of Economic Analysis, Government Printing Office inflation values.

[b] For years 2002 and later, property damage was estimated as the sum of all public and private costs reported in the 30-day incident report, adjusted to 2005 dollars. For years prior to 2002, accident report forms did not include a breakdown of public and private costs; therefore, property damage for these years is the reported total property damage field in the report, adjusted to 2005 dollars.

Source: PHMSA 2007.

TABLE 3.13.2-3
Nationwide Hazardous Liquid Pipeline Systems, Causes of Significant Incidents (1986–2005)

Cause	Number of Incidents	Percent of Total Incidents (%)	Fatalities	Injuries	Property Damage [a, b]	Percent of Property Damage (%)
All other causes	736	24	20	127	$239,498,819	19
Corrosion	724	24	1	17	$255,514,544	20
Excavation damage	675	22	15	85	$141,841,074	11
Human error	204	7	3	29	$28,032,680	2
Material failure	542	18	2	9	$304,928,405	24
Natural force damage	147	5	3	5[c]	$247,870,514	20
Other outside force damage	23	1	0	0	$32,497,848	3
Total	**3,051**	**100**	**44**	**272**	**$1,250,183,884**	**100**

Note:

Significant incidents are those incidents reported by pipeline operators that meet any of the following conditions: (1) fatality or injury requiring in-patient hospitalization; (2) $50,000 or more in total costs, measured in 1984 dollars; (3) highly volatile liquid releases of five barrels or more, or other liquid releases of 50 barrels or more; (4) liquid releases resulting in an unintentional fire or explosion

[a] The costs shown in the tables are in 2005 dollars. Costs are adjusted via the Bureau of Economic Analysis, Government Printing Office inflation values.

[b] For years 2002 and later, property damage is estimated as the sum of all public and private costs reported in the 30-day incident report, adjusted to 2005 dollars. For years prior to 2002, accident report forms did not include a breakdown of public and private costs; therefore, property damage for these years is the reported total property damage field in the report, adjusted to 2005 dollars.

Source: PHMSA 2007.

Corrosion is another dominant incident cause, constituting 24 percent of all hazardous liquid pipeline incidents over the past 20 years. The frequency of incidents is also strongly dependent on pipeline age because corrosion is a time-dependent process (Keifner and Trench 2001). Pipeline age is important when assessing risk based on records of incident frequencies. In 2004, the Transportation Research Board (TRB 2004) published a review of pipelines that included "Pipeline Safety Data and Trends" as an appendix and relied heavily on previous work done for API (Keifner and Trench 2001). The API work confirms that hazardous liquid pipeline age is a significant spill risk factor. Several industry standards and practices and DOT requirements would tend to reduce the potential for spill incidents associated with the proposed pipeline relative to industry experience.

Intentional acts do not appear as a specific causal item in the PHMSA data. Terrorism has become a very real issue for energy infrastructure. DHS has been involved with FERC and other federal agencies in developing a coordinated approach to protecting the energy facilities of the United States, and continues to coordinate with these agencies to address this issue.

3.13.2.2 TransCanada Company-Specific Oil Pipeline Operating History

TransCanada is a well known and longstanding natural gas transportation company in Canada and the United States, with limited experience operating crude oil pipeline systems. Through a 50/50 joint venture, TransCanada and Alberta Energy Company (now EnCana Corporation) purchased the Platte pipeline in February 1996 and developed and constructed the Express pipeline in 1996. Together, the Express and Platte pipelines constitute a 1,700-mile system between Hardesty, Alberta and Wood River, Illinois. The system became operational in February 1997, with commercial deliveries beginning in April 1997. Alberta Energy Company operated the Express and Platte systems on behalf of the joint venture partnership until October 2000, when TransCanada divested its 50-percent interest to Encana Corporation.

Although TransCanada did not operate the Express and Platte pipeline systems, Keystone has provided a search of all records available to it, as well as the Freedom of Information Act On-Line Library at the PHMSA website (available online: <http://ops.dot.gove/state/IA98.htm>), to identify pipeline incidents that occurred during TransCanada's ownership interest in the system. No incidents were found to have occurred in Canada. One incident occurred in the United States in 1996: in Section 8, T53N, R17W, Chariton County, (Salisbury Station), approximately 3 miles west on Highway 24 near Salisbury, Missouri. The DOT-assigned identification number was 19960027. Corrosion is listed as the cause of the release of 220 bbls of crude oil**,** of which an unknown amount was recovered. No habitat, resources, or human services were affected.

The limited operating history with oil pipelines precludes comparison of accident and oil spill incident rates specific to TransCanada with the industry average rates. The extent of specific operating experience does not affect the regulatory requirements to be met by the operator.

3.13.2.3 Oil Pipeline Incident History in States That Would Be Traversed by Keystone

Of the 600 crude oil spills reported in the PHMSA database between 1996 and 2005, 9 percent were very large (defined as greater than 100,000 gallons [2,380 bbls]). Five of the very large spills were reported in Oklahoma. No other very large spills were reported from states in the Keystone Project area. Insufficient incident data and pipeline mileage on a state-by-state basis prevent a statistical analysis with conclusions applicable to estimating very large spill incident frequencies for the proposed Keystone pipeline.

3.13.3 Risk Assessment

This section summarizes the potential for oil spills from the proposed Project, including potential types of spills and sources, and an evaluation of oil spill frequency and volume that may be expected. A more detailed description of the components and methods included in the risk assessment are found in Appendix L.

3.13.3.1 Construction Spills

The majority of construction spills tend to be relatively small, refined products (e.g., gasoline, diesel, and lubricating and hydraulic fluids); and most result from vehicle and construction equipment fueling and maintenance in construction staging areas or along the construction ROW. A tanker truck accident or a fuel storage tank failure is the most likely source of the largest construction spills. Fueling operations can be a source of frequent but small spills. Construction staging areas may include portable fuel and oil storage tanks, staged onsite during the course of the construction activity. The potential oil spill volume from these sources would be small relative to the potential oil spill volume from a pipeline incident. Specific preventive and mitigating measures found in this section under “Mitigation Measures” address potential spills from construction activities.

3.13.3.2 Operations Spills

Spills from the pipeline or associated pump stations, valves, or pigging facilities could occur during operation and have the potential to result in larger-volume spills and could occur any time in the year.

A large spill is most likely to result from a major pipeline break. Although pipeline leak detection technology could identify a leak and shut down flow quickly, actual response with containment equipment and cleanup crews may be delayed for several reasons, including:

- The exact leak location may not be known;
- Snow or other factors may hinder visual detection; and
- The leak is remote from response capabilities, and reporting the leak may be delayed.

Pipeline operational spills can occur anywhere along a pipeline from leaks, drips, and spills. Oil releases from the pipeline can occur due to corrosion, damage caused by third parties performing excavation or soil borings, external forces due to landslides or washouts, or other causes. Pump station operational leaks can occur from causes similar to pipeline leaks or maintenance activities, such as changing filters and pig launching or receiving incidents.

3.13.3.3 Oil Spill Frequency and Volume

Risk of oil spills is expressed as a combination of spill frequency and spill volume and is assessed using failure frequencies that are derived from general hazardous liquid pipeline operating history. General incident frequencies and spill volumes then were reviewed for relevance to the proposed Keystone Project. This risk assessment approach has been performed at different levels. As part of the NEPA review, a frequency-volume analysis was performed using PHMSA data specific to the states that would be crossed by the proposed pipeline. Incidents occurring in Canada have been documented by regulatory agencies and popularly reported (e.g., Glenavon oil spill; available online: <http://dogwoodinitiative.org/newsstories/pipelineoilspillraisesquestions>). However, data on these incidents are not readily available or expected in formats amenable to pooling with PHMSA data for analysis. Keystone submitted a Project-specific analysis that used various reference frequencies for different types of incidents and was adjusted for Project-specific factors (ENSR 2006b, DNV 2006). Use of these different approaches results in a range of spill frequencies that "bracket" the number of spills expected from the proposed pipeline. Details of how the different approaches are used and variations in results are provided in Appendix L.

Spill frequencies and volumes estimated from PHMSA data and applied to the proposed Keystone pipeline are presented in Table 3.13.3-1. The frequency factors give an overall frequency (for spills or leaks greater than 50 bbls) between 1.1 and 1.49 spills per year, depending on which data set is used as the basis. The volume factors give an estimated annual gross spill volume between 18,000 and 60,000 gallons (429 and 1,420 bbls) per year, depending on the data set used as the basis.

Keystone submitted a frequency-volume study (DNV 2006) and a Risk Assessment and Environmental Consequence Analysis (ENSR 2006b) This study evaluated hypothetical pipeline releases from three hole sizes—small holes (<0.1-inch diameter), medium holes (1-inch diameter), and large holes (>10-inch diameter) from various failure causes. The report also evaluated the risk at two different pipeline flows—435,000 and 591,000 bpd. These are the nominal and maximum proposed throughputs for the Keystone pipeline. Spill frequencies were estimated from historical data and modified by factors specific to the Keystone Project in order to estimate spill frequencies for the Keystone pipeline system. The study produced an overall frequency for spills or leaks greater than 2,100 gallons (50 bbls) of 0.143 spill per year for the nominal flow of 435,000 bpd and 0.186 spill per year for the 657,000-bpd maximum flow case. Table 3.13.3-2 summarizes the results for both flows.

TABLE 3.13.3-1
Projected Spill Incidents (>50 Barrels) per Year
for the Proposed Keystone Project

Spill Incidents per Year	Full PHMSA Hazardous Liquids Dataset [a]	PHMSA Data– Keystone States [b]	PHMSA Data– Crude Oil [c]
Incidents per mile per year	0.00081	0.0009	0.00109
Mainline Project(1,078 miles)	0.87	0.96	1.17
Cushing Extension (293 miles)	0.24	0.26	0.31
Keystone Project total (1,371 miles)	**1.10**	**1.23**	**1.49**

Notes:

PHMSA = Pipeline and Hazardous Materials Safety Administration.

Columns may not add due to rounding.

[a] "Full" includes all hazardous liquid pipelines in the United States, onshore and offshore.

[b] "Keystone states" includes data only for onshore hazardous liquid pipelines in the states that would be crossed by the Keystone pipeline.

[c] "Crude oil" includes data only for onshore crude oil pipeline incidents, all states.

Source: PHMSA 2007.

TABLE 3.13.3-2
Spill Frequency Associated with the Proposed Keystone Project—Keystone's Analysis

Pipeline	Spills per Year [a]	Spills per Year [b]
Mainline Project (1,078 miles)	0.112	0.146
Cushing Extension (293 miles)	0.031	0.040
Keystone Project total (1,371 miles)	**0.143**	**0.186**

[a] Calculated based on specific analysis for the Keystone Project of spill probabilities for 435,000 bpd (DNV 2006).

[b] Calculated based on specific analysis for the Keystone Project of spill probabilities for 657,000 bpd (DNV 2006).

Source: DNV 2006.

The PHMSA data gives a spill frequency that is an order of magnitude higher than that given by the analysis performed by Keystone for the Keystone Project. Although future events cannot be predicted with certainty, spill frequencies can be used to estimate the number of events that might occur. Actual frequency may differ from the predicted values of either analysis. Explanations for the differences between spill frequency estimates include:

- PHMSA data reflect incidents on existing pipeline infrastructure. With implementation of DOT's Integrity Management Rule, continually improving industry operating practices, and advancements in best available control technology (BACT), the number of spills is expected to decline from historical levels of older pipelines.
- The Keystone analysis (DNV 2006) used an additive method, starting from specific types of incidents and adding their respective frequencies. This approach would omit incidents from other causes.
- Based on these factors, the PHMSA data would tend to overestimate the Keystone spill frequency, and the DNV method would tend to underestimate the spill frequency. The expected frequency of incidents would probably be a value between the two estimates.

For purposes of the risk and impact assessment of the Keystone pipeline, a reasonable generalization is that small spills are likely to occur and very large spills are highly unlikely to occur. Although large to very large spills are highly unlikely to occur, they have occurred in the past (as indicated by the PHMSA data); therefore, the potential impacts of such events should be considered. It is also important to consider that, as additional engineering and design information and refinements become available, Keystone would update its risk assessment and submit the updated assessment in subsequent filings with DOS.

3.13.4 Impacts Related to Oil Spills

Crude or refined oil released into the environment (spills) may affect natural resources, human uses and services, and aesthetics to varying degrees, depending on the cause, size, type, volume, location, season, environmental conditions, and associated response actions. Small oil spills (e.g., intermittent leaks and drips from construction machinery and operating equipment) are almost certain to occur during construction and operation of the Keystone Project. There is also a finite potential for a spill of sufficient magnitude to substantially affect natural resources and human uses of the environment. This section summarizes impacts from a range of potential oil spill scenarios associated with the proposed Keystone Project. Details on the potential scenarios are provided in Appendix L.

