Standing Rock Sioux Tribe

Impacts of an Oil Spill from the Dakota Access Pipeline on the Standing Rock Sioux Tribe

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This report was prepared under the direction of

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Standing Rock Sioux Tribe

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List of Acronyms

AI/AN	American Indian/Alaska Natives
ANPRM	Advanced Notice of Proposed Rule Making
ANSI	American National Standards Institute
API	American Petroleum Institute
ArcGIS	ESRI geographic information system
bbls	Barrels of oil (42 gallons/barrel)
CCPS	Center for Chemical Process Safety
CFR	Congressional Federal Register
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CP	cathodic protection
CPM	computational pipeline monitoring
DAPL	Dakota Access Pipeline
DDV	drain down time
DEP	Department of Environmental Protection
DoD	Department of Defense
DOT	U.S. Department of Transportation
EA	Environmental Assessment
EFRD	emergency flow restriction devices
EIS	Environmental Impact Statement
EJ	environmental justice
EJ IWG	Interagency Working Group on Environmental Justice
EPA	U.S. Environmental Protection Agency
EPRCR	Emergency Planning and Community Right-to-Know Act of 1986
ERAP	emergency response action plan
ETP	Energy Transfer Partners
Fed. Reg.	Federal Register
FERC	Federal Energy Regulatory Commission

FONSI	Finding of No Significant Impact
FP	flash point
FR	flow rate
FRP	facility response plan
GAO	U.S. Government Accounting Office
GIS	geographic information system
GRP	geographic response plan
HCA	high consequence area
HDD	horizontal directional drilling
HecRas	U.S. Army Corps of Engineers Hydrologic Engineering Center's River Analysis System
H_2S	hydrogen sulfide
IBP	initial boiling point
IDLH	immediately dangerous to life and health
IG	Inspector General
LEL	lower explosive limit
LEPC	local emergency response committee
MCL	maximum contaminant level
MR&I	Standing Rock Sioux Tribe Municipal, Rural & Industrial Program
MRS	Missouri River System
msl	mean sea level
MT DEQ	Montana Department of Environmental Quality
ND	North Dakota
NDIC	North Dakota Industrial Commission
NEB	National Energy Board
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NTSB	National Transportation Safety Board
PAH	polycyclic aromatic hydrocarbon
PG&E	Pacific Gas & Electric
PHMSA	Pipeline and Hazardous Materials Safety Administration
PKC	Prairie Knights Casino
ppb	parts per billion

ppm	parts per million
psi	Pounds per square inch
PSMS	pipeline safety management system
RBCA	Montana Risk-Based Corrective Action Guidance for Petroleum Releases
Res Sim	U.S. Army Corps of Engineers Reservoir Simulation Model
RP	pipeline recommended practice
RT	response time
RVP	Reid vapor pressure
SCADA	supervisory control and data acquisition
SCBA	self-contained breath apparatus
SDS	Safety data sheet
SERC	state emergency response committee
ST	shutdown time
TEPC	tribal emergency planning committee
TERC	tribal emergency response committee
USGS	United States Geological Survey
VOC	volatile organic compounds
WCD	worst case discharge
WHO	World Health Organization

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I. Summary of Findings

(1) An Environmental Impact Statement is necessary to properly evaluate the impacts of an oil Spill from DAPL on fish and wildlife on the Standing Rock Indian Reservation. The Corps of Engineers and DAPL's current estimates of a worst case oil release into the Missouri River and underlying aquifer are based upon unrealistic assumptions, and the environmental impacts of an oil spill may be far greater than disclosed in the Final Environmental Assessment. The reservoir conditions and amount of stored water in Lake Oahe at the time of a release of oil into the Missouri River will affect its impacts on fish and wildlife. The Corps of Engineers must implement its Reservoir Simulation Model to determine the impacts of an oil spill under the divergent reservoir conditions caused by the operation of Oahe Dam.

(2) In 2017, the Standing Rock Sioux Tribe Department of Game and Fish has prepared a report entitled Missouri River High Consequence Area Assessment: Establishing Baseline Ecological Information and Impacts to Hunting and Fishing from the Proposed DAPL Pipeline in the Event of an Oil Spill in the Missouri River in North Dakota Adjacent to the Standing Rock Reservation. This report documents the significant impacts of an oil spill on sensitive wetland habitat, macroinvertebrates, shellfish, fish, birds and waterfowl, as well as on mammals and big game on the Standing Rock Reservation. The report finds that subsistence hunting and fishing by Tribal members shall be adversely affected by an oil spill from DAPL.

(3) Subsistence hunting and fishing are integral to the Lakota and Dakota way of life on the Standing Rock Reservation. The Lakota believe that all things in creation have a spirit and are relatives to the Lakota. The stories that have been passed down for generations instruct that the land, water and living things that depend on them are all entitled to respect. Thus, the harvesting of fish and wildlife is for subsistence purposes and is conducted in a sustainable and respectful manner. Prayer and offerings are part and parcel of the subsistence hunting experience. Historically, within the Tribe, there are various societies, or groups with common expertise or gifts. The different societies gave everyone a place in the community; for example, the prestigious Kit Fox Society was a prominent men's society of hunters and warriors. Today, young men are taught to contribute to the well-being of their extended family (*tiospaye*) and their community by engaging in subsistence hunting and fishing and sharing their harvest with elders. Subsistence hunting and fishing, and the cultural norms that remain intact, are jeopardized by an oil spill from DAPL.

(4) The Tribe's wildlife habitat has already been decimated by the development of Oahe Dam and Reservoir, which destroyed nearly 56,000 acres of wooded Missouri River bottomlands on the Standing Rock Indian Reservation. This land was prime wildlife habitat. Four Tribal communities were relocated by the Corps of Engineers in 1960, from the bottomlands to the plains above bottomlands area. The entire fabric of the Lakota and Dakota way of life on the Standing Rock Reservation was disrupted by the Corps of Engineers. This includes the vibrant subsistence hunting and fishing culture. The Corps must consider the cumulative impact of the potential harm from an oil spill with the loss of habitat caused by the construction and operation of Oahe Dam.

(5) From 2006 to 2017, Energy Transfer Partners and Sunoco had incurred 291 hazardous liquid pipeline incidents – more than any other operator for that period in the PHMSA operator database – resulting in $56,590,698 in property damage. However, ETP and Sunoco prior performance was not considered in a valid risk assessment.

(6) Recently constructed pipelines can have serious spills, and the leak detection systems for oil pipelines have a poor record of effective operation. Pipeline shutdown times provided to regulators in Facility Response Plans for worst case discharge (WCD) calculations can be grossly inaccurate. Spill remediation can leave a significant volume of unrecovered crude oil with the potential for persistent threats to human health and the environment.

(7) The DAPL and Corps of Engineers documentation fails to effectively identify the specific hazards of Bakken crude oil and leaves human health and the environment vulnerable to harm if not addressed. Bakken crude is extremely flammable and can pose greater health and safety risks than heavier crude oil. Vapor samples from Enbridge's Berthold, ND terminal crude storage tanks were determined contain more than 1200 ppm of hydrogen sulfide – twelve times the level immediately dangerous to life and health. Elevated concentrations of benzene in Bakken crude oil poses significant negative human health and environmental impacts. Addressing the elevated hazards of Bakken crude in the risk assessment (spill consequences) and the dangers facing emergency responders is absolutely necessary to protect lives and the environment. The Corps of Engineers has failed to do so, however.

(8) DAPL's worst case discharge (WCD) calculations lack any documented methodology or supporting data. DAPL's informal WCD calculations take a "best case" approach and grossly underestimate the likely volume of Bakken crude oil released. This flaw underestimates the potential hazards from a release 92-feet or more under Lake Oahe. Other more realistic performance-based approaches would show a much greater WCD. DAPL's approach severely underestimates the potential WCD, leaving out important

considerations from both the regulatory requirements and good practice safety guidelines. The DAPL WCD calculation 9-minute shutdown time limited to pump shutdown time is incomplete and grossly underestimates the WCD. The WCD fails to consider other alternatives such as a smaller leak below the detection limit.