Oil spills are typically unpredictable in cause, location, time of occurrence, size, and duration (J. L. Mach et al. Hart Associates 2000). The potential occurrence of oil spills can be assessed by analyzing the risk of spills based on historical operation of pipeline systems. When an oil spill occurs, the resulting environmental impact depends on a number of factors, including:

- Fate and behavior of the spilled oil (i.e., potential for a spill reaching an environmental receptor),
- Concentration and chemical composition of the oil, and
- Toxicity (hazard) of the oil to the receptor.

Given the range of potential events and environmental and released oil variables that could occur during an oil spill, an assessment of potential oil spill impacts requires a depiction of hypothetical potential spill scenarios and environmental variables that reasonably bracket spilled oil behavior and fate. These scenarios are provided with the caveat that they are necessarily simplified and do not represent the entire spectrum of possible values or combinations of values and events that might be realized in actual spills. The full assessment of spill scenarios and environmental variables prepared for this EIS (Appendix L) is summarized in the following sections.

3.13.4.1 Factors Affecting Oil Spill Impacts

Impacts related to oil spills can be affected by the release location, type of oil released, volume of oil released, nearby receptors and resource uses, seasonal variations, response time and response actions, weather, water levels, and other factors that are discussed below.

Location of Spill

Most spills would occur and be contained within, or in close association with, the pipeline ROW or the associated infrastructure, such as construction yards, pump stations, and maintenance yards. During construction, refined product spills also could occur from incidents such as tank truck accidents along roads leading to the construction sites. These spills typically would be small and would be promptly cleaned up as required by federal, state, and local regulations before they reached offsite lands or water bodies. Some spills from vehicles, including fuel and other tank trucks running off the roads, may result in much or all of a load being spilled to the land, wetlands, ponds and lakes, or flowing water bodies adjacent to the road or pad. Based on the pipeline spill data base, operational spills from the pipeline system itself would be more likely in areas where subsurface excavations are more frequent and in areas where corrosion potential is high.

Type of Oil

For the Keystone Project, the materials that could be released during the construction or operations phase include:

- Crude oil;

- Refined oil—diesel, gasoline, hydraulic fluid, transmission oil, lubricating oil and grease, waste oil, mineral oil, solvents, and other petroleum-based products; and

- Other hazardous materials—methanol, antifreeze, water-soluble chemicals, corrosion inhibitors, scale inhibitors, drag-reducing agents, and biocides.

Refined oil products could be released in relatively small quantities during construction or operation of the Keystone Project. Crude oil releases during operations could range from small to large volumes along the pipeline route. Corrosion inhibitors, scale inhibitors, drag-reducing agents, and biocides are considered part of the crude oil stream. Crude oil that would be transported by the Keystone Project originates as bitumen, a thick black oil extracted from the WCSB tar sands. For the bitumen to be transported by pipeline, an upgrading technology is applied to convert the bitumen to synthetic crude oil. The general chemical composition, solubility, toxicity, persistence, and other properties of the synthetic crude oil are described in Appendix L.

Volume

Spill volumes can be categorized as:

- Very small spills—less than 5 bbl (<210 gallons),
- Small spills—5–49.9 bbl (210–2,100 gallons),
- Significant[2] spills—50–499,9 bbl (2,100–21,000 gallons),
- Large spills—500–5,000 bbl (21,000–210,000gallons), and
- Very large spills—>5,000 bbl (>210,000 gallons).

This size classification is generally similar to the unofficial categories used by OPS for spill reporting. The very small spill and very large spill categories were added because the vast majority of spills are less than 210 gallons and very rarely spills do exceed 210,000 gallons.

Habitat, Natural Resources, and Human Use Receptors

The impact of an oil spill would be heavily influenced by the types of receptors (i.e., habitats, natural resources, and human uses) that might be exposed to the oil. Sensitive receptor categories, listed in order of increasing perceived sensitivity to an oil spill, include:

- Terrestrial–agricultural land—includes grazing, field and row crops, fallow fields, and similar land uses;
- Terrestrial–natural habitat—includes native and second-growth forests, naturally restoring grasslands, and similar areas that are not being used directly by people;
- Groundwater—emphasis is on areas where the water table is close to the surface and is overlain by soils permeable to oil or karst formations;
- Aquatic–wetland habitat—includes all areas that meet the definition of wetlands;
- Aquatic–lake/pond habitat—includes agricultural stock ponds, small and large lakes, reservoirs, and similar non-flowing water bodies;
- Aquatic–stream/small river habitat—includes smaller flowing water bodies and those that are intermittent or ephemeral;

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[2] Terminology from OPS spill reporting requirements.

- Aquatic–large river habitat—includes large flowing water bodies (i.e., the Platte River and the Missouri River) that are perennial, support commercial traffic, and may be restricted by dams and major reservoirs;
- Threatened and endangered species and their critical habitat—a special case of resources that may be found in any of the habitats but are limited in population size or spatial distribution;
- Human use–residential—areas where the pipeline ROW is near rural, suburban, or urban populations;
- Human use–commercial—areas (especially large rivers) that may be closed to normal use during a spill response action and result in substantial economic impacts;
- Human use–recreational—areas (especially lakes, small and large rivers, and reservoirs and associated parks) used by people for various recreational activities;
- Human use–water intakes—usually in reservoirs, large rivers, and some groundwater aquifers from which drinking water, industrial cooling water, or agricultural water supplies are obtained.

Season

The season in which a spill occurs could dramatically influence its behavior, resulting impacts, and the cleanup response actions. Seasonal effects are categorized for spring through fall and for winter.

The duration of the spring–fall season depends on the location along the pipeline route and the weather regime of the year. In this analysis, the season generally is defined as the period when the ground is free of snow and access to the pipeline ROW is not restricted by snow and ice. Most of the rivers and creeks are flowing; ponds, lakes, and reservoirs are open water; land is mostly snow-free; and biological use of land and water bodies is high. Currents, winds, and passive spreading forces would disperse spills that reach the water bodies. Spills to land would directly affect the vegetation, although dispersal of the spilled material is likely to be impeded by the vegetation. Spills to wetlands may float on the water or be dispersed over a larger area than would spills to dry land or to snow-covered land.

In winter, water bodies may be covered with ice, and snow partially to completely covers the land surface. Dispersal of material spilled to the land generally would be slowed, although not necessarily stopped by freezing within the active layer and by the snow cover. Depending on the depth of snow cover, as well as the temperature and volume of spilled material, the spill may reach the underlying dormant vegetation or wetlands, ponds, and lakes. Similarly, spills to flowing rivers and creeks generally would be restricted in areal distribution by the snow and ice covering the water body, compared to seasons with little or no snow and ice cover. Spills under the ice to creeks, rivers, and ponds/lakes might disperse slowly as the currents are generally slow to non-existent in winter. Also, because of the snow and ice, winter spills may be harder to detect and, when found, more difficult to contain and clean up.

Spring melt is the short transition period between winter and spring when thawing begins and river flows increase substantially and quickly, often to flood stages. Major floods could cause bank erosion, and any released oil entering the river could be widely dispersed and difficult to contain or clean up.

Weather and Water Levels

Weather, especially rapid warming periods and heavy rainfall, may cause snowmelt and runoff that could result in major flood flows in the larger rivers; these flood flows could breech levees, erode river banks and channels, and expose the pipeline to structural forces. If spilled oil is released to the flooded area, especially to flowing waters, the oil could be distributed to adjacent terrestrial, wetland, and aquatic habitats. High wind velocity may result in widespread distribution of any material released under pressure. Major flooding or adverse weather conditions (e.g., high winds, tornadoes, blizzards, and extreme cold) also may limit the ability to detect a suspected release, as well as hinder or stop the spill response contractors from implementing oil spill containment and cleanup operations.

Keystone Response Time and Actions

For the very small to most significant spills, response time and actions typically would prevent the oil from reaching sensitive receptors or would contain and clean up the spill before it causes significant environmental impacts. For large to very large oil spills and potentially some significant spills, especially those that reach aquatic habitats, the response time between initiation of the spill event and arrival of the response contractors would influence the magnitude of impacts to the natural environment and human uses. Once the response contractors are at the spill scene, the efficiency, effectiveness, and environmental sensitivity of the response actions (e.g., containment and cleanup of oil, and protection of resources and human uses from further oiling) would substantially influence the type and magnitude of additional environmental impacts. Keystone's plans to prevent, detect, and mitigate oil spills are discussed in more detail in the following section and in Appendix C.

Keystone Actions to Prevent, Detect, and Mitigate Oil Spills

Keystone has designed and committed to a comprehensive slate of processes, procedures, and systems to prevent, detect, and mitigate potential oil spills that may occur during pipeline operations. These are summarized below and described in more detail in Appendix C (Keystone's Draft Emergency Response Plan [ERP]).. The Final ERP that will contain further detail would be completed in the first quarter of 2009.

Prevention. Keystone has conducted a pipeline threat analysis using the pipeline-industry published list of threats under ASME B31.8S and by PHMSA to determine the applicable threats to the Keystone pipeline. Safeguards then were developed to protect against these potential threats, which have been identified as follows:

- Manufacturing defects – flaws in the seam of the pipeline created during the manufacturing process;
- Construction damage – flaws such as dents, cracks, nicks in the coating that are a result of transport, or construction;
- Corrosion (internal and external) – defects that develop over time during operation;
- Mechanical damage – external contact with the pipeline (e.g., backhoes, excavators, and drills); and
- Hydraulic event – overpressure of the pipeline.

Safeguards have been implemented during the design phase of the Project and would be implemented during construction and operations of the pipeline. These include the pre-qualification and surveillance during production by steel suppliers, pipe mills, and coating plants using formal qualification and surveillance processes consistent with ISO standards.

The regulations require the use of a design safety factor contained in 49 CFR 195.106 to establish a maximum operating pressure for steel pipelines. This formula for calculating maximum operating pressure specifies a design safety factor of 0.72 for onshore pipelines. This factor of safety ensures that the maximum allowable operating pressure (MAOP) of the pipeline would not exceed 72% of the specified minimum yield strength (SMYS) of the steel used to construct the pipeline. Under the federal Pipeline Safety Act, a waiver of any regulatory requirement may be granted by the federal Pipeline and Hazardous Materials Safety Administration (PHMSA) if the agency finds that granting the waiver is not inconsistent with pipeline safety (49 USC 60118). On November 17, 2006, Keystone filed a request for waiver of 49 CFR 195.106, seeking permission to use an 0.80 design factor, meaning that the MAOP of the proposed Keystone pipeline would not exceed 80% of the SMYS of the steel used to construct the pipeline. This waiver has been granted for rural areas; therefore, the Keystone pipeline at a maximum operating level will be 20% below the yield strength of the steel used to construct the pipeline.

PHMSA undertook an extensive, detailed technical review of Keystone's request. PHMSA also engaged outside experts in the field of steel pipeline fracture mechanics, leak detection, and supervisory control and data acquisition (SCADA) systems to assist in the review of Keystone's application. PHMSA publicly noticed Keystone's application and incorporated the concerns expressed in public comment into its review. As a result of its review, PHMSA issued a Special Permit allowing Keystone to design, construct, and operate its crude oil pipeline project using a design factor and operating stress level of 80 percent of the steel pipe's SMYS in most areas.

In issuing the Special Permit, PHMSA found specifically that allowing Keystone to operate at 80 percent of SMYS is consistent with pipeline safety and that it "will provide a level of safety equal to or greater than that which would be provided if the pipelines were operated under existing regulations." The Special Permit contains 51 conditions that Keystone must comply with, addressing such areas as steel properties, manufacturing standards, fracture control, quality control, puncture resistance, hydrostatic testing, pipe coating, overpressure control, welding procedures, depth of cover, SCADA, leak detection, pigging, corrosion monitoring, pipeline markers, in-line inspection, damage prevention program, and reporting. Failure to comply with any condition may result in revocation of the Special Permit. In addition, the Special Permit is not applicable to certain sensitive areas, including commercially navigable HCAs; high population HCAs; highway, railroad, and road crossings; and pipeline located within pump stations, mainline valve assemblies, pigging facilities, and measurement facilities. Issuance of the Special Permit was based on PHMSA's determinations that the aggregate effect of Keystone's actions and PHMSA's conditions provide for more inspections and oversight than would occur on pipelines installed under the existing regulations, and that PHMSA's conditions would require Keystone to more closely inspect and monitor its pipeline over its operational life than similar pipelines installed without a Special Permit. The pipe is non-destructively examined, hydrostatically tested, and mechanically tested to prove strength, fracture control, and fracture propagation properties in the mill. All pipes are traceable. The pipe also is examined for fatigue related defects when it is off-loaded from rail cars at stockpile sites.

Pipe welds and coating are inspected using non-destructive methods. The pipeline is hydrostatically tested to a minimum of 100 percent of specified minimum yield strength (SMYS) once placed into the trench, and an in-line inspection is performed for construction-related damage. The pipeline is coated with fusion-bonded epoxy (FBE), and corrosion protection (CP) systems are installed to protect all facilities.

During operations, Keystone would enforce a specification for sediment and water content in the commodities transported, in addition to implementing a comprehensive Integrity Management Program that would use prevention tools such as in-line inspection, CP system surveys, geotechnical monitoring, corrosion coupons and associated testing, corrosion inhibitor and biocide injection, aerial patrol, and public awareness programs. Ground-level patrols would be undertaken in the event of a suspected leak but are not routinely undertaken as is the case with aerial patrols.

Detection. Keystone would utilize a comprehensive Supervisory Control and Data Acquisition (SCADA) system to monitor and control the pipeline. Data provided by the SCADA system would alert the Operations Control Center (OCC) operator to an abnormal operating condition, indicating a possible spill or leak. A back-up communication system also would be available should SCADA communications fail between field locations and the OCC.

The SCADA system would continuously monitor pipeline conditions and update information provided to the OCC operator. Data received via the SCADA system also would be directed to the dedicated leak detection system, capable of independently sending an alarm to the OCC operator.

Keystone also would incorporate computer-based accumulated gain/loss volume trending to assist in identifying low rate or seepage releases below the 1.5- to 2-percent-by-volume detection threshold referenced in Section 2.3.2. These low rate releases often are referred to as pinhole leaks. This involves performing calculations on routine time intervals (approximately 30 minutes) of the volume of oil gained or lost within a pipeline segment bounded by flow measurement equipment. By accumulating these gain/loss results over a succession of time intervals, the cumulative imbalance, if any, of the segment can be determined. Once this cumulative imbalance exceeds a prescribed threshold, further investigation and evaluation is required. Thresholds would be established based on the accuracy and repeatability of flow measurement equipment and the extent to which flow imbalances generated by the normal operation of the pipeline can be tuned out.

In the event that a volume imbalance is identified and warrants further investigation, Keystone would use measures such as the following to identify the leak location:

- Shut-in pressure testing between isolation valves to identify pressure loss within a pipeline segment;
- Aerial and ground patrols to provide direct observation and identification of leak location;
- Internal inspection surveys; and
- Other methods of external leak detection, including odorant-based.

Spill Response Procedures. Standard operating and response procedures would be utilized by the OCC operator in responding to abnormal pipeline conditions, including leak alarms. The OCC operator would have the full and complete authority to execute a pipeline shutdown. Keystone’s OCC operator would follow prescribed procedures in responding to possible spills that may be reported from sources such as:

- Abnormal pipeline condition observed by the OCC operator,
- Leak detection system alarm,
- Employee reported, and
- Third party reported.

Upon receipt of notification, as outlined above, the OCC operator would execute the following procedures:

- Follow prescribed OCC operating and response procedures for specific directions on abnormal pipeline condition or alarm response;
- Dispatch First Responders;
- Shut down the pipeline within a predetermined time threshold if abnormal conditions or leak alarm cannot be positively ruled out as a leak; and
- Complete internal notifications, as outlined below.

The chart on the following page outlines the notification process for reporting and evaluating a potential oil spill, as well as activation of the Oil Spill Response Plan. The Regional Emergency Operations Center (EOC**)** Manager (Qualified Individual) is the key individual responsible for evaluating and activating the Oil Spill Response Plan.

All Keystone employees are authorized to communicate directly with the OCC should they observe conditions that may signify a possible spill.

OCC operators have the full and complete authority to shut down the pipeline and proceed with pipeline segment isolation in the area of the leak. The OCC can designate any qualified Keystone field employee as a First Responder in order to mitigate the early impacts of the spill. The First Responder is required to immediately respond and investigate the suspected location.

Procedures are established within Keystone outlining regular signing and financial authority limits. It is recognized that these standard authorities may not apply in an emergency due to the requirement to immediately contain and control the emergency situation.

Accordingly, Keystone has established the following policy related to financial authority in an emergency:

> "The Emergency Site Manager (Qualified Individual) or Region EOC Manager (QI) has financial authority to obtain Tier 1, 2, and 3 resources and any other resources necessary to contain and control the emergency situation."[3]

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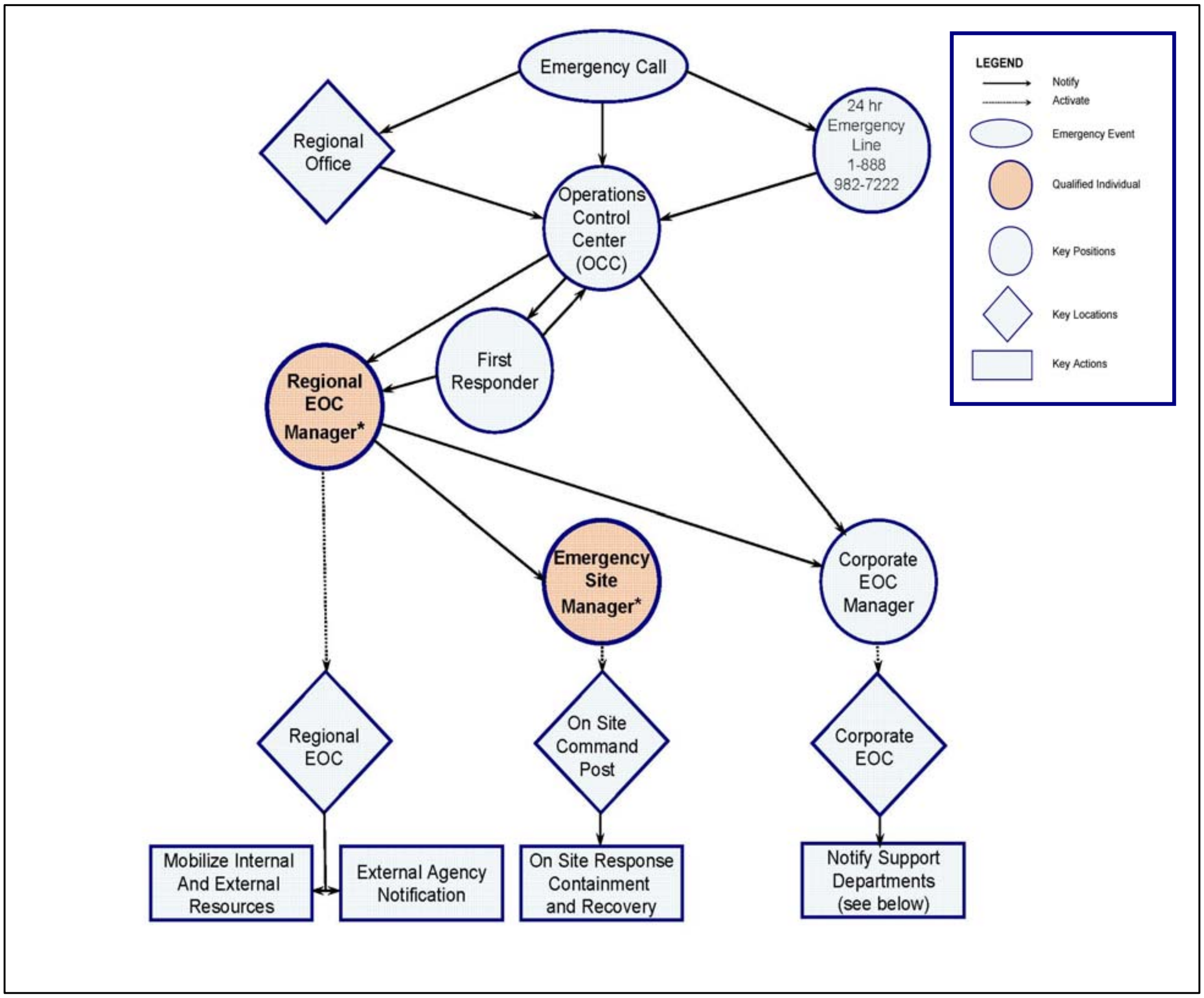
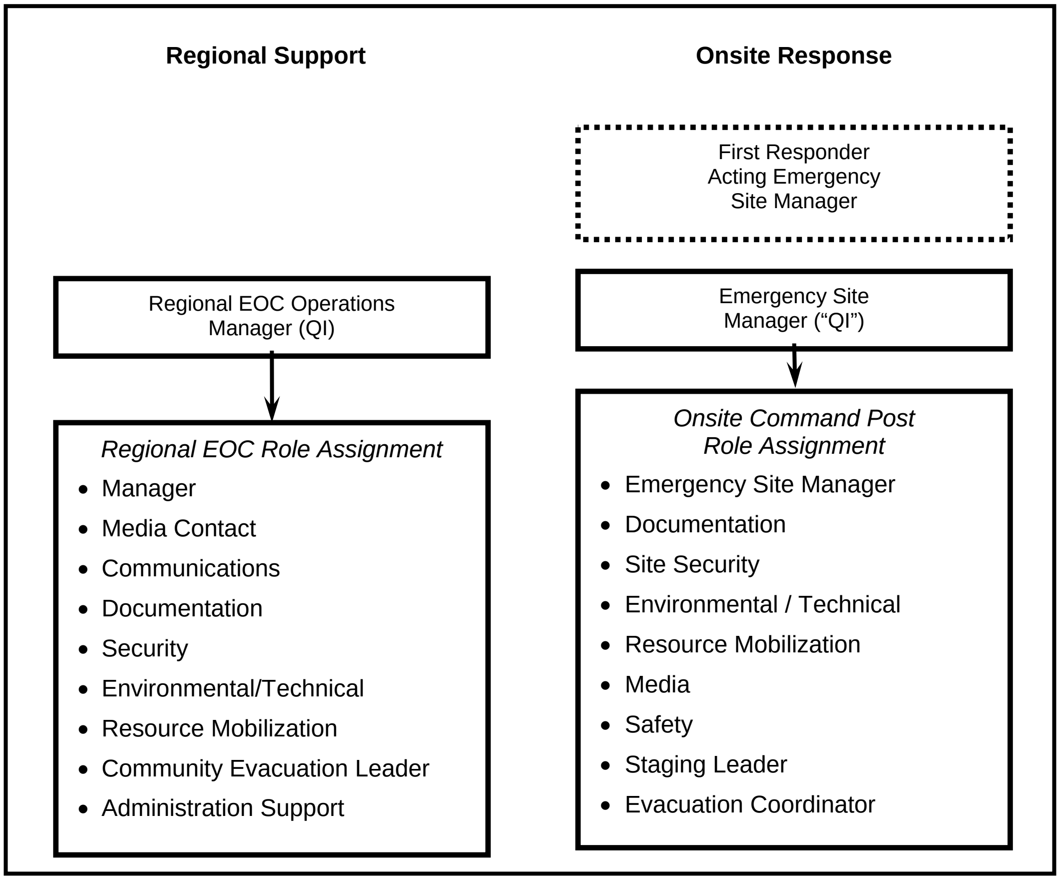
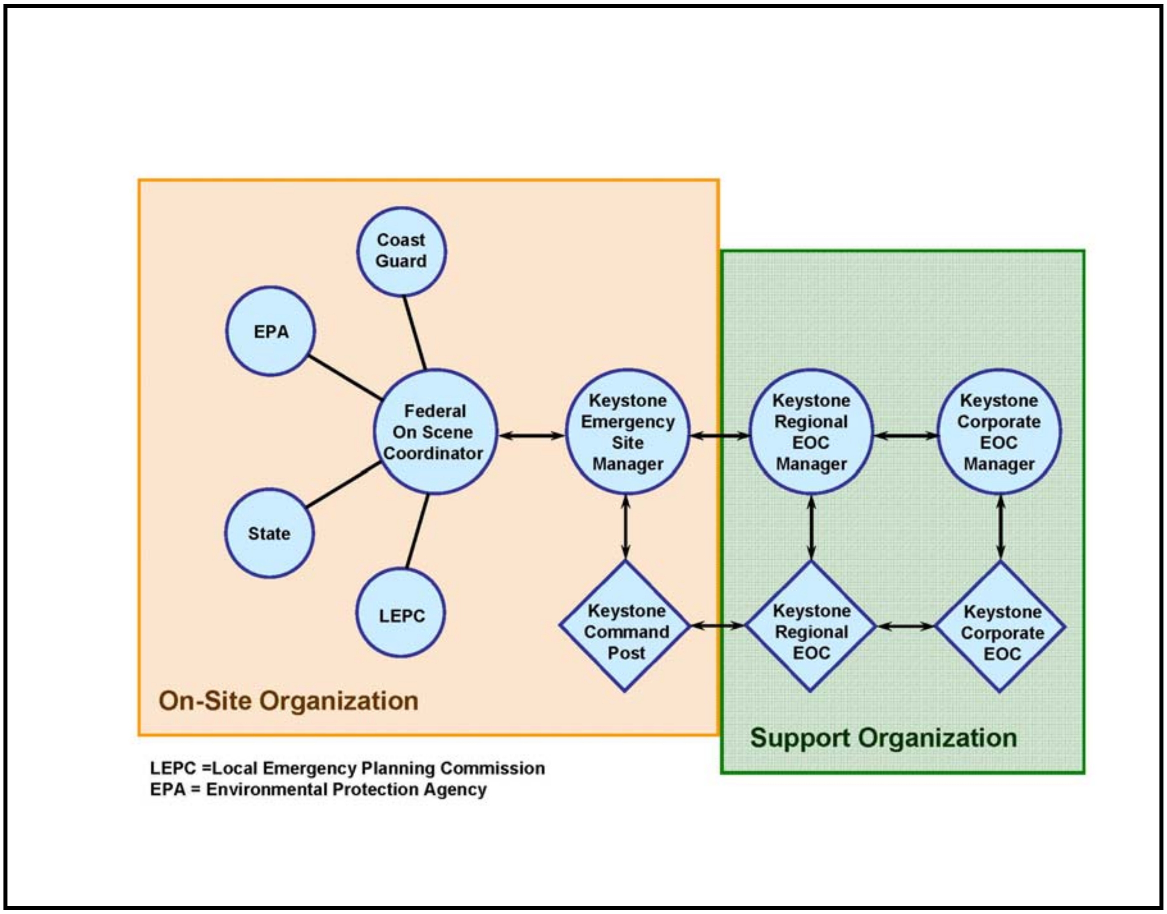
[3] Tiers are response time categories to remove a substantial threat of a worst-case discharge. Table 3.13.4-1 describes the response time requirements along the Keystone pipeline, as defined in 49 CFR Part 194.115(b).