(9) The DAPL and Corps of Engineers documentation lacks a detailed technical spill plan or a realistic WCD calculation – both are essential for effective emergency response planning. DAPL does not address the adverse weather impact on the WCD for the shutdown of the pipeline. Issues include harsh ND winter conditions, deep snow, extreme cold and availability and operation of the shutdown valves in extreme environments.

(10) The DAPL and Corps of Engineers documentation lacks transparency and is poorly documented regarding the route selection methodology used to conduct spatial analysis in the evaluation of potential pipeline routes. Justification for the particular DAPL datasets used and a clear understanding of ranking/weighting methodology is similarly lacking. A truly robust "least cost" analysis needs to be conducted that properly weights the risks and benefits of the relevant engineering, environmental, and social costs and constraints of various pipeline routes alternatives. Non-pipeline oil transport alternatives (e.g., trucks and trains) must also be evaluated equally.

(11) The Standing Rock Sioux Tribe has incurred a plethora of tangible and intangible costs stemming from DAPL. The Tribe clearly suffers disproportionate costs in the construction and operation of the pipeline. Ignoring or suppressing known costs leads to inequitable and economically inefficient outcomes, as happened with DAPL. A proper accounting of the actual cost borne by the Tribe is required under Executive Order 12898 on Environmental Justice.

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II. Potential Impacts of an Oil Spill from the Dakota Access Pipeline on the Treaty-Protected Hunting and Fishing Rights of the Standing Rock Sioux Tribe

A. An Environmental Impact Statement is Necessary to Properly Evaluate the Impacts of an Oil Spill from DAPL on Fish and Wildlife on the Standing Rock Reservation

For the *Hunkpapa Lakota* of the Standing Rock Reservation, hunting is in our blood. Historians literally refer to the *Hunkpapas* as the "hunting band" – the last militant band of the *Oceti Sakowin Oyate* to lay down our arms. The hunting and fishing rights of the Standing Rock Sioux Tribe are important Treaty rights, because they are so closely identified with our Tribe's history and culture.

The preparation of an environmental impact statement (EIS) is necessary in order to properly evaluate the potential impacts of an oil spill on our Treaty-protected hunting and fishing rights. An oil spill from the Dakota Access pipeline poses a meaningful risk of a significant adverse environmental impact to culturally and economically important fish and wildlife and its habitat on the Standing Rock Indian Reservation. Notably, the information needed to evaluate the potential impacts of an oil spill on the Tribe's hunting and fishing rights has not been disclosed. An EIS is needed in order to fully disclose the maximum spill estimate and a range of spill scenarios, under varying riverine conditions, to determine the potential impacts on fish and wildlife and subsistence hunting and fishing on the Standing Rock Reservation.

As discussed more fully below, the maximum spill estimate is based on optimistic and unverified assumptions. A much larger oil spill may occur than that estimated by Energy Transfer Partners. Consequently, the impacts to fish and wildlife may far exceed anything disclosed by the Corps of Engineers.

Moreover, the reservoir conditions and amount of stored water in Lake Oahe at the time of a release of oil into the Missouri River will affect its impacts on fish and wildlife. In order to reasonably estimate the impacts of a potential oil spill from DAPL on fish and wildlife on the Standing Rock Reservation, the Corps of Engineers should implement its Reservoir Simulation Model to identify the movement of oil downstream under varying reservoir and

hydrological conditions.[1] A range of oil spill scenarios should be modelled under a range of reservoir conditions. Differing weather conditions must also be factored in.

The use of the Res Sim model is necessary to estimate how the oil will behave and impact sensitive fish spawning beds, wetlands and shoreline habitats, under differing conditions. Without the information ascertained from reservoir modelling, it is not possible for the Corps of Engineers to take the hard look required by the National Environmental Policy Act and Judge's Boasberg's Order Granting Partial Summary Judgment in Standing Rock Sioux Tribe v. U.S. Corps of Engineers of Engineers.[2] Nevertheless, the Standing Rock Sioux Tribe Department of Game and Fish has released a survey of baseline ecological data which indicates a high and previously-undisclosed risk to the Treaty-protected hunting and fishing resources of the Standing Rock Sioux Tribe, from an oil spill from the Dakota Access Pipeline.

B. The Standing Rock Game and Fish Department MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT Indicates Significant Damage to Sensitive Habitat from an Oil Spill

The Standing Rock Game and Fish Department prepared a report in 2017 entitled Missouri River High Consequence Area Assessment: Establishing Baseline Ecological Information and Impacts to Hunting and Fishing from the Proposed DAPL Pipeline in the Event of an Oil Spill in the Missouri River in North Dakota Adjacent to the Standing Rock Reservation. (Appendix A). The Standing Rock Game and Fish Department and its consultant (New Century Environmental) inventoried wetlands, conducted field research of flora, evaluated shoreline and riparian habitat, and surveyed representative fish, bird and mammalian communities and upland game on the Standing Rock Reservation, in the area of the Dakota Access Pipeline. The potential impacts on Tribal subsistence hunting and fishing are identified in the report.

The MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT was prepared under the supervision of Mr. Jeff Kelly, the Director of the Standing Rock Sioux Tribe Department of Game and Fish, and an expert witness whose declaration provided the basis for the remand study by the Corps of Engineers. The report includes extensive field surveys, fish and wildlife counts and habitat assessment, as well as a comprehensive literature search. It documented approximately 80 flora species, 24 fish species (approximately 1,000 fish collected) and 41

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[1] U.S. Army Corps of Engineers, *Final Environmental Impact Statement, Missouri River Master Water Control Manual Review and Update* (2004) (*available at:* http://www.nwd-mr.usace.army.mil/mmanual/feis/Index.htm) (last accessed 2-1-2018).

[2] 2017 WL 2573994 (D.D.C. June 14, 2017).

bird species (3,366 observations), in the river reach utilized by Standing Rock Tribal members for subsistence hunting and fishing.[3]

The Tribe and its consultants found that the Missouri River reach that would be impacted by an oil spill includes unique and sensitive habitat, with diverse submergent communities, fisheries, and aquatic and shoreline flora. The particularly sensitive habitats in depositional areas – such as the mouth of the Cannon Ball River immediately downstream from the DAPL Lake Oahe crossing – contain strata utilized as fish spawning beds. Shoreline plants and grasses – including culturally-significant plants to the Lakota – are abundant, particularly in bays, inlets, and marshes, where oil naturally settles. Mammals and big game feed in these areas, especially near the abundant woody draws above the Missouri River.

The report found significant impacts of an oil spill on wetlands, macroinvertebrates, shellfish, fish, birds and waterfowl, as well as on mammals and big game on the Standing Rock Reservation. This includes impacts on bald eagles, the Tribe's buffalo herd along the Missouri River, and culturally-significant and medicinal plants. Specifically, Tribe and its consultants found that the potential impacts include:

Wetlands and Benthic Zone Habitat

- "Almost 40,000 acres of wetlands were documented by National Wetland Inventory maps from the pipeline crossing to the North Dakota-South Dakota state line adjacent to the Standing Rock Indian Reservation."[4]

- "The bottom or benthic zone of standing or flowing water bodies with varying wetland types, which are often comprised of silt, sand or gravel substrate, serve as home to many worms, insects and shellfish (benthos). These specific habitats may also serve as a breeding ground and food source for these organisms and higher animals… sediment traps the oil and affects the organisms that live in or feed off of the sediments."[5]

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[3]Standing Rock Sioux Tribe Department of Game and Fish, Missouri River High Consequence Area Assessment: Establishing Baseline Ecological Information and Impacts to Hunting and Fishing from the Proposed DAPL Pipeline in the Event of an Oil Spill in the Missouri River in North Dakota Adjacent to the Standing Rock Reservation, p. 32 (2017) (Appendix A).