Emergency Call
Regional Office
24 hr Emergency Line 1-888 982-7222
Operations Control Center (OCC)
First Responder
Regional EOC Manager*
Emergency Site Manager*
Corporate EOC Manager
Regional EOC
On Site Command Post
Corporate EOC
Mobilize Internal And External Resources
External Agency Notification
On Site Response Containment and Recovery
Notify Support Departments (see below)
LEGEND
Notify
Activate
Emergency Event
Qualified Individual
Key Positions
Key Locations
Key Actions

The organizational chart for the keystone oil spill response team is presented below. The Emergency Site Manager (QI) in conjunction with the Regional EOC Manager (QI) is responsible for creating an oil spill response organization to effectively manage the incident. Role assignments for the Regional EOC and the Command Post represent the specific functional areas that the Emergency Site Manager (QI) and Regional EOC Manager (QI) determine are necessary to address a specific spill.



The diagram below outlines the action and communication paths under a Unified Command Structure. The Emergency Site Manager (QI) is the primary contact for the Federal On-Scene Coordinator.



Response Time. In the event of a potential pipeline leak or spill, the estimated time to complete an emergency pipeline shutdown and close remotely operable isolation valves is as follows:

- Stop pumping units at all pump station locations: approximately 9 minutes
- Close remotely operable isolation valves: approximately 3 minutes
- **Total time: approximately 12 minutes**

Consistent with industry practice and in accordance with regulations, including 49 CFR Part 194.115, Keystone's response time to transfer such additional resources to a potential leak site would follow an escalating or tier system. Dependent on the nature of site-specific conditions and resource requirements, Keystone would meet or exceed the following requirements along the entire length of the pipeline system (Table 3.13.4-1).

TABLE 3.13.4-1
Response Time Requirements along the Keystone Pipeline

49 CFR Part 194	Tier 1 Resources	Tier 2 Resources	Tier 3 Resources
High-volume area[a]	6 hours	30 hours	54 hours
All other areas	12 hours	36 hours	60 hours

[a] "High-volume area" indicates an area where an oil pipeline with a nominal outside diameter of 20 inches or more crosses a major river or other navigable waters; because of the velocity of the river flow and vessel traffic on the river, this area would require a more rapid response in the case of a worst-case discharge or the substantial threat of such a discharge.

Spill Response Equipment. In general, the types of emergency response equipment that would be pre-positioned for access by Keystone are highlighted below (A more detailed description would be provided in the Final ERP, to be prepared in the first quarter 2009):

- Pick-up trucks, 1-ton trucks and vans;
- Vacuum trucks;
- Work and safety boats;
- Containment boom;
- Skimmers;
- Pumps, hoses, fittings, and valves;
- Generators and extension cords;
- Air compressors;
- Floodlights;
- Communications equipment including cell phones, two-way radios, and satellite phones;
- Containment tanks and rubber bladders;
- Expendable supplies, including absorbent booms and pads;
- Assorted hand and power tools, including shovels, manure forks, sledge hammers, rakes, hand saws, wire cutters, cable cutters, bolt cutters, pliers, and chain saws;
- Ropes, chains, screw anchors, clevis, and other boom connection devices;
- Personnel protective equipment, including rubber gloves, chest and hip waders
- Air monitoring equipment to detect H_2S, O_2 Lower Explosive Level, and benzene concentrations; and
- Wind socks, signage, air horns, flashlights, megaphones, and fluorescent safety vests.

Additional equipment, including helicopters, fixed-wing aircraft, all-terrain vehicles, snowmobiles, backhoes, dump trucks, watercraft, bull dozers, and front-end loaders also may be accessed depending on site-specific circumstances. Other types, numbers, and locations of equipment would be determined upon conclusion of the pipeline detailed design and the completion of Keystone's Final ERP (Oil Spill Response Plan). This plan would be completed in the first quarter of 2009 and submitted to PHMSA prior to commencing operations.

The primary task of the Tier 1 response team is to minimize the spread of product on the ground surface or water in order to protect the public and unusually sensitive areas, including ecological, historical, and archeological resources and drinking water locations. The Emergency Site Manager ("QI") would perform an initial assessment of the site for specific conditions, including the following:

- The nature and amount of the spilled product;
- The source, status, and release rate of the spill;
- Direction(s) of spill migration;
- Known or apparent impact of subsurface geophysical features that may be affected;
- Overhead and buried utility lines and pipelines;
- Nearby population, property, or environmental features and land or water use that may be affected; and
- Concentration of wildlife and breeding areas.

The Emergency Site Manager (QI) would request additional resources in terms of personnel, equipment, and materials from the Tier 2 and. if necessary, the Tier 3 response teams. Once containment activities have been successfully concluded, efforts then would be directed toward the recovery and transfer of free product. Site cleanup and restoration activities would then follow, all of which are conducted in accordance with the authorities having jurisdiction, including development of a natural resource damage assessment in the event that it is required.

Spill Response Personnel and Training. The number of emergency responders comprising specific response teams would be determined upon completion of Keystone's Emergency Response Plan (Oil Spill Response Plan) in the first quarter of 2009. Emergency responders would meet or exceed the requirements of 49 CFR Part 194.115, and would typically be comprised of Hazardous Waste Operations and Emergency Response ("HAZWOPER") trained personnel as follows:

- Tier 1: 8 HAZWOPER trained personnel (includes Emergency Site Manager ("QI") and Command Post Safety Officer).
- Tier 2: 12 HAZWOPER trained personnel.
- Tier 3: 24 HAZWOPER trained personnel.

Keystone's training requirements for key personnel are provided below. The response organization would follow the industry accepted Incident Command System ("ICS") and would typically consist of personnel both on site and within an established remote or Regional Emergency Operations Center ("EOC)".

Table 3.14.4-2 lists identified positions and training requirements for onsite personnel.

Table 3.14.4-3 lists identified positions and training requirements for the personnel related to the Regional Emergency Operations Center.

TABLE 3.14.4-2
Positions and Training Requirements for Keystone Onsite Spill Response Personnel

Position	Specialized Training to Meet Oil Spill Response Duties
First Responders	Hazardous Waste Operations and Emergency Response (HAZWOPER) training to Hazmat Technician Level 3 with annual refresher, as required
	Keystone Emergency Management System (EMS) training
	National Fire Protection Association (NFPA) training
Emergency Site Manager – Qualified Individual	HAZWOPER training to Hazmat Level 4 Specialist with annual refresher, as required
	ICS Communication training
	Keystone EMS training
	NFPA training
Command Post Media	Keystone EMS training
	Keystone Media Relations training
Command Post Safety	Keystone EMS training
	Advanced safety related training
Command Post Documentation	Keystone EMS training
Command Post Site Security	Keystone EMS training
Command Post Resource Mobilization	Keystone EMS training
Command Post Environmental/Technical	Keystone EMS training
Command Post Staging Leader	Keystone EMS training
Command Post Evacuation Coordinator	Keystone EMS training

Locations of Spill Responders. Keystone would base emergency responders consistent with industry practice and in compliance with applicable regulations, including 49 CFR Part 194 and 49 CFR Part 195. Consequently, emergency responders would be based in closer proximity to the following areas:

- Commercially navigable waterways and other water crossings;
- Populated and urbanized areas; and
- Unusually sensitive areas, including ecological, historical, and archeological resources and drinking water locations.

The specific locations of other emergency responders would be determined upon conclusion of the pipeline detailed design and completion of Keystone's ERP (Oil Spill Response Plan). The final ERP would be completed by the first quarter of 2009 and submitted to PHMSA prior to commencing operations.

TABLE 3.14.4-3
Positions and Training Requirements for Keystone Regional Emergency Operations Center Spill Response Personnel

Position	Specialized Training to Meet Oil Spill Response Duties
Regional Emergency Operations Center (EOC) Manager – Qualified Individual	HAZWOPER training to the Level of Hazardous Materials Specialist with annual refresher, as required ICS training Keystone EMS training
Regional EOC Media Contact	Keystone EMS training Keystone Media Relations training
Regional EOC Communications	Keystone EMS training
Regional EOC Documentation	Keystone EMS training
Regional EOC Security	Keystone EMS training
Regional EOC Environmental / Technical	Keystone EMS training
Regional EOC Resource Mobilization	Keystone EMS training
Regional EOC Community Evacuation Leader	Keystone EMS training
Regional EOC Administration Support	Keystone EMS training

Oil Spill Containment Strategies. With respect to spill containment, Keystone's containment strategies would include land-based and water-based measures, as follows:

- Land based:
  - Confining the spilled oil to as small an area as practical;
  - Preventing spilled product from migrating offsite;
  - Preventing spilled product from reaching waterways or water bodies; and
  - Blocking culverts, manholes, or other possible means for further product migration.
- Water based:
  - Confining the spill as close as practical to the spill source;
  - Containing the spill prior to it becoming wider and more difficult to effectively contain;
  - Preventing the spilled material from reaching rivers, streams, and other water bodies; and
  - Protecting sensitive areas in the direction of spill movement.

Typical containment and recovery techniques utilized to contain potential land-based spills would include:

- Earth containment berms,
- Street containment,
- Culvert blocking,
- Storm drain blocking,
- Sorbent booms / barriers, and
- Interception barriers.

Typical containment and recovery techniques utilized to contain potential water-based spills would include:

- Beach berming,
- Beach sumps,
- Boom techniques,
- Calm water containment booms,
- Flowing water containment booms,
- Open water containment booms,
- Exclusion booms,
- Cascading booms,
- Skimmers,
- Suction devices,
- Rotating discs,
- Weir devices,
- Blocking dams,
- Flowing water dams,
- Sorbent booms and barriers,
- Spills on ice,
- Spills under ice, and
- Spills during freeze-up or break-up.

Typical cleanup techniques would include:

- Pressurized equipment,
- Water flooding,
- Manual labor,
- Sorbents,
- Natural recovery,
- Bioremediation,
- Burning, and
- Dispersants and other chemicals.

Spill Training Exercises and Drills. Keystone's exercise program is designed to meet the exercise requirements as outlined in the National Preparedness for Response Exercise Program Guidelines developed by the U.S. Coast Guard and adopted by the PHMSA, the Minerals Management Service, and EPA. Participation in this program ensures that the Company meets all federal exercise requirements mandated by the Oil Pollution Act of 1990 (OPA '90).

The primary elements of the exercise program are notification exercises, tabletop exercises, Company-owned equipment deployment exercises, contractor exercises, unannounced exercises by government agencies, and area-wide exercises up to and including actual field drills conducted by industry and government agencies.