[4] *Id*. at 7.

[5] *Id*. at 7.

- "The Cannonball River and Porcupine Creek appear to be major tributaries that could realize the greatest impacts in the event of a spill… The most sensitive depositional areas in the event of a spill are found within the first 15 miles of the approximately 30 miles of river survey."[6]

Macroinvertebrates

- "Nine submergent macrophytes were documented within the study area and appeared most diverse in Reach 1, the upper most reach… The impact of an oil spill on this submergent macrophyte community could be significant to the local benthic community… These are organisms that are larger than 250-500 microns which are called macroinvertebrates; these include insect larvae (Ephemeroptera, Plecoptera and Diptera being the most common), annelids (oligochaetes and leeches), mollusks, crustaceans, and miscellaneous groups such as flatworms, nemerteans and cnidarians."[7]

Missouri River Fishery

- "In the open water or pelagic zone, oil can be toxic to the frogs, reptiles, fish, waterfowl… Fisheries located in fresh water are also subject to the toxic effects of oil."[8]

- "Impoundment of the MRS (Missouri River System) has transformed the aquatic environment into a biologically diverse community of both native and non-native fishes. Forty-three native species and 22 non-native (including unknown patronization) species of fish have been identified by the North Dakota Game and Fish Department during sampling of North Dakota's MRS since 1956… In 2009 alone, forty-six species were documented."[9]

- "Our sampling effort on the Missouri River certainly confirmed a viable and thriving fishery… Our walleye, northern pike, smallmouth bass,

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[6] *Id*. at 32.
[7] *Id*. at 11.
[8] *Id*. at 7.
[9] *Id*. at 16.

yellow perch and channel catfish catch and weights were representative of other fisheries investigations on Lake Oahe."[10]

- "The likely depositional areas in the tributaries will certainly be the highest sensitivity for impact going forward as we found extensive reproduction of several fish species in these locations… Fish eggs in shallow water, such as salmon eggs in a streambed, can be wiped out by an oil spill."[11]

- "Other habitats of concern for fish kills are in contained areas, such as lakes, lagoons and some shallow-water nearshore areas, where spilled oil naturally concentrates. (NOAA 2017). Many shellfish species are relatively immobile and often are indiscriminate filter-feeders, which means they may not be able to avoid exposures to oil. In addition, they don't possess the same suite of enzymes to breakdown contaminants as finfish and other vertebrates. (NOAA 2017)."[12]

Emergent Shoreline Plant Species and Wildlife Habitat

- "Oiling of plants and grasses that are rooted or float in the water can also occur, harming both the plants and the animals that depend on them for food or shelter… cattails and other emergent species provide many important functions for life in and around the water. They serve as food sources, shelter for small mammals, and nesting grounds for many types of animals. Oil spills can coat these areas, affecting the plants and organisms that depend on them."[13]

- "Emergent stands of cattails, bulrushes and sedges were prominent in the many shallow bays, backwaters and side channels observed. Six of the eleven species were determined to be culturally important plants of the Lakota. These emergent hydrophyte communities are vulnerable to any potential oil spill that occurs above the Cannon Ball River."[14]

[10] *Id*. at 17-18.
[11] *Id*. at 18.
[12] *Id*.
[13] *Id*. at 7.
[14] *Id*. at 12.

Mammals and Big Game

- "On Standing Rock, buffalo are located… in a large pasture adjacent to the river. Antelope still can be seen from the river within our (30 mile) study area."[15]

- "The study area in general provides habitat for approximately 70 species of mammals… The larger mammals, mainly big game including elk (*Cervus elaphus*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*) pronghorn (*Antilocapra americana*) and mountain lions (*Puma concolor)* are much more visible and play a larger role in contributing to the economics of the reservation."[16]

- "In the event of an oil spill there is no doubt that Standing Rocks (sic) whitetail, mule deer and antelope could be impacted in the river corridor."[17]

Representative Bird Communities in the Missouri River Corridor

- "The Missouri River and its surrounding areas provides habitat for a number of different bird species… (and) specifically provides habitat for sensitive species of North Dakota. Sensitive species utilizing such habitat could make them exceptionally vulnerable in the case of an oil spill."[18]

- "A total of 41 bird species were observed in our assessment, with 3,366 total individuals recorded."[19]

- "The Missouri River System is critical habitat to two species of federally threatened status… Piping Plover (*Charadrius melodus*) and Least Tern (*Sternula antillarum*). Both of these species were listed in 1985 due to negative habitat impacts from the alternation of the natural stream flows of the Missouri River… A total of seven Least Terns… were observed in our assessment. One individual of plover species was observed."[20]

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[15] *Id*. at 8.
[16] *Id*. at 24.
[17] *Id*. at 30.
[18] *Id*. at 20.
[19] *Id*.
[20] *Id*.

- "The Bald Eagle (*Haliaeetus leucocephalus*)… is now listed as threatened, is also known to utilize the Missouri River system as wintering and nesting habitat. (Dyke et al. 2015)… (E)ight Bald Eagles were observed in our assessment."[21]

- "Approximately 25 species of raptors use the planning area during migration and as breeding habitat. Common breeding species include the red-tailed hawk (*Buteo jamaicensis*)… Nineteen eagles were observed during our survey, which are species of special significance to the tribe."[22]

Subsistence Hunting and Fishing

- "An oil spill from DAPL could impact these important habitat areas which would have a devastating impact on fishery spawning, rearing and foraging areas as well as impact many aquatic mammals including potential acute assaults to big game adjacent to the rover complex. In our assessment, we predict that significant impairment could result in the sub-mergent and emergent wetland vegetation communities."[23]

- "Subsistence hunting and fishing would be deleteriously affected in the event of an oil spill."[24]

Ultimately, the Tribe's MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT demonstrates that the Missouri River reaches below DAPL on the Standing Rock Reservation contain a wealth of fish and wildlife, as well as important, sensitive habitat. Terrestrial and bird species of special significance to the Tribe are abundant in this area. Historically, bison played a central role in the economic and spiritual life of the Lakota, and today the Tribe manages a buffalo herd along the Missouri River as part of the survival and re-emergence of Lakota culture.

Bald eagles are considered to be messengers between the people and the Creator, and their feathers are used in ceremonies and worn to signify distinction. In fact, the significance of Bald eagles and Golden eagles in the Lakota religious world view was acknowledged by Congress in the Bald and Golden Eagle Protection Act.[25] Red tail hawks are also a special

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[21] *Id*.

[22] *Id*. at 21.

[23] *Id*. at 32.

[24] *Id*.

[25] 16 U.S.C. §668a.

species to the Lakota, revered as messenger birds that provide guidance and protection. Pheasant and goose hunting on the Reservation is nationally-renown and provides an important source of commerce for the Tribe.

In evaluating the environmental impact of DAPL, the Corps of Engineers must give full consideration to the extreme importance of subsistence hunting and fishing at Standing Rock. The Corps ignored this in the Final Environmental Assessment on DAPL; however, the Corps has acknowledged this in other studies and accordingly prepared an EIS. "Opportunities for fishing, hunting and trapping can be essential for Tribal members."[26] The Corps of Engineers must similarly prepare an EIS for DAPL.

The MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT details the type of harm suffered by submergent species and macroinvertebrates, amphibians and reptiles, fish and mammals and big game and their habitat on the Standing Rock Reservation. The findings on the potential impact on the Missouri River ecosystem at Standing Rock of an oil spill from DAPL evoke the findings of the state and federal Natural Resources Trustees on the 2015 oil spill in Montana's Yellowstone River. The Trustees released a joint report estimating the cost of the wildlife damage assessment at $1.3 million. The report states:

> On or about January 17, 2015, Bridger's Poplar Pipeline ruptured near Glendive, Montana, spilling at least 30,000 gallons of Bakken crude oil into the Yellowstone River (MT DEQ 2015). The spill occurred when ice covered much of the Yellowstone River.
>
> Oil sheen was reported at least as far downstream as Crane, Montana (59 river miles downstream from the pipeline crossing). (POLREP 12, US EPA 2015). Ice on the Yellowstone River prevented clean-up of most of the oil. The conditions also made it difficult to characterize the nature and the extent of the contamination. The oil remained in the river from January 17, 2015 through at least the time that the ice started to break up in mid-March 2015.
>
> (T)he oil caused exceedances of surface water quality standards contained in Montana's Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ-7 Standards) and the screening levels in the Montana Risk-Based Corrective Action Guidance for Petroleum Releases (RBCA) in the Yellowstone River. Elevated concentrations of oil constituents, including

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[26] U.S. Army Corps of Engineers, *Draft Missouri River Recovery Management Plan and Environmental Impact Statement*, p. 3-540 (December 2016) (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:70:0::NO:::) (last accessed 1-30-2018).

> benzene and polycyclic aromatic hydrocarbons (PAHs) extended for several miles downstream, with exceedances of the DEQ-7 Standards and screening levels in RBCA as far downstream as Glendive, 6.5 miles from the spill site.
>
> The discharge continues to adversely affect the natural resources... Approximately 2,730 of the 30,000 gallons of crude oil were recovered from the Yellowstone River.[27]

The confluence of the Yellowstone and Missouri Rivers is a sacred site for the Lakota. This location is known as the first of "seven sisters" – seven sites along the Missouri River whose low-lying areas provided corridors for migrating wildlife. As described in a Class III archaeology survey for the Foxtail Wind Energy Project in western North Dakota:

The Seven Sisters was the name given to seven water bodies at specific locations across the Dakotas. The location of each of these sites is of individual spiritual significance. Distinctive sets of ceremonies were performed at each site in accordance with the yearly cycle of tribal migration. Different bands within the *Oceti Sakowin Oyate* would move through various specified river drainages… as required by ceremony and circumstance. As the early new grass was exhausted and the animals migrated, the *Oceti Sakowin Oyate* moved in progress through the Seven Sisters, while the *wichahpe optaye*, constellations, made their yearly progression around *Wicahpi Wanzi*, the North Star.[28]

The oil in the Yellowstone River migrated 59 river miles. As found in the MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT, the most sensitive fish spawning and substrate habitat in the Missouri River reach of the DAPL crossing is within 15 miles downstream.[29]

The MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT is the most up-to-date and comprehensive survey of the aquatic and terrestrial habitat and fish and wildlife surveys in the area affected by an oil spill from the Dakota Access Pipeline. The report found that an oil spill from the Dakota Access Pipeline would undoubtedly adversely affect subsistence hunting and fishing on the Standing Rock Indian Reservation. The Corps of Engineers must incorporate these authoritative findings in the remand study and vacate the Finding of No Significant Impact (FONSI) by DAPL. An environmental impact statement (EIS) is necessary.

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[27] State and Federal Trustees, State of Montana and U.S. Department of the Interior, *Partial Claim for Past and Future Assessment Costs: January 2015 Yellowstone River Oil Spill*, pp. 2-3 (March 2017) (*available at:* https://www.cerc.usgs.gov/orda_docs/CaseDetails?1D=1121) (last accessed 1-30-2018).

[28] AECOM, Class III: Intensive Cultural Resources Survey for the Foxtail Wind Energy Center in Dickey County North Dakota, p. 6-13 (October 2017).

[29] Standing Rock Sioux Tribe Department of Game and Fish, at 32.

C. Subsistence Hunting and Fishing are Integral to the Lakota and Dakota Way of Life on the Standing Rock Reservation

As explained by the prominent Lakota medicine man, the late Pete Catches, Sr.:

> To the traditional Lakota, every day is sacred to him. He looks at the world on this creation and knows they are all interrelated. The trees and the grasses, the animal world, the flowing stream and the mountains. Everything he's related to and he respects it.[30]

This reflects the core belief of the Lakota (and Dakota) of *mitakuye oyasin*, "we are all related." Indeed, for the Lakota, a person is related to all things made by the Creator. This includes what is referred to in the stories told by elders as the "four leggeds" – what non-Indians would refer to as wildlife. It includes all things in nature – the earth, the rocks, plants, insects, animals, and fish. The Lakota believe that all things in nature have their own spirit, and that all of Creation is sacred.

This is taught to the Lakota as children, by their parents and grandparents. According to the Lakota author Joseph M. Marshall III:

> Stories and storytelling were all around me in my childhood… These stories were not just of humans, or "two-leggeds," they were about other kinds of people as well: the elk people, the bear people, the bird people, and so on. And they were about the land. I never heard a story that did not involve the land in some way.
>
> Everything in these stories is equally alive and able to affect everything else. A winter storm, for example, could have a personality; it could be impatient, pushy, broad shouldered. A cottonwood sapling could whine and argue; the winter wind could be persuasive, enticing all the blades of grass to bend and sway in the same direction at the same moment. These mechanisms in Lakota storytelling exist because the storytellers believe all things are related…
>
> To the Lakota, virtues such as humility, respect, sacrifice, and honesty carry a different weight and substance than they do in western culture. For us these qualities are not so much elusive goals as they are essential parts of everyday life…I knew growing up that at some point I was supposed to be the things I learned in the stories: compassionate, honorable, and brave, and so

[30] Don Doll, S.J., Vision Quest: Men, Women and Sacred Sites of the Sioux Nation, p. 24 (1994).

> forth. I knew this because the storytellers lived the lessons they imparted in their stories, and they practiced what they preached: They were compassionate, they were honorable, they were wise and brave.
>
> When life for us was forever altered by the arrival of the Europeans… we survived by being true to our stories. We relied on being the kind of people our stories told our ancestors had been, and thereby we remained true to ourselves and to them, and we are still surviving.[31]

That is where hunting comes in. The Standing Rock Sioux Tribe is comprised of the bands of hunters that resisted the Reservation lifestyle and fought to maintain their way of life. Standing Rock is the Tribe of the great War Chief and Holy Man Sitting Bull, whose vision foresaw the outcome of the Battle of Little Big Horn, and who led the hunting bands to victory on June 25, 1876. Historian Robert M. Utley noted:

> As Sitting Bull strove for excellence in everything he undertook, he became a noted hunter as well as warrior. In a communal or village hunt, he stood our conspicuously.[32]

Today, the community hunt on the Standing Rock Reservation takes place among *tiospaye* – subsistence hunting and fishing for food for the extended family. Important Lakota values include generosity, and, as Marshall explained, sacrifice. Today, young men on the Reservation are taught to maintain their culture by hunting, butchering and distributing deer and other meat to elders throughout one's extended family, as well as to elders throughout one's community who are no longer able to hunt.

Mitakuye oyasin establishes an ethic of sustainability. No more game or fish are taken than what the resource allows, because we are related to the deer, antelope, elk and other game. All parts of the animal are used, nothing is wasted. Young hunters are taught to identify male game that no longer are able to reproduce – the wisdom of the elders, passed down, to help ensure a sustainable harvest of game for the future.

This relates to what is often considered to be traditional ecological knowledge of the Lakota and Dakota (and other Native Tribes). For example, to the Lakota, water has a spirit. Centuries later, non-Indian scientists have detected bacteria and other microorganisms in free-flowing water – the water contains life, and it helps create life in the womb.

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[31] Joseph M. Marshall III, The Lakota Way - Stories and Lessons for Living: Native American Wisdom on Ethics and Character, pp. xii-xiii (2001).

[32] Robert M. Utley, The Lance and the Shield: The Life and Times of Sitting Bull, p. 18 (1993).

The Lakota emphasize that water is life-giving. This is derived from the Lakota Creation Story. As described by *Sinte Gleska* University Professor Ronald Goodman:

> *Inyan* had no beginning for he was there when here was no other. His spirit was *Wakan Tanka*… *Inyan* longed to exercise his powers but could not do so for there was no other that he might use his powers upon. If there were to be another, he must create it of that which he must take from himself, and he must give it to his spirit and a portion of his blood. As much of his blood would go from him, so much of his powers would go with it, for his powers were in his blood and his blood was blue…
>
> To do this, he took from himself that which he spread around about himself in the shape of a great disk whose edge is where there can be no beyond. This disk he named *Maka* (earth)…
>
> To create *Maka*, *Inyan* took so much from himself that he opened his veins, and all his blood flowed from him so he shrank and became hard and powerless. As his blood flowed from him, it became blue waters that are the waters of the earth.[33]

As explained by Joseph M. Marshall, Lakota oral histories carry lessons. In the Creation story, *Inyan* sacrifices – literally gives his blood – to create life; the land and water. Sacrifice for the community is an important Lakota value, and it underlies the expectation that young Lakota men are to engage in subsistence hunting and fishing, in order to share their harvest. The giving of flesh, and along with it blood, is part of the sacrifice experienced in the most sacred Lakota ceremony, the Sun Dance.

> Water plays an important role in the Sun Dance, in which participants fast and refrain from drinking water for four days. It is also important in the sweat lodge ceremony, where it is poured upon heated rocks for purification. It is significant to the Lakota that water is the one thing needed by all living things. Water binds all living things together, as the Lakota say, *mitakuye oyasin* – we are all related. Thus, to the Lakota, the protection of water quality is part and parcel of the protection of fish and wildlife, and indeed all living things.
>
> For these reasons, prayers and the burning of sage are a part of the hunting experience for the Lakota, giving thanks to a relative that has been sacrificed, to feed the people. Hunting for the Lakota is not a recreational

[33] Ronald Goodman, Lakota Star Knowledge: Studies in Lakota Stellar Theology, p. 25 (1992).

activity, it is a subsistence and a quasi-religious activity. As explained by Goodman:

> There is no Lakota word for "religion." While it is true that certain Lakota… rites and rituals have… a recognizably "religious" character, to the Lakota themselves these are rather the intensification of daily activities all of which must be lived in a sacred manner. The whole Lakota way of life *Lakol Wicoh'an* is their religion.[34; 35]

Professor Goodman documented the relationship between star constellations and the oral histories described by Marshall. All of Creation is considered sacred, not just the earth, and respect for all of Creation extends throughout the universe. Star constellations are thought to coincide with sacred land forms on earth, and form circles that are projected throughout Lakota life, such as in the design of tipis. The movement of stars across the sky identified seasons and were used to guide the movement and activities of the Lakota throughout the year, and in particular for ceremonies. These important Lakota values of respect for Creation and for the universe instruct subsistence hunting practices.

Lakota culture is prayerful. Prayer remains part and parcel of the subsistence hunt. As a result, the hunt keeps the Lakota culture alive, and re-emergent.

The harvest must be sustainable, so the resource remains healthy for future generations. Lakota values emphasize that one should only take what is needed.

These experiences of subsistence hunting also promote a culture of cooperation. Everyone is expected to do their part, for the betterment of extended family, and community. Within the Tribe, there are various societies, which are groups with common expertise or gifts. The different societies gave everyone a place in the community, and a role and responsibility based upon their strengths and skills. The Kit Fox Society was a prominent men's society of providers – hunters, and protectors – warriors.

DAPL directly attacks this ethic, because of the risk of a deadly oil spill. The Tribe's conservation ethic may not be enough to save its fish and wildlife resources on the Standing Rock Reservation. The risk of a spill threatens sensitive ecological habitat, as well as fish, wildlife, birds and water, all considered to be relatives of the Lakota and Dakota people of the Standing Rock Reservation. Subsistence hunting and fishing is integral to the way of life on

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[34] *Id*. at 2.

[35] *See* also Appendix B. Declaration of Jon Eagle Sr., Standing Rock Sioux Tribe Traditional Historic Preservation Officer.

the Standing Rock Reservation – a way of life that is jeopardized by the potential of an oil spill from the Dakota Access Pipeline.

D. The Standing Rock Sioux Tribe's Hunting and Fishing Rights are Treaty Rights and Must be Respected by the Corps of Engineers

The hunting and fishing rights of the Standing Rock Sioux Tribe are guaranteed by Treaty.

The geographical boundaries of the Tribe's Treaty-recognized territory was initially described in Article 5 of the 1851 Fort Laramie Treaty:

> The territory of the Sioux, or Dacotah Nation, commencing the mouth of the White Earth River, on the Missouri River; thence in a southwesterly direction to the forks of the Platte River; thence up the north fork of the Platte River to a point known as the Red Butte, or where the road leaves the river; thence along the range of mountains known as the Black Hills, to the headwaters of the Heart River; thence down the Heart River to its mouth; thence down the Missouri River to its place of beginning.[36]

In exchange for the recognition of Sioux ownership of the vast area of the northern plains, in Article 2 of the 1851 Treaty, Standing Rock's forebears granted to the United States the right to establish the Oregon Trail across Sioux land:

> The aforesaid Indian nations do hereby recognize the right of the United States Government to establish roads, military and other posts, within their respective territories.[37]

As explained by the Lakota Treaty historian and former President of the Oglala Sioux Tribe, the late Johnson Holy Rock:

> Everything from the Missouri to the Little Big Horn was within the boundaries of the 1851 Treaty. The 1851 Treaty, as you are probably aware, was just a guarantee of right of way across Indian Country while the settlers, the emigrants, headed west. A right of way. Nothing more, nothing less.[38]

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[36] Charles J. Kappler, INDIAN AFFAIRS LAWS AND TREATIES II, p. 594 (1904); 11 Stat. 749.

[37] *Id.*

[38] Herman J. Viola, Little Big Horn Remembered: The Untold Story of Custer's Last Stand, p. 67 (1999).

Significantly, Article 5 of the 1851 Treaty explicitly recognized the hunting and fishing rights of the bands of the Standing Rock Sioux Tribe, on both our Treaty-recognized and other aboriginal lands:

> It is understood, however, that in making this recognition and acknowledgement, the aforesaid Indian nations do not hereby abandon or prejudice any rights or claims they may have to other lands; and further, that **they do not surrender the privilege of hunting, fishing** or passing over any tracts of country heretofore described.[39]

The late Professor Vine Deloria Jr., an enrolled member of the Standing Rock Sioux Tribe, explained that, "It is clear that the United States never intended to keep any of its promises" made in the Treaties with the Sioux Nation.[40] Indeed, not long after the 1851 Treaty, the Army disrupted Lakota hunting in the important buffalo hunting ground of the Powder River valley, in order to protect trespassing gold prospectors on what became known as the Bozeman Road. This violated the 1851 Treaty, and the Lakota forced the closure of Bozeman Road, in what became known as the Powder River War.