Keystone would ensure that operating personnel participate in exercises or responses on an annual basis in order to ensure that they remain trained and qualified to operate the equipment in the operating environment and to ensure that the Oil Spill Response Plans are effective. However, personnel and equipment that are assigned to multiple Response Zones would participate in only one deployment exercise per year.

The exercise year for all Keystone facilities would be from January 1 to December 31.

In addition to the exercise program described in Table 3.14.4-4, Keystone would be required to participate in unannounced federal agency-led exercises, and in other area exercises when requested by appropriate authorities.

TABLE 3.14.4-4
Keystone's Spill Training Exercise Program

Exercise Type (for Each Response Zone)	Exercises Conducted in Triennial Cycle
Qualified individual notification (one per year to be conducted during non-business hours to ensure that the notification process is tested during non-business hours once per year)	12
Spill management team tabletop (One must involve a worst-case discharge scenario)	3
Equipment deployment (Using either internal and/or external)	3
Unannounced (Any of the above exercises-with the exception to the qualified individual notification exercise-satisfy this requirement if conducted unannounced)	3

Notes:

Tabletop exercise is an exercise of the response plan and the spill management team's response efforts without the actual deployment of equipment.

Spill management team is the group of personnel identified to staff the appropriate organizational structure to manage spill response implementation in accordance with the response plan.

Internal exercises are those that are conducted wholly within the plan holder's organization. Internal exercises include personnel such as the qualified individual and those affiliated with the plan holder's spill management team, including Oil Spill Response Officers. The internal exercises do not involve other members of the response community.

External exercises are those that extend beyond the internal focus of the plan holder's organization and involve other members of the response community. The external exercises are designed to examine the response plan and the plan holder's ability to coordinate with the response community to conduct an effective response to an incident.

3.13.4.2 Factors Affecting the Behavior and Fate of Spilled Oil

The environmental fate of released oil is controlled by many factors, and persistence cannot be predicted with great accuracy. Major factors affecting the environmental fate include the type of product, spill volume, spill rate, temperature of the oil, terrain, receiving environment, time of year, and weather. Crude oil would weather differently than diesel or refined products in that both diesel and refined products would evaporate at a faster rate than crude oil.

The characteristics of the receiving environment, such as the type of land cover, soil porosity, land surface topography and gradient, type of freshwater body, presence of ice on water or snow on land, and flowing water current velocity, would affect how the spill behaves. In ice-covered waters, many of the same weathering processes are occurring as in open water; however, the ice changes the rates and relative importance of these processes (Payne et al. 1991).

The time of year when a spill occurs substantially affects the fate of the crude oil. The season controls climatic factors such as temperature of the air, water, or soil; depth of snow cover; whether there is ice or open water; and the depth of the active layer. During winter, the air temperature can be so cold as to modify the viscosity of the oil so that it would spread less and could even solidify. The lower the ambient temperature, the less crude oil evaporates. Frozen ground would limit the depth of penetration of any spill.

3.13.4.3 Types of Oil Spill Impacts

Oil spills can result in physical, chemical or toxicological, and biological impacts.

Physical Impacts

Physical impacts of oil spills to natural resources and human uses typically result from physical coating of soils, sediments, plants, animals, or areas used by people. Typical physical impacts include:

- Smothering living organisms so they cannot feed or obtain oxygen;
- Coating feathers or fur, which reduces their insulating efficiency and results in hypothermia;
- Adding weight to the organism so that it cannot move naturally or maintain balance;
- Coating sediments and soils, which reduces water and gas (e.g., oxygen and carbon dioxide) exchange and affects subterranean organisms;
- Coating beaches, water surfaces, and other places used by people; and
- Coating or contaminating existing infrastructure, such as buried waterlines in the spill zone.

Chemical and Toxicological Impacts

Toxicological impacts are the result of chemical and biochemical actions on the biological processes of individual organisms. The results may include direct and acute mortality; sub-acute interference with feeding or reproductive capacity; disorientation; reduced resistance to disease; tumors; reduced or loss of various sensory perceptions; interference with metabolic, biochemical, and genetic processes; and a host of other acute or chronic effects. In general, these impacts are manifested in sick, dying, or dead organisms. Oil spills typically are not toxic to humans, although the fumes from the spilled oil may make people sick if they are exposed long enough to sufficiently high concentrations in the air. Other than response personnel, most people generally are restricted from areas where fumes from the spilled oil potentially would pose a health threat.

Biological Impacts

The physical and chemical impact processes described previously are manifested at the individual organism level. Additional biological and ecological impacts may affect the local population, community, or ecosystem, depending on the location, size, type, season, duration, and persistence of the spill, in addition to the type of habitats and biological resources exposed to the spilled oil. Loss or reproductive impairment of a substantial portion of a population or biological community from an oil spill would be considered a significant environmental impact. Potential biological impacts would be greater if the affected species have long recovery times (e.g., low reproductive rates), have limited geographic distribution in the affected area, are central species in the ecosystem, are key habitat formers, or are otherwise critical to the local biological community or ecosystem. If the species or community is a key recreational or commercial resource, biological impacts at the population or community level also would constitute a significant impact.

3.13.4.4 Oil Spill Scenarios

A range of spill scenarios is provided to facilitate the impact assessment. It is impractical to evaluate all the reasonably likely, let alone possible, combinations of factors that are associated with and constitute an oil spill impact assessment. Most of the spills that may result in significant environmental impacts are likely to be crude oil from the pipeline. For that reason and because a key criterion for the OPS spill reporting system is the volume of oil released, the spill scenarios are based on the spill volumes listed in Section 3.13.4.2.

Very Small and Small Spills

The most common scenarios are the very small (< 5 bbl) and small (5–49.9 bbl) spills of diesel, hydraulic fluid, transmission oil, and antifreeze on work pads, roads, and facility parking or work areas. Some small spills may result from slow and small leaks of crude oil from the pipeline (also known as pinhole leaks). Most of these small spills would not reach non-facility land or water bodies. However, some of the spills could reach natural or cultivated land, or could seep into the soil toward groundwater or into nearby water bodies remote from the roads and pads. The few small spills that reached terrestrial habitats typically would affect a limited area adjacent to the road, ROW, or pad. Even the small spills that reached water bodies generally would result in a limited impact because of the small volume of oil involved.

Significant and Large Spills

Significant (50–499.9 bbl) and large (500–5,000 bbl) spills are much less common. Significant spills are more likely to: (1) be caused by accidents at construction and operation/maintenance sites; (2) be composed of refined products; and (3) occur on or near roads, construction pads, facility sites, or along the ROW.

Large spills are more likely to be crude oil releases from the pipeline and typically would occur in the ROW. Both significant and large spills are likely to result from tanker truck accidents (during construction), outside forces such as excavators and major earth movement, or corrosion of the pipe. Significant and large spills are more likely than small ones to reach natural or agricultural lands and water bodies adjacent to the ROW, roads, and pads. For the spills that reach water bodies, especially flowing streams and rivers, the area of impact generally would be more extensive than for the small spills because of the larger volume of oil involved. Likewise, the potential for large spills to reach groundwater surfaces is greater than for small spills. Large spills that result from a rupture in the pipeline, for whatever reason, are likely to be detected quickly by the SCADA system; both automatic and manual responses would be quickly activated to stop and isolate the leak.

Very Large Spills

Very large (>5,000 bbl) spills are a highly unlikely, but nonetheless possible, event. They are likely to result from a major rupture or a complete break (referred to as a “guillotine rupture”) in the pipeline and would release crude oil somewhere along the ROW. Causes could include corrosion; major earth movement resulting from slides, earthquakes, or flood flows eroding river banks at non-HDD crossings; mechanical damage from excavation work; or vandalism and terrorist actions. The actual volumes spilled could vary, depending on the location and the activation methods and times for valves, pressure in the line, actual location of the break, the extent to which the pipeline follows the topographic contours and presence of low spots in the pipeline, and other factors.

Very large spills are likely to reach both land and adjacent water bodies, especially if they occur in the ice-free seasons. The proximity of the pipeline to major streams and rivers may be the most important factor in the spill scenarios. In general, if the spilled material flows to dry land, natural or agricultural, the oil probably would not disperse very far. Crude oil is more viscous and would percolate downward more slowly than diesel fuel or other refined products. A substantial portion of crude oil may adhere to soil particles, thereby reducing the amount that reaches the groundwater. Once at the upper groundwater surface, most crude oil would float and may move downgradient with the groundwater. If a very large spill reaches a flowing creek or river, the oil could be dispersed for substantial distances downstream. In flood flows, the oil also could be distributed over the flooded natural, agricultural, or residential/ commercial lands and could flow into ponds, reservoirs, and lakes. Whether a very large spill would reach these rivers or streams would depend on several variables, including the type, temperature, and volume of oil spilled; the topographic relief and slope; air temperature; presence of snow or vegetation; and response time and actions.

3.13.4.5 Assessment of Impact Magnitude

Based on the worldwide literature accumulated over the past 50 years on oil spill impacts to ecosystems and human uses (e.g., NRC 1985, 2003a, 2003b), the magnitude of impact is primarily a function of the size of the spill, type of oil, and sensitivity of the receptors affected. For the Keystone Project, the crude oil stream represents the most likely source of an oil spill release that could produce a significant environmental impact. The size of a crude oil spill and the receptor types therefore would be key variables for estimating the magnitude of potential environmental impacts from such a spill. The size of the spill, measured in barrels, is an objective variable that can be measured or estimated within a reasonable margin of error in most cases. Receptor sensitivity, however, is more subjective and is markedly influenced by the perspectives and biases of the evaluators. The relative sensitivities of receptors that could be affected by the Keystone Project are presented as a hierarchy in Table 3.13.4-5, based on historical spill sensitivity assessments and typical stakeholder input.

The magnitude of environmental impacts generally increases within a receptor type as spill size increases (i.e., from left to right in the table). Within a spill size, the magnitude of impact increases with increasing sensitivity of the receptors (i.e., from top to bottom in the table). Combining size and sensitivity, the magnitude of impacts generally increases from top left to bottom right in the table. In many oil spills, the relative value of impacts on natural resources, including wildlife and wildlife habitats, is perceived to be higher or lower than the value of impacts to human uses, depending on stakeholder biases. Table 3.13.4-5 attempts to reflect a consensus of the ranking of these values, recognizing that the concept of “impact assessment and magnitude” is an anthropogenic one and not a component of ecosystem function.

3.13.5 Resource-Specific Impacts

This section summarizes potential Project-related impacts on specific resources that could result from oil spills and leaks.

TABLE 3.13.4-5
Significance of Environmental Impacts of Crude Oil Spills with Increasing Oil Spill Size and Increasing Sensitivity of Receptors

Type Of Receptor [a]	Size of Spill (in barrels)				
	Very Small (<5 bbl)	**Small (5–49.9 bbl)**	**Significant (50–499.9 bbl)**	**Large (500–5,000 bbl)**	**Very Large (>5,000 bbl)**
Terrestrial–agricultural land	Negligible	Negligible to minor	Minor to substantial	Minor to substantial	Substantial
Terrestrial–natural habitat	Negligible	Minor	Minor to substantial	Substantial	Substantial
Groundwater	Negligible	Negligible	Negligible to minor	Minor to substantial	Substantial
Aquatic–wetlands	Negligible	Minor	Minor to substantial	Substantial	Major to catastrophic
Aquatic–lakes and ponds	Negligible	Negligible to minor	Minor to substantial	Substantial	Major
Aquatic–streams and small rivers	Negligible	Negligible to minor	Substantial	Major	Major to catastrophic
Aquatic–large rivers	Negligible	Negligible	Minor	Substantial to major	Major to catastrophic
Threatened and endangered species and habitat	Negligible to minor	Minor to substantial	Substantial	Substantial to major	Major to catastrophic
Human use–commercial	Negligible	Negligible to minor	Minor	Minor to substantial	Substantial to major
Human use–residential	Negligible	Negligible to minor	Minor	Minor to substantial	Substantial to major
Human use–recreational	Negligible	Negligible to minor	Minor to substantial	Substantial to major	Major to catastrophic
Human use– water intakes	Negligible to minor	Negligible to minor	Minor	Minor to major	Major to catastrophic

Notes:

Negligible impact—little to no detectable impact on most resources; maybe some visible presence of oil on land, vegetation, or water. No to very few organisms apparently killed or injured. Temporary (days) and very local to spill site.

Minor impact—measurable presence of oil and limited impacts on local habitats and organisms. Temporary (days to weeks) and local (acres). Some organisms (likely birds, fish, and aquatic macroinvertebrates) may be killed or injured in the immediate area.

Substantial impact—patchy to continuous presence of oil on terrestrial and aquatic habitats near the spill site. Impacts may be present for weeks to a few months and may affect tens of acres or a few miles of stream/river habitat. Local community- and population-level effects on organisms and human uses of the area.