The military victory of the Lakota in the Powder River War led to the Fort Laramie Treaty of 1868. Article 2 of the 1868 Treaty established the Great Sioux Reservation, of which the Standing Rock Reservation is a constituent, as follows:

> The United States agrees that the following district of country, to wit, viz: **commencing on the east bank of the Missouri River** where the 46th parallel of north latitude crosses the same, thence along low-water mark down said east bank to a point opposite where the northern line of the State of Nebraska strikes the river, thence west across said river, and along the northern line of Nebraska to the 104th degree of longitude west from Greenwich, thence north on said meridian to a point where the 46th parallel of north latitude intercepts the same, thence due east along said parallel to the place of beginning.[41]
>
> The Great Sioux Reservation thus consists of all of present-day South Dakota west of the Missouri River. The east bank of the Missouri constitutes the Reservation border, placing the Missouri River within the

[39] Kappler, INDIAN AFFAIRS LAWS AND TREATIES II, at 595 (emphasis added).

[40] Vine Deloria, Jr., Custer Died for Your Sins: An Indian Manifesto, p. 55 (1969).

[41] 15 Stat. 635 (emphasis added).

Reservation and thus recognizing the property right of the Lakota to the Missouri River fishery.

In exchange, the Sioux agreed that it would maintain no permanent settlements outside of the Great Sioux Reservation, and permitted the Bozeman Road and Platte River railroad to be built. Under Article 11 of the 1868 Treaty, the Lakota stipulated that:

> (T)he tribes who are parties to this agreement hereby stipulate that they will relinquish all right to occupy permanently the territory outside their reservation as herein defined… And they, the said Indians, further expressly agree… They withdrawal all opposition to the military posts or roads now established south of the North Platte River.[42]

The Great Sioux Reservation established in Article 2 of the 1868 Treaty contained only a portion of the land previously reserved by the Sioux in the 1851 Treaty. Important hunting grounds along the Platte River (present day Nebraska), and the perhaps the most important buffalo hunting grounds in the Powder River valley (present day Wyoming), are outside of the Great Sioux Reservation. But in Articles 11 and 16 of the 1868 Treaty, the Sioux Nation reserved hunting and fishing rights on these lands outside of the Great Sioux Reservation.

Article 11 of the 1868 Treaty addressed the important Platte River hunting grounds:

> (T)he tribes… yet reserve the right to hunt on any lands north of the North Platte, and on the Republican Fork on the Smoky Hill River.[43]

Article 16 recognized that the Powder River hunting grounds remained in Sioux ownership as well:

> The United States hereby agrees and stipulates that the country north of the North Platte River and east of the summits of the Big Horn Mountains shall be held and considered to be unceded Indian territory, and also stipulates and agrees that no white person or persons shall be permitted to settle upon or occupy any portion of the same… and it is further agreed by the United States that within ninety days… the military posts now established in the territory in this article named shall be abandoned.[44]

[42] 15 Stat. 638.

[43] *Id.*

[44] 15 Stat. 639.

Article 12 of the 1868 Treaty required the consent of three-fourths of the adult males of the Sioux Nation, for any further land cessions. This provision stated:

> No treaty for the cession of any portion or part of the reservation herein described… shall be of any validity or force as against the said Indians, unless executed and signed by at least three-fourths of the adult male Indians.[45]

Congress passed the Act of February 28, 1877, unilaterally removing the Black Hills from the Reservation, in order to confiscate gold and other valuable minerals.[46] There was no attempt to comply with the requirements of Article 12 of the 1868 Treaty. The United States Supreme Court ruled that the Act of 1877 was an unconstitutional taking, and stated that "(a) more ripe and rank case of dishonorable dealings will never, in all probability, be found in our nation's history."[47] The Act of March 2, 1889 divided the Great Sioux Reservation into six Reservations, including the Standing Rock Reservation, and further diminished the Sioux land base – causing the loss of millions of acre of wildlife habitat.[48]

In sum, in the 1851 Fort Laramie Treaty, the United States agreed that a broad area of the northern plains, extending from the Big Horn mountains to the west, Heart and Missouri Rivers to the north and east, and Republican River to the south, was Sioux Country.[49] The Sioux Nation granted to the United States the right to pass through, on the Oregon Trail.[50] Subsequently, trespassers entered the Powder River hunting grounds in violation of the 1851 Treaty, prompting the Powder River War from 1865-1867. The Powder River War was settled by the 1868 Fort Laramie Treaty, which proclaimed, "From this day forward all war between the parties shall forever cease."[51]

Under the 1868 Treaty, the Great Sioux Reservation was established, comprising of all of present-day South Dakota west of the Missouri River. The Missouri's east bank constituted the Reservation boundary, placing the river squarely within the Great Sioux Reservation.[52] The Lakotas retained hunting rights in the Platter River basin, and the Powder River and Heart River basins remained unceded, with hunting and fishing rights intact.

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[45] 15 Stat. 638.

[46] 19 Stat. 254.

[47] United States v. Sioux Nation of Indians, 448 U.S. 371, 387 (1980).

[48] 25 Stat. 888.

[49] Kappler, Indian Affairs Laws and Treaties II, at 595.

[50] *Id.*

[51] 15 Stat. 635.

[52] *Id.*

Thus, the Standing Rock Sioux Tribe's hunting and fishing rights were essential provisions of the 1851 and 1868 Fort Laramie Treaties. Without question, Tribal members possess the Treaty right to engage in subsistence hunting and fishing in the Missouri River reach that would be affected by an oil spill from DAPL. These treaty obligations remain in effect today. As explained by Chief Justice John Marshall:

> The Indian nations had always been considered as distinct, independent communities, retaining their original natural rights, as the undisputed possessors of the soul from time immemorial… The very term 'nation," so generally applied to them, means "a people distinct from all others." The constitution, by declaring treaties already made, as well as those to be made, the supreme law of the land, has adopted and sanctioned the previous treaties with the Indian nations, and consequently admits their rank among those powers who are capable of making treaties. The words "treaty" and "nation" are words of our own language, selected in our diplomatic and legislative proceedings by ourselves, having each a definite and well understood meaning. We have applied them to Indians as we have applied them to other nations of the earth. They are all applied in the same sense.[53]

Thus, the obligations of the United States to the Standing Rock Sioux Tribe and Great Sioux Nation under the 1851 and 1868 Fort Laramie Treaties remain in effect today, with a legal status that has been recognized by the Supreme Court as comparable to the treaties with foreign nations. Significantly, the "right of informed consent" for such development projects was adopted by the United Nations, in Article 32, paragraph 2 of the *Declaration of the Rights of Indigenous Peoples.*[54] In the absence of consent by the Standing Rock Sioux Tribe, DAPL violates international law.

With respect to the interpretation of Treaties with the Indian Tribes, the Supreme Court has repeatedly recognized that:

> (T)reaties with the Indians must be interpreted as *they* would have understood them.[55]

The members of the Standing Rock Sioux Tribe possess hunting and fishing rights within the Standing Rock Reservation and the Great Sioux Reservation, pursuant to the 1868 and 1851 Fort Laramie Treaties. It is our interpretation that this includes the Treaty right to wildlife habitat undisturbed by toxic oil pollution. Our ancestors worshiped the land and water.

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[53] *Worcester v. Georgia*, 31 U.S. (6 Pet.) 515, 559-560 (1832).

[54] UN Doc. A/RES/61/295 (Sept. 13, 2007).

[55] *Choctaw Nation v. Oklahoma*, 397 U.S. 620, 631 (1970) (emphasis added).

They would never agree to subject our land, our water, our home – and the home of our animal relatives – to the threat posed by an oil spill from DAPL.

The Corps of Engineers must heed our interpretation of our Treaty rights. Executive Order 13175 governs Consultation and Coordination with Indian Tribal Governments. (65 Fed. Reg. 67249). Significantly, section 3(a) of the executive order states –

> Agencies shall respect Indian tribal self-government and sovereignty, **honor treaty rights** and other rights… (and) ensure meaningful and timely input by tribal officials…[56]

The Department of Defense implements E.O 13175 through the *DoD American Indian and Alaska Native Policy*. The Corps of Engineers must comply with the *DoD Policy* in the applying NEPA to the DAPL Missouri River crossing. Article IV of the *DoD Policy* requires respect for Treaty-protected hunting and fishing rights:

> **Undertaking DoD actions and managing DoD lands** consistent with the conservation of protected tribal resources and **in recognition of Indian treaty rights to fish, hunt** and gather resources at both on-reservation and off-reservation locations.[57]

Accordingly, the Corps of Engineers must honor the Treaty rights of the enrolled members of the Standing Rock Sioux Tribe to hunt and fish on the Standing Rock Reservation and Great Sioux Reservation. DAPL clearly jeopardizes these rights.