Major impact—patchy to continuous and heavy presence of oil on terrestrial and aquatic habitats near the spill site and for substantial distances downgradient of the spill site. Impacts may be present for weeks to months and potentially for a year or more. Area may include many acres to sections of land or wetlands and several miles of riverine habitat. Local community- and population-level impacts on organisms and habitats, and disruption of human uses of local oiled areas.

Catastrophic impact—mostly continuous or nearly continuous presence of oil on all habitats near and for substantial distances downgradient of the spill site. Impacts may be present for months to years. Area may include many acres to sections of land or wetlands, and several to numerous miles of river or other aquatic habitat. May cause local and regional disruption of human uses. May cause local and regional impacts to biological populations and communities.

[a] In increasing order of sensitivity from top to bottom.

3.13.5.1 Geology

The proposed Keystone Project does not involve geological features that have received state or federal protection.

Paleontological Resources

Most spills are confined to a construction or facility pad, access roadway, or pipeline ROW—or to an adjacent area. The primary exceptions are large to very large spills from pipelines that affect areas beyond the ROW. For example, a large to very large spill may enter a river crossing the ROW, and oil may be carried for several miles downstream to a paleontological site, should any be found to be present. Although no known sensitive paleontological resources would be crossed by the pipeline, surficial materials along the proposed ROW may contain Quaternary vertebrate fossils. Glacial deposits in particular may contain fossils of mastodon, mammoth, horses, and other Pleistocene large vertebrates (Paleontology Portal). Vertebrate fossils are relatively rare, and locations containing vertebrate fossils are more likely to be scientifically significant than those containing invertebrate or plant fossils. Where exposed, bedrock may contain Cretaceous and earlier marine fossils. Upper Cretaceous bedrock outcrops may contain fossils of marine organisms, including turtles, fish, ammonites, and various invertebrates. Pennsylvanian bedrock outcrops may contain fossils of marine invertebrates, including mussels, echinoids, bryozoans, crinoids, snails, corals, and trilobites. Pennsylvanian rocks in Illinois may contain plant fossils. Permian outcrops may contain fish and shark fossils. Along the Cushing Extension route in Noble County, Oklahoma, the Wellington Formation has yielded non-mammal vertebrate, invertebrate, and plant fossils (Paleontology Portal).

Because no areas of known sensitive paleontological resources would be crossed by the Keystone pipeline ROW or facilities, the likelihood of impacts on these resources from an oil spill is remote.

Mineral and Fossil Fuel Resources

The proposed route does not cross any active surface mines or quarries, but potentially valuable sand, gravel, clay, and stone resources may lie within the proposed Mainline Project ROW for the approximately 800 miles that traverse glacial deposits. Sand, gravel, crushed stone, and dimensional limestone are also present along the Kansas portion of the Cushing Extension ROW (ENSR 2006a). As discussed in preceding sections, impacts from spills vary with the type of oil, volume, site features (e.g., topography), season, hydrologic factors (e.g., spread by surface waters), degradation (e.g., volatilization), and the type and distribution of resources present. For surface and near-surface resources such as sand, gravel, clay and stone, small to significant spills may result in localized reduction in resource availability and value depending on actions involved in the incident response and subsequent remedial activities. For large and very large spills, the impacts may be proportionally greater. However, the distribution of these mineral resources and their relatively undeveloped state along the ROW indicate that the overall potential for impacts to the resources and their associated industries is small. In North Dakota, South Dakota, and Nebraska, the proposed route would cross deposits of sand, gravel, clay, and stone; but the acreage of deposits covered by the proposed ROW is insignificant compared to the total acreage of deposits present in each state. Thus, impacts from spills in the vicinity of these resources would be negligible for small or even significant spills that are rapidly contained. Even large spills would result in minor impact because of the distribution of these resources and their current state of development.

The proposed Mainline Project route does not cross the well pads of any active or proposed oil or gas wells (ENSR 2006a). The proposed Cushing Extension ROW in Kansas crosses or passes near several oil and gas fields. In addition to four abandoned oil fields in Clay County, the proposed route passes near the active El Dorado oil field (Brooks et al. 1975 in ENSR 2006a). In Oklahoma, numerous oil and gas fields are in the vicinity of the proposed Cushing Extension route. Oil and gas fields that would be crossed by the Mainline Project and Cushing Extension ROWs are identified in Table 3.1.3-1 (in Section 3.1.3). Impacts of spills of any size that are rapidly and effectively addressed, as expected, are not likely to result in any contamination or alteration of these oil and gas resources due to pipeline location and the depth and containment afforded by the extraction equipment, operations, and sites.

In Kansas, coal beds are present in Pennsylvanian rocks below the proposed route; they are too deep to mine, although coal bed methane production is a possibility (Charpentier and Rice 1995). The proposed route crosses approximately 40 miles of underlying coal seams between Wood River and Patoka, Illinois, where coal is mined with underground methods (USGS 2004 in ENSR 2006a). Coal fields that would be crossed by the Mainline Project are identified in Table 3.1.3-2 (in Section 3.1.3); no coal fields would be crossed by the Cushing Extension. Oil spills are not expected to affect coal resources.

3.13.5.2 Soils and Sediments

Soils

The impact of oil spills on soil is a function of several variables, including the type of oil, permeability of the soil, type and amount of vegetation and other surface cover, and the release point (e.g., above or on the surface or below ground). Crude oil, lubricating oil, and similar heavy oils would be less likely to penetrate through the surface soil layers than refined oil (for example, gasoline or diesel), which could infiltrate through the vegetation, debris, and litter cover. Refined products are more likely to reach the soil—especially in the warmer snow-free seasons because their low viscosity would allow penetration into the vegetation and even the thin snow layers.

Once the oil reaches the soil surface, the depth of penetration into the soil would depend on the viscosity of the spilled oil, the porosity of the soil, and the extent to which the soil is frozen or saturated with liquid water. Porous soils (e.g., sand, gravel, and moraines) are generally more permeable than clays and silts, especially if the latter are saturated. Karst areas may be especially vulnerable to impacts from a spill.

Spills could affect soils indirectly by affecting the vegetation, which could die and expose the soil to water and wind erosion even if the soil was not directly affected by the spilled material. Spill cleanup is more likely to affect the soils than the presence of the spilled material itself, unless the cleanup is well controlled and heavy traffic and digging are minimized (especially for spills in summer).

Sediments

Sediments (defined here as submerged soils in wetlands and aquatic habitats) are typically fine grained and saturated with water. The sediment may be coarser grained in fast-flowing streams and rivers, and in areas where glacial moraines dominate the soil types. Crude or refined oils typically do not penetrate beyond the surface layer in sediments unless (1) there is a substantial amount of turbulence that mixes the oil and sediments, followed by deposition of the mixture in low-energy areas; (2) the interstitial spaces are large enough (e.g., in gravel and coarse sand) to allow for penetration of the oil as it sinks; or (3) physical activities associated with spill response actions mix the surface-deposited oil-sediment mixture into deeper subsurface levels of the sediment profile. Refined products also typically would not penetrate sediments because of their water content but may penetrate or be mixed further into the sediments under the same turbulent or cleanup actions as for crude oil.

3.13.5.3 Water Resources

Surface Water

An oil spill that reached a freshwater body could reduce dissolved oxygen DO and increase toxicity to aquatic organisms. Decreases in DO concentrations in wetlands, ponds, and small lakes could result from decreased oxygen influx from the air because of the relative impermeability of the oil slick to oxygen and the relatively high rate of natural sediment respiration in many shallow water bodies. In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters because low biological abundance and activity result in low to negligible respiration rates in the sediment and water column. Sediment respiration has even less relative effect in the thicker water column of lakes deep enough not to freeze solid in winter. Such lakes, even those that hold fish, tend to be supersaturated with DO in winter (BLM and MMS 1998). During open water periods in most of the water bodies, especially the larger lakes, rivers, and streams, spilled materials would result in no detectable impacts on DO levels. The relatively high river volume (relative to the volume of oil) and the high rate of water flow would disperse the oil before it affected DO concentrations.

Although spills are not considered a part of routine operations, there is the possibility of a crude oil release occurring with the potential to affect surface water bodies. A large spill could affect drinking water sources and irrigation water supplies. Implementation of the procedures in Section 3 of Keystone's CMR Plan (Appendix B) would minimize the potential for spills and leaks to affect surface water resources. Keystone's draft ERP (Appendix C) describes actions to reduce the potential for crude oil releases to affect surface water and groundwater resources.

Minor temporary to short-term surface water quality degradation is possible from maintenance equipment and vehicle spills or leaks. During all construction activities, all refueling would be conducted at least 100 feet away from all surface water bodies. Although washout-related spills are not considered a part of routine operations, in the event that channel migration or streambed degradation threatens to expose the pipeline, protective activities such as reburial or bank armoring are likely be implemented. In its CMR Plan (Appendix B), Keystone has committed to a minimum depth of cover of 5 feet below the bottom of all water bodies, maintained for a distance of at least 15 feet to either side of the edge of the water body. However, in Keystone's Frequency and Volume Analysis Report (DNV 2007) the likelihood of washout-related spills for cover depths less than or equal to 10 feet is estimated to be twice that for cover greater than 10 feet. Channel incision of several meters is typical of many Midwestern streams and rivers; such incision would expose and threaten pipelines buried 5 feet below the channel bed. Furthermore, channel incision can sufficiently increase bank heights to destabilize the slope, ultimately widening the stream. Sedimentation within a channel also can trigger lateral bank erosion, such as the expansion of a channel meander opposite a point bar. Bank erosion rates can exceed several meters per year. Maintaining an adequate burial depth for pipelines 15 feet (5 meters) beyond either side of the active stream channel may necessitate bank protection measures that would increase both maintenance costs and environmental impacts. In light of these concerns, Keystone has committed to having the design of water crossings assessed by a qualified professional scientist or engineer to ensure that the depth of the pipeline near the water crossing is adequate based on flood scour potential and also to ensure that the pipeline depth is maintained for an adequate distance back from either side of the active channel. All water crossing designs would also be reviewed by the COE prior to the issuance of construction permits. The level of assessment for each crossing would vary based on the professional judgment of the qualified design personnel. The pipeline would be installed as determined to be necessary to address any hazards identified by the assessment. The design of the crossings would also include the specification of appropriate stabilization and restoration measures.

Control valves would be installed on both sides of larger perennial streams for the Mainline Project and the Cushing Extension pipelines. In the event of a crude oil release, the presence of valves and enactment of Keystone's ERP and spill containment measures would minimize the potential for any crude oil releases to affect surface water resources.

Groundwater

In the region of the proposed Keystone Project route, unconsolidated deposit aquifers in Quaternary-aged sediments are the most productive aquifers and are the source of water for thousands of shallow wells (Whitehead 1996). Shallow groundwater in this region is often used for agricultural, domestic, and industrial purposes. The Mainline Project route does not cross over any sole source aquifers, as designated by EPA Regions 5, 6, 7, and 8 (EPA 2007). (A detailed description of groundwater aquifers in proximity to the Project is presented in Section 3.3.1.1 and Appendix J.)

Significant spills of refined products, especially diesel, and significant to very large spills of crude oil may reach groundwater if the overlying soils are porous and not water saturated and if the water table is relatively near the surface. Areas near major wetlands and meandering streams or rivers are key examples where the water table may be close to the surface and the soils are wet to saturated, depending on rainfall and snowmelt conditions. In some of these areas, it may be difficult to distinguish between groundwater and surface water.

Diesel fuel has a low viscosity and likely would percolate toward the water table, where it would float on the water. It may move downgradient with the groundwater, although potentially at a lower rate than the groundwater. Some of the diesel may become dispersed in the groundwater, contaminating the groundwater for agricultural or domestic drinking supply uses. Also, the oil-contaminated groundwater may contaminate surface waters (e.g., wetlands, ponds and lakes, streams and rivers) if the groundwater surfaces and discharges into these surface water areas.

Crude oil is more viscous and would percolate downward more slowly. Also, a substantial portion of the crude oil may adhere to the soil particles, thereby reducing the amount that reaches the groundwater. Once the crude oil reaches the upper groundwater surface, most of it would float and may move downgradient with the groundwater—although probably more slowly. The oil also would undergo some biodegradation, adsorption to soil particles, and dispersion into the water—all of which effectively results in a natural attenuation remediation of the contamination. Like diesel fuel, the crude oil may reduce or eliminate agricultural or domestic uses of the groundwater and may contaminate surface water bodies if the contaminated groundwater discharges into these waters.