E. The Corps of Engineers Must Evaluate the Cumulative Impacts on Wildlife Habitat of an Oil Spill from DAPL *and* the Pick-Sloan Program

In order to comply with Judge Boasberg's directive on remand, the Corps of Engineers must evaluate the adverse environmental impact of an oil spill from DAPL on Standing Rock's hunting and fishing rights, in combination with the impact of the construction and operation of Oahe Dam on wildlife habitat at Standing Rock.[58] The current cumulative impacts analysis in the Final EA excluded this information, and it must be supplemented in accordance with the remand instructions.

The authority of the Corps of Engineers to issue the section 10 permit and the easement for DAPL at the Lake Oahe crossing stems from the Pick-Sloan program, which consists of

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[56] 65 Fed. Reg. 67250 (emphasis added).

[57] U.S. Department of Defense, American Indian and Alaska Native Policy.

[58] 40 CFR §§1508.7, 1508.27(7).

numerous multipurpose water storage projects in the upper Missouri Basin, authorized in the Flood Control Act of 1944.[59] These projects are collectively referred to as the "Pick-Sloan program."

The Oahe Dam is a major component of the Pick-Sloan program. "The Oahe Dam destroyed more Indian land than any other public works project in America."[60] As Professor Vine Deloria, Jr. explained:

> The Pick-Sloan Plan was, without doubt, the single most destructive act ever perpetuated on any Indian Tribe by the United States.[61]

The Corps of Engineers acquired 56,000 acres of Standing Rock Reservation lands for the site of Lake Oahe, under the authority of the Act of September 2, 1958.[62] This land was prime Missouri River bottomland, teeming with timberlands and wildlife; a low lying area in the plains with abundant water supplies and fertile soil. Four Standing Rock Reservation communities were located in this area and were forcibly relocated by the Corps of Engineers in the winter of 1960. As reported by the U.S. Senate Committee on Indian Affairs:

> (The Standing Rock Reservation was) strategically located along the resource rich Missouri River. **The Missouri River's wooded bottomlands provided the tribes'** reservation economies with fertile agricultural lands, timber for lumber and fuel… seasonal fruits, **habitat for wild game**, medicines, shelter for domestic animals, and plentiful supplies of clean water. These lands were also part of the tribes' cultural and spiritual ties.[63]

The author Michael L. Lawson documented the horrendous impact of the inundation of Tribal lands and wildlife habitat at Standing Rock:

> For those unfamiliar with Sioux culture and the geography of the Dakotas, it is perhaps difficult to appreciate how important the bottomlands were to their way of life. The trees along the river had provided the tribes with their primary source of fuel and lumber… **The inundation of the bottomlands destroyed 99 percent of the timber** on all of the reservations…

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[59] 58 Stat. 887.

[60] Michael L. Lawson, Dammed Indians: The Pick-Sloan Plan and the Missouri River Sioux, 1944-1980, p. 50 (1982).

[61] *Id.*, 1st ed., *Introduction* (1982).

[62] 72 Stat. 1762.

[63] S. Rep. 111-357, pp. 1-2 (2010) (emphasis added).

> The gathering and preserving of wild fruits and vegetables was a traditional facet of Plains Indian culture. The many herbs, roots, berries, currants, plums, cherries and beans that grew in the bottomlands added bulk and variety to the diet… Traditionally, they were also used for ceremonial and medicinal purposes. Buffalo berries, for example were… used in female puberty rites, and chokecherries were a cure for (digestive ailments)… A form of wild bean called a "mouse bean" was regarded… as a palatable wild vegetable… According to tradition, the Sioux always replaced the beans they took with an equal amount of corn or other grain (as an offering)… The loss of these and other plants greatly reduced the Indians' natural food supply.
>
> The wooded bottomlands also served as shelter and feeding grounds for many kinds of wildlife. Deer, beaver, rabbits, and raccoons were abundant year-round, and thousands of pheasants and other game birds wintered there. The hunting and trapping of this game provided the tribes with an important source of food, income, and recreation. **Destruction of this environment by the Pick-Sloan dams reduced the wild game and plant supply on all of the Sioux reservations… by 75 percent.**
>
> Damages caused by the Pick-Sloan projects touched every aspect of Sioux life. Abruptly the tribes were transformed from a subsistence to a cash economy, and forced to develop new ways of making a living…
>
> Because of their close relationship with nature, the Sioux had a sacred attachment to their land. The areas along the river had afforded them a comfortable and relatively scenic environment with resources to sustain their way of life. The loss of this land and livelihood had a strong emotional impact.[64]

The Pick-Sloan plan dramatically altered the natural environment of the Great Plains. The silty, rambling waters of the Missouri River, and the riverine ecosystem surrounding the Missouri, were destroyed. The riparian canyon carved across the plains by the Missouri River has been inundated. According to author Marc Reisner:

> **The worst natural damage was the flooding of some of the best riparian waterfowl habitat in the world.** A former director of the U.S. Fish and Wildlife Service, John Gottschalk, remembers walking along the

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[64] Michael L. Lawson, Dammed Indians Revisited: The Continuing Saga of the Pick-Sloan Plan and the Missouri River Sioux, pp. 50-51 (2009) (emphasis added).

> undammed middle Missouri for five miles and flushing countless flocks of pheasants and migrating ducks; today, one would be lucky to see anything at all. The birds thrived in the spacious, secluded bottomlands and oxbow pools and marshes, and those are almost entirely gone.[65]

The braided Missouri River, teeming with waterfowl and other wildlife, and the deep wooded bottomlands that thrived in the river corridor, have been completely destroyed by the Corps of Engineers dams. The natural channel and riparian forest are under water. In their place lies the vast Oahe Reservoir, controlled by the Corps.

The manner in which the Corps of Engineers operates Oahe dam causes significant water level fluctuations in Lake Oahe. The maximum pool level of the Oahe Reservoir is 1620 msl, and the base flood pool is 1607 msl – the fluctuation zone of the reservoirs is miles wide.

The Corps of Engineers operates the Oahe Dam exclusively for lower Missouri River navigation, intakes and flood control. The amount of water released at Oahe Dam fluctuates significantly, with daily releases of 17,000 cfs between November 15-March 15, and daily releases of up to 35,000 cfs during the March 15-November 15 navigation season.[66] The timing of the water releases at Oahe Dam, in combination with varying levels of winter recharge into the Missouri watershed, result in the extreme fluctuations in the water elevation of Lake Oahe.

The management of Missouri River water flows by the Corps of Engineers has significantly and permanently disrupted the patterns of erosion and sedimentation. Unique and sensitive wildlife habitat is adversely affected. The fluctuating stream flows cause alternating erosion, scouring and deposition of sediments in the river reaches that will would also be impacted by an oil spill from DAPL. There is a cumulative impact.

This also affects culturally-significant and medicinal plants and fruits, which used to thrive in Missouri bottomlands and are now more difficult to find, but which still grow naturally in the depositional areas such as the mouth of the Cannonball River and Porcupine Creek. One of the most spiritually significant plants to the Lakota are Cottonwoods (*Salix* sp.). As stated above, 99 percent of the timber resources at Standing Rock were destroyed by Oahe Dam, and most of these strands were Cottonwood. They depended upon the spring high water events to deposit sandbars, which provided habitat for reproduction, and the higher water table promoted growth. The natural floods and braided riverine environment was destroyed by the Corps of Engineers, however.