Overall, it is not anticipated that groundwater quality would be affected by disposal activities, spills, or leaks during construction activities. Many of the aquifers present in the subsurface beneath the proposed route are isolated by the presence of glacial till, which characteristically inhibits downward migration of water and contaminants into these aquifers. However, shallow or near-surface aquifers are also present beneath the proposed route. Temporary fueling stations would be used to refuel construction equipment. To prevent releases, fuel tanks or fuel trailers would be placed within secondary containment structures equipped with impervious membrane liners. Implementation of procedures outlined in Sections 2 and 3 of Keystone's CMR Plan (Appendix B) would ensure that (1) contractors would be prepared to respond to any spill incident; and (2) all contaminants would be contained and not allowed to migrate into the aquifer during construction activities, regardless of the depth of the underlying aquifer.

During the life of the Keystone Project, potential minor short- to long-term groundwater quality degradation is possible from equipment and vehicle spills or leaks. Routine operation and maintenance is not expected to affect groundwater resources; however, if a crude oil release occurred, crude oil could migrate into subsurface aquifers and into areas where these aquifers are used for water supplies. Keystone's draft ERP (Appendix C) describes actions to be taken in the event of a crude oil release or other accident. As noted earlier, the ERP would be finalized prior to initiation of operation.

3.13.5.4 Wetlands

Impacts of spills of crude oil or refined products to wetlands are influenced primarily by the type of oil, the amount and proportion of water surface area covered, the type of vegetation present in the wetland, and cleanup response actions. Refined products tend to be more toxic than crude oil, while crude oil tends to cause more physical impacts (e.g., smothering). Because the oil tends to remain on the water surface, the slick may affect the oxygen exchange between water and air. A large and continuous slick may result in a low DO environment under the released oil. The slick of refined product also may result in toxic components being dissolved and dispersed in the underlying water column over a large area. Dense stands of emergent vegetation tend to act like an oil boom and collect oil at the edges of the stand because the oil adheres to the vegetation. As noted earlier, crude oil tends to infiltrate the vegetation stands less than refined products because the crude oil is more viscous. Aggressive and intrusive cleanup methods tend to mix the oil into the water and especially the sediments (which are often anoxic below the surface layer), where the oil may have long-lasting effects. Such cleanup methods may directly affect the vegetation, sediments, and animals more than the spilled oil. Passive cleanup methods, especially natural attenuation and biodegradation processes, generally result in much less impact on wetland resources.

Spills of refined product (e.g., diesel or gasoline) that affect wetlands are more likely to occur during construction and are more likely to be very-small to small-volume spills from construction pads or from access roads. If the spills occur in winter, the wetland may be covered in ice; the spilled product may be contained by snow and remain on top of the ice. In either case, it probably would be recovered before it directly affected the wetland habitat and associated vegetation or animals. For spills occurring during the rest of the year, most of the product would float on the water or wet soil surface—although some of the volatile fraction may dissolve or disperse in the water where it could injure or kill organisms. Although gasoline spills evaporate quickly, they may cause a short-term acute toxicological effect on animals in the wetland; and the vegetation may be chemically "burned" from the water line up. Diesel spills tend to be more persistent, and the oil may become incorporated into the sediments as well as adhere to the emergent vegetation.

Crude oil spills could occur only during operation. Most spills that could affect wetlands would occur in the ROW, where the pipeline crosses wetlands or water bodies such as ponds, lakes, reservoirs, streams, rivers, or adjacent riparian habitats. Crude oil spills that occur in winter may be restricted in the area affected because the cold plus the snow would increase the oil viscosity. In warmer seasons, large to very large spills of crude oil may flow into wetlands, where oil would cover the water surface, coat plants and animals, and restrict oxygen exchange between air and water. Some of the crude oil may sink, become incorporated into the sediments, and remain there for years—depending on the amount of biodegradation and chemical or physical weathering that takes place.

Very small refined product or crude oil spills generally would cause negligible to minor impacts on wetlands unless the wetland is small and isolated from other water bodies. In these cases, the ecological impacts may be substantial because the majority of the wetland may be exposed to the oil. Some significant and many large to very large spills would result in substantial to catastrophic ecological impacts on wetlands because of the large size of the spill and the proportion of the wetlands that would be affected. Impacts may approach a catastrophic level in areas where the wetlands are heavily used by migratory waterfowl and the spill occurs during the spring or fall migration.

3.13.5.5 Biological Resources

Terrestrial

Vegetation

Because most spills are very small and would likely occur within the ROW, their effects would not reach natural or agricultural terrestrial habitats and would negligibly affect the vegetation and associated animals. However, some of the significant and the large to very large spills could reach the adjacent vegetation and habitat by directly flowing from the facility, or spilling from a pipeline leak in the ROW. During winter in the northern areas of the pipeline corridor, sufficient snow cover or sufficiently low temperatures may slow the flow of spilled oil and allow spill cleanup efforts to occur before oil spreads substantial distances from the spill source. Thus, even a large spill could result in a limited impact to vegetation and habitat. Cleanup operations, however, could cause impacts on vegetation and habitat if activities are not implemented carefully and with regard for minimal disturbance of the surface soils and vegetation. Whenever there are warmer temperatures and little to no snow cover, the spilled oil may flow a greater distance on the land surface thereby increasing the area where vegetation is potentially affected.

Most oil spills would cover less than an acre, but large to very large spills might cover several to tens of acres. After past spills, terrestrial habitats and ecosystems have shown a good potential for recovery; wetter areas have recovered more quickly (Jorgenson and Martin 1997, McKendrick 2000b). The length of time that a spill persists depends on several factors, including oil and soil temperature, availability of oleophilic microorganisms (organisms that biodegrade oil), soil moisture, and the concentration of the product spilled. For the most part, the effects of oil spills on land would be localized and are not expected to contaminate or alter the quality of habitat outside a limited area. Spills that occur within or near streams, rivers, and lakes could indirectly affect riparian vegetation and habitat along these water bodies.

Birds

Minor spills on or near the roads, pads, or facilities would not affect populations of birds, although a few individual shorebirds, waterfowl, and raptors (and very few passerine birds) could be exposed to the spilled oil. These exposed individuals are likely to die from hypothermia or from the toxic effects of ingesting the oil. Potential similar impacts would be limited to a few individual birds, especially waterfowl and shorebirds using the small ponds and creeks that could be affected by very small to small spills. These spills would not cause a population-level impact.

A substantial to very large spill onto dry land could cause the mortality of small numbers of shorebirds and passerines from direct contact. If the spilled material entered local or inter-connected wetlands, water-dependent birds and waterfowl, plus additional shorebirds, could be exposed. The numbers of individuals oiled would depend primarily on wind conditions and on the numbers and location of birds following entry of the spill into the water. Impacts would be detectable at the local population level, especially for resident species with limited geographic distribution.

If the spill entered a wetland, stream, or small river, a variety of waterfowl and shorebird species could be present, particularly during the spring and fall migrations. Losses resulting from the spill in this case could be substantial and at the population level for resident species, but likely would be negligible for migrating species with large geographic distributions. If raptors, eagles, owls, vultures, and other predatory or scavenging birds are present in the spill vicinity, they could become secondarily oiled by eating oiled birds. Mortality of breeding raptors likely would represent a minor loss for the local population but is not likely to affect the regional population.

If a large spill moved into wetlands, adjacent riparian habitats, or the open water habitats of other major rivers along the ROW, several waterfowl species that breed, stage, or stop there during migration may be at risk. A spill entering a major river in spring, especially at flood stage could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate before occupying nesting areas or continuing their migration.

Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Oiled individuals could lose the water repellency and insulative capacity of their feathers and subsequently die from hypothermia. Light to moderate exposure could reduce future reproductive success because of pathological effects on liver or endocrine systems (Holmes 1985) that interfere with the reproductive process and are caused by oil ingested by adults during preening or feeding. Stress from ingested oil can be additive to ordinary environmental stresses, such as low temperatures and metabolic costs of migration. Oiled females could transfer oil to their eggs, which at this stage could cause mortality, reduced hatching success, or possibly deformities in young. Oil could adversely affect food resources, causing indirect, sub-lethal effects that decrease survival, future reproduction, and growth of the affected individuals.

In addition to the expected mortality due to direct oiling of adult and fledged birds, potential effects include mortality of eggs due to secondary exposure by oiled brooding adults; loss of ducklings, goslings, and other non-fledged birds due to direct exposure; and lethal or sub-lethal effects due to direct ingestion of oil or ingestion of contaminated foods (e.g., insect larvae, mollusks, other invertebrates, or fish). Population depression at the local or regional scale is greater than for smaller spills. However, the effects of even a large spill are attenuated with time as habitats are naturally or artificially remediated and populations expand to again utilize them.

Mammals

Typical oil spills, even large to very large ones, would result in a limited impact on most of the terrestrial mammals found in the pipeline area. The proportion of habitat affected would be very small relative to the size of the habitat utilized by most of the mammals. Most of the mammals would not be present in the immediate vicinity of the spill or would be limited in abundance and distribution in the general area.

A large to very large spill that reaches the land in or adjacent to the pipeline ROW could affect terrestrial mammals directly or indirectly through impacts to their habitat or prey. For example, a large spill likely would affect vegetation, the principal food of the larger herbivorous mammals—both wild (i.e., deer) and domestic (i.e., cattle). Some to most of these animals probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume. For most spills, control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten animals away from the spill and reduce the possibility of these animals grazing on the oiled vegetation. Nevertheless, the spilled oil could affect the vegetation and reduce its availability as food for several years. This impact would be limited in area and would not affect the overall abundance of food for the grazing mammals.

For large spills that are not immediately or successfully cleaned up, the potential for contamination would persist for a longer time and the likelihood of animals being exposed to the weathered oil would be greater. Cleanup success could vary, depending on the environment. Over time, any remaining oil would gradually degrade. Although oiling of animals likely would not remain a threat after cleanup efforts, some toxic products could remain for some time. Depending on the spill environment, part of the oil could persist for up to 5 years.

Small mammals and furbearers could be affected by spills due to oiling or ingestion of contaminated forage or prey items. These impacts would be localized around the spill area and would not cause population-level impacts.

3.13.5.6 Fisheries

If the oil reaches aquatic habitats, spills could affect fish, macroinvertebrates (e.g., mussels, crustaceans, insects, and worms), algae and aquatic plants, amphibians, and reptiles. Aquatic habitats include wetlands, ponds, lakes, reservoirs, drainage ditches, streams, rivers, and cavern lakes in karst formations.

For the majority of spills, especially very small to large spills, impacts likely would be negligible to minor. Spill response would contain and remove almost all of the oil from ice-covered water bodies prior to snowmelt during winter. During the rest of the year, spills could reach and affect water bodies and aquatic habitats before spill response is initiated or completed.

The effects of oil spills on freshwater fish, macroinvertebrates, and other aquatic organisms have been documented and discussed in numerous previous spills. The specific effect depends on the concentration of petroleum present, the length of exposure, and the stage of development involved (larvae and juveniles are generally most sensitive). If lethal concentrations are encountered (or sub-lethal concentrations over a long enough period), mortality of aquatic organisms might occur. Extensive mortality caused by oil spills is seldom observed except in small, enclosed water bodies and in the laboratory environment. Concentrations observed under the oil slick of oil spills usually have been less than the acute values for fish, macroinvertebrates, and plankton. The concentration in flowing rivers and creeks in the Keystone Project area also would be relatively low, even for most substantial to large oil spills.

If an oil spill of sufficient size occurred in a small body of water with restricted water exchange (e.g., ponds and small slow-flowing creeks) that contained fish or other sensitive aquatic species, lethal and sub-lethal effects could occur for the fish and food resources in that water body. Toxic concentrations of oil in a confined area would result in greater lethal impacts on larval/juvenile fish versus adults. If a large to very large spill reached a slow-flowing, small to moderate size river in summer, the impacts due to toxic exposures may be greater than in the same river when flows are higher and water temperatures are cooler.

McKim (1977) found that, in most instances, larval and juvenile stages were more sensitive than adults or eggs. Increased mortality of larval fish is expected because they are relatively immobile and are often found at the water’s surface, where contact with oil is most likely. Adult fish would be able to avoid contact with oiled waters during a spill in the open water season, but survival would be expected to decrease if oil were to reach an isolated pool of ice-covered water. Barsdate et al. (1980) found that photosynthesis was briefly reduced and then returned to normal levels after several months in a closed lake. *Carex aquatilis*, a vascular plant, was affected after the first year because of emerging leaves encountering oil. Certain aquatic insects and invertebrates that lived in these plant beds were reduced in numbers, presumably from entrapment in the oil on plant stems. Some of the insects were still absent 6 years after the spill. Reducing food resources in a closed lake or pond, as described above, would decrease fitness and potentially reduce reproduction until prey species recovered.