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[65] Marc Reisner, Cadillac Desert: The American West and Its Disappearing Water, p. 199 (1986).

[66] Army Corps of Engineers, Missouri River Master Water Control Manual pp. VII-10, 12 (2006) (*available at:* http ://www.nwd-mr.usace.army.mil/mmanual/mast-man.htm) (last accessed 2-1-018).

The remaining Cottonwood strands in the depositional areas are thus extremely important to the Standing Rock Sioux Tribe. The Cottonwood is a key element in the Sun Dance ceremony, where it becomes the Tree of Life.

Red willow (*Cansasa*) is also found in the sandy depositional areas. The bark from Red willow is used as the offering in smoking the sacred pipe. The lack of abundance of Red willow is an increasing problem on the Standing Rock Indian Reservation. The prospect of an oil spill intensifies the risk that the habitat for important ceremonial plants, which have been used at Standing Rock for centuries, will be completely destroyed, first by the dam, and then by oil pollution.

Chokecherry trees (*Prunus virginiana*) also thrive in the remaining riparian habitat and woody draws along the Missouri River. The fruit are a staple in the traditional diet of the Standing Rock Sioux and are used for meals that give thanks for healing, prayers and blessings – *wopila*. Chokecherry stems are used to construct the sweat lodge.

Other important naturally-occurring fruits that are still harvested at the mouths of these rivers include Plums (*Orunus* sp.) and Buffaloberries (*Shepherdia* sp.). Historically, Sioux hunters could determine if buffalo has been in the area, by inspecting the condition of Buffaloberry bushes. Their sharp thorns were favored by the buffalo, who used them for scratching.

The leaves of many riparian shrubs and bushes are boiled and used by Lakota in tea, for various maladies. For example, Wild verbena (*Glandularia* sp.) is a remedy for stomach ailments. Wild bergamot (*Monarda fistulosa*), or Horsemint, cures abdominal pains.[67] These important medicines are located in the riverine depositional areas, including the mouth of the Cannonball River.

Sweet grass (*Hierochloe odorata*) is found in certain marshy areas at the rim of Lake Oahe. Sweet grass is burned in virtually all Lakota ceremonies, for its purification properties. Bitterroot may also be found in marshy soils. It is boiled and used for many ailments, and bolsters immunity and protects from the common cold.

Thus, many medicinal and culturally significant plants are found in sensitive habitats along the Missouri River. Their abundance has diminished as a result of the construction and operation of Oahe Dam, but they are still found within the river reach that could be affected by an oil spill from DAPL.

Other contemporary developments, such as climate change, also impact the Missouri

[67] Melvin R. Gilmore, Use of Plants by the Indians of the Missouri River Region, pp. 14, 35-36 54 (1977 ed.).

River habitat at Standing Rock and must be included in a cumulative impacts analysis on remand. The National Wildlife Federation report entitled *Wildlife in a Warming World: Confronting the Climate Crisis* (2013) described the impacts on wildlife of persistent drought in the northern plains. The report describes the situation facing wildlife on the Standing Rock Indian Reservation:

> Terrestrial wildlife are no less susceptible to heat and drought. Drought can cause important wildlife food sources to produce less fruit or even kill the plant. Forced to range further in search of food, wildlife become more vulnerable to predation. Furthermore, deer and other wildlife have difficulty fattening up for winter and face starvation. Those that do survive are less likely to produce strong and healthy offspring.[68]

In sum, the manner in which the Corps of Engineers operates the Oahe Dam adversely affects wildlife habitat and cultural plants and fruits on the Standing Rock Reservation. A spill will intensify the existing adverse impacts caused by the operation of Oahe Dam on subsistence hunting and fishing at Standing Rock. A changing climate further exacerbates these impacts.

The potential impacts of an oil spill on fish and wildlife and sensitive and unique Missouri River habitat must be evaluated in that context. This will demonstrate that the environmental impact of DAPL is indeed significant, mandating the preparation of an environmental impact statement under the National Environmental Policy Act.

A way of life is in jeopardy at Standing Rock. As explained by the former Standing Rock Sioux Tribal Chairman, the late Aljoe Algard, who was a distinguished national Indian leader:

> We are still a sovereign people… We must change attitudes. We must show there's a different way of life to follow.[69]

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[68] http://www.nwf.org/climatecrisis (pages not numbered).

[69] *Quoted in* Doll, p. 73.

III. DAPL Spill Impacts Subject to Scientific and Expert Dispute: Spill Risk, Worst Case Discharge, Leak Detection, Bakken Crude Hazards and Emergency Response

A. ETP/Sunoco Past Performance Indicates the True Risk Posed by DAPL

On August 29, 2016, the Sunoco/ETP[70] Control Center experienced "line imbalance indications" on their Permian Express II crude oil pipeline operating in central Texas.[71] The Sunoco report noted there was no thought that a serious spill was underway. The imbalance was stated not to exceed "established normal operating tolerances."[72] The crew kept the pipeline running but continued to look for the cause of the product imbalance. For twelve days they reviewed their control system calculations, performed pressure testing and patrolled the pipeline. Finally, on September 10 the leak was discovered by a company ground patrol and the pipeline shutdown.

A "pinhole leak" from external corrosion had develop on the pipeline that had only been in operation for just over a year. A causal factor for the corrosion was "DC stray current interference from an adjacent pipeline." While initial reports stated the leak was 800 barrels, it was later determined that the spill was ten times larger with 361,000 gallons (8600 bbls) of crude oil released resulting in over $4,000,000 in property damage. Less than 25% of the oil was recovered. The soil was remediated but no long-term assessment was conducted to determine the impacts of the crude contamination.

On September 14, 2016, the Pipeline and Hazardous Materials Safety Administration issued a Corrective Action Order requiring a plan for restart and repairs – one of many Sunoco enforcement actions by the federal regulator. A few months earlier on the same pipeline it was reported that Sunoco had been issued a "Notice of Probable Violation" by PHMSA that

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[70] For purposes of this technical report Sunoco and Energy Transfer Partners will be treated as the same party. Sunoco and ETP completed their merger in April 2017 and Sunoco changed its name to Energy Transfer Partners. Sunoco was announced early on as the operator of DAPL having drafted a version of the facility response plan in 2015. DAPL is a pipeline joint venture with ETP having the controlling interest. (*available at:* http://www.energytransfer.com/ops_bakken.aspx) (last accessed 2-1-18).

[71] PHMSA Distribution, Transmission & Gathering, LNG, and Liquid Accident and Incident Data, Hazardous Liquid Accident Data – January 2010 to Present, Incident Report Number 2016035. (*available at:* https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data) (last accessed 2-1-18). The description of the incident comes from the report data and narrative.

[72] *Id.*

included a $1.3 million fine for construction welding practices and use of unqualified welders.[73] From 2006 to 2017, Sunoco had incurred 291 hazardous liquid pipeline incidents **- more than any other pipeline operator for that period in the PHMSA operator database**. Those incidents resulted in $56,590,698 in property damage.[74]

The 2016 Sunoco/ETP spill highlights many of the technical health, safety and environmental concerns raised by the Standing Rock Sioux Tribe and its experts to the Corps of Engineers in the NEPA process and litigation related to the Dakota Access Pipeline (DAPL):

- Recently constructed pipelines can have serious spills,
- Highly-touted leak detection systems have a poor record of effective operation,
- Pipeline shutdown times provided to regulators in Facility Response Plans for worst case discharge (WCD) calculations can be grossly inaccurate
- Control center human factors decision-making can significantly delay response,
- Risk assessments miss key hazards,
- Spill remediation can leave a significant volume of unrecovered crude oil