Another potential impact could occur if oil that spilled during a high-water event (e.g., spring floods or a dike failure) was dispersed into some of the adjacent wetlands or lakes with continuous or ephemeral connection to the rivers and large creeks. Lethal effects to fish in streams and some lakes are unlikely during high-water events such as floods because toxic concentrations of oil are unlikely to be reached. However, toxic levels may be reached in lakes that are normally not connected to the river/creek system except during the high-water periods. If the oil concentrations in the water column reach toxic levels, these fish could suffer mortality or injury.

Although lethal effects of oil on fish have been established in laboratory studies (Rice et al. 1979, Moles et al. 1979), large kills following oil spills are not well documented. This is likely because toxic concentrations are seldom reached. In instances where oil does reach the water, sub-lethal effects are more likely to occur, including changes in growth, feeding, fecundity, survival rates, and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey.

Most oil spills are not expected to measurably affect fish populations in the Project area over the life of the Keystone Project. Oil spills occurring in a small body of water containing fish with restricted water exchange might be expected to kill a small number of individual fish but are not expected to measurably affect fish populations. The same assessment is generally applicable to many of the macroinvertebrates, amphibians, and reptiles because they are motile and generally have a wide geographic distribution. However, freshwater mussels, all of which are sedentary and many of which have limited geographic distribution could be affected at a population level in large to very large spills that affect a substantial segment of a stream or river.

Although very unlikely to occur, a large to very large spill from a break in the pipeline under or adjacent to a river could affect water quality, aquatic resources, and other water-associated resources (e.g., birds and riparian habitats), as well as subsistence and recreational uses of the down-current areas. If the spill is not detected—especially under ice, the volume of oil could be substantial compared to the volume of the receiving water downcurrent from the spill. Fish and macroinvertebrates in the deeper pools may be exposed and likely would die. In addition, containment and cleanup of a large or very large oil spill could be difficult, depending on the season of occurrence (e.g., winter freezeup compared to spring breakup or summer open water). The energized fluid released would mix with water and the oil is likely to emulsify, dissolve, disperse, and adhere to sediment particles. Fish and other aquatic animals and plants, and riparian habitats could be affected for a substantial portion of the down-current channel.

3.13.5.7 Threatened and Endangered Species

Most of the potential impacts to the habitats used by threatened, endangered, and protected species are included in the previous discussions of impacts on biological resources. The important additional consideration for these species is that, by definition, their distribution and population sizes are limited. Although exposure to oil may adversely affect only a few individuals or a small, localized population of individuals, such a loss may represent a significant portion of the population and gene pool. Consequently, even a very small or small spill could substantially affect a threatened or endangered species. Spilled oil is more likely to affect species that heavily use or completely depend on aquatic and wetland habitats than those in terrestrial habitats.

3.13.5.8 Land Use, Recreation and Special Interest Areas, and Visual Resources

Agriculture is the predominant land use along the pipeline corridor, comprising about 94 percent of land crossed by the Keystone Project. As noted earlier, a large to very large spill could affect agricultural activities, including irrigation water supplies. Potential effects would be minimized by implementing Keystone's CMR Plan and ERP (Appendices B and C, respectively).

Spills ranging from very small to very large would be confined to construction and maintenance pads, roads, facility sites, or the immediate vicinity of the pipeline ROW. Impacts on recreational uses and wilderness-type values (scenic quality, solitude, naturalness, or primitive/unconfined recreation) resulting from spills likely would be confined to the same areas and therefore would be negligible to minor. Should a significant to very large spill reach a stream or river, the impacts may be substantial to catastrophic. The spilled oil might be visible and thus could result in a short-term (and possibly long-term) impact on recreation values. Fishing, boating, kayaking, camping, scenic values, and other recreation pursuits could be affected as a result of an oil spill in a riverine environment that is used by recreationists. The obvious short-term effects would be the oil residues in areas of use. The long-term effects would possibly be reduction or loss of fishing and diminished scenic value of the area, as oil residue could take a long time to weather and not be detectable.

3.13.5.9 Socioeconomics

Oil spills may affect several components of the socioeconomic environment, including:

- Agricultural activities;
- Water intakes and water supplies (both drinking water and agricultural irrigation water);
- Other commercial activities; and
- Populated areas, especially residential areas, and other HCAs.

The risk to populated areas and other HCAs along the Keystone Project can be compared with the general risk to the population encountered in everyday life. Proposed actions that result in negligible additional risk are generally acceptable. The National Center for Health Statistics (CDC 2006; URL http://www.cdc.gov/nchs/fastats/pdf/mortality/nvsr54_13_t01.pdf) age-adjusted average annual death rate in the United States is approximately 830 per 100,000 (approximately 0.8 percent). The DOT reports the historical average risk to the general population per year associated with hazardous liquids transmission pipelines, such as the Keystone pipeline, is 1 in 27,708,096 (DOT 2006). Therefore, the predicted risk of fatality to the public from incidents associated with the Keystone pipeline over and above the normal U.S. death rate is negligible (approximately 0.000004 percent).

Short term disruption in local agricultural production could result from a spill that enters agricultural lands. The extent of the economic impact would depend on the number of productive acres affected. Crop losses likely would be reimbursed by Keystone; therefore, the short-term economic impact would be minor. If a spill affected recreational lands, businesses relying on hunting, fishing, and sightseeing activities could experience a short-term negative impact.

Response to oil spills could generate local economic activity for the duration of the spill response activity.

3.13.5.10 Cultural Resources

As noted, most spills are confined to maintenance or construction pads, roadways, facility sites, the pipeline ROW, or an adjacent area. Further, cultural and historical resources identified in the environmental analysis that would be potentially eligible under the NHPA have been avoided by Keystone through small changes in the proposed pipeline alignment. Therefore it is not expected that these resources would be affected by most spills or by subsequent spill cleanup.

Although cleanup from these spills could be invasive, there is little chance that cultural resources would be affected by either the spill or cleanup. Because occurrence of most of the potentially eligible surface and subsurface cultural resources near the facilities and pipeline ROW would will be documented and avoided prior to construction, the risk of impact is low.

Depending on where the spill occurs, Keystone's Unanticipated Discoveries Plan approved for the spill area would address any potential cultural resources encountered during a spill or associated cleanup activities. Implementation of the plan(s) would avoid impacts on inadvertently encountered cultural resources.

3.13.5.11 Air

Impacts on air quality from an oil spill are localized and transient, even for very large spills. Evaporation of the lighter hydrocarbon fractions typically occurs within 1 or 2 days, and the vapors are usually dissipated below risk levels within a short distance of the source. The oil spill response contractors or Keystone pipeline health and safety personnel would monitor air for hydrocarbon vapors. They would restrict public access to areas exceeding specified risk levels while also ensuring that authorized personnel within the restricted areas are equipped with and using appropriate personal protective equipment.

Based on modeling work by Hanna and Drivas (1993), the majority of volatile organic compounds (VOCs) from crude oil spills likely would evaporate almost completely within a few hours after the spill occurred, especially during late spring-early fall, when many of the biological resources (including migratory birds) are present. The heavier compounds take longer to evaporate, particularly at the colder temperatures typical of the winter season, and might not peak until more than 24 hours after the spill. In the event of an oil spill on land, the air quality effects would be less severe than those for a spill on water because some of the oil could be absorbed by vegetation or into the ground.

A diesel spill would evaporate faster than a crude oil spill. Ambient hydrocarbon concentrations would be higher for a diesel spill than for a crude oil spill but would persist for a shorter time. Further, because any such spill would probably be smaller than potential crude oil spills, air quality effects from a diesel spill likely would be even lower than for other spills.

Impacts on air quality related to oil spills would be localized and short term. The associated VOC air emissions would result in little impact on the biological or physical resources of the Keystone Project area.

3.13.6 Mitigation Measures

The Keystone pipeline system will be designed, constructed, and maintained in a manner that meets or exceeds industry standards and regulatory requirements. The proposed Keystone Project would be built within an approved ROW. Signage would be installed at all road, railway, and water crossings—indicating that a pipeline is located in the area—to help prevent third-party damage or impact to the pipeline. Keystone would manage a crossing and encroachment approval system for all other operators. Keystone would ensure safety near its facilities through a combination of programs encompassing engineering design, construction, and operations; public awareness and incident prevention programs; and emergency response programs.

To prevent or mitigate potential oil spills during pipeline construction, measures would be implemented at each construction or staging area where fuel, oil, or other liquid hazardous materials are stored, dispensed, or used. Implementation of the procedures in Section 3 in Keystone's CMR Plan (Appendix B) would minimize the potential for spills and leaks to affect surface water resources. During construction activities, all refueling would be conducted at least 100 feet away from all surface water bodies. Keystone’s ERP (Appendix C) describes actions to reduce the potential for crude oil releases to affect surface water and groundwater resources. During all construction activities, all refueling would be conducted at least 100 feet away from all surface water bodies.

To prevent or mitigate potential oil spills during pipeline construction, measures would be implemented at each construction or staging area where fuel, oil, or other liquid hazardous materials are stored, dispensed, or used. In addition to the mitigation included in the CMR Plan (Appendix B), Keystone has agreed to the following mitigation measures:

- For all locations subject to CWA Section 311, Keystone would prepare a. site-specific oil Spill Prevention, Control, and Countermeasure (SPCC) Plan that contains all requirements of 40 CFR Part 112 for every location used for staging fuel or oil storage tanks and for every location used for fuel or oil transfer. Each SPCC Plan would be prepared prior to introducing the subject fuel, oil, or hazardous material to the subject location.
- Prior to construction, all project personnel would be given an orientation outlining the environmental permit requirements and environmental specifications including the requirement that fuel or oil storage tanks cannot be placed closer than 100 feet to wetlands or water bodies.
- Environmental inspectors would place signs a minimum of 100 feet from the boundaries of all wetlands and water bodies prior to construction. The construction contractor would not be allowed to place a fuel or oil storage tank without first getting the environmental inspector to inspect the tank site for compliance with the 100-foot setback requirement and receiving approval of the tank site from the environmental inspector.
- During construction, no fuel or storage tank would be allowed to be relocated within or to a new construction yard by the contractor without first getting the environmental inspector to inspect the tank site for compliance with the 100-foot setback requirement and receiving approval of the tank site from the environmental inspector.
- Fuel and storage tanks would be placed only at contractor yards. No fuel and storage tanks would be placed on the construction ROW.
- No oil or hazardous material storage, staging, or transfer with the exception of refueling stations would occur within 50 feet of any surface water body, surface drainage, storm drain drop inlet, or HCA. As described above, refueling stations would not be located within 100 feet of these areas.
- Any fuel truck that transports and dispenses fuel to construction equipment or Keystone Project-related vehicles along the construction ROW or within equipment staging and material areas would carry an oil spill response kit and spill response equipment onboard at all times. In the event that response materials are depleted through use, or their condition is deteriorated through age, the materials would be replenished prior to placing the fueling vehicle back into service.
- Fixed-fuel dispensing locations would be provided, with a means of secondary containment to capture fuel from leaks, drips, and overfills.

Historically, the most significant risk associated with operating a crude oil pipeline is the potential for third-party excavation damage. Keystone would mitigate this risk by implementing a comprehensive Integrated Public Awareness Program focused on education and awareness. The program would provide awareness and education that encourages use of the state One-Call system before people begin excavating. Keystone’s operating staff also would complete regular visual inspections of the ROW and monitor activity in the area.

Keystone's preventative maintenance, inspection, and repair program would monitor the integrity of the pipeline and make repairs if necessary. Keystone is required to prepare an Integrity Management Plan that would describe Keystone's Pipeline Maintenance Program in detail. In compliance with applicable regulations governing the operation of pipelines, periodic inline inspections would be conducted to collect information on the status of pipe for the entire length of the system. Inline inspections would be used to detect internal and external corrosion, a major cause of pipeline spills. From this type of inspection, suspected areas of corrosion or other types of damage (e.g., a scratch in the pipe from third-party excavation damage) can be identified and proactively repaired. Additional types of information collected along the pipeline would include cathodic protection readings, geotechnical investigations, aerial patrol reports, and routine investigative digs. In addition, line patrol, leak detection systems, SCADA, fusion-bond epoxy coating, and construction techniques with associated quality control would be implemented.

In summary, the reliability and safety of the Keystone project can be expected to meet or exceed industry standards. Further, the low probability of large, catastrophic spill events and the routing of the pipeline to avoid most sensitive areas suggest a low probability of impacts to human and natural resources. Still, some potential for construction- and operation-related spills can be expected. Commitments and procedures described for reliability and safety in this section and in Appendixes B and C are intended to mitigate spill effects, particularly when considered in combination with rapid and effective response and clean-up procedures.

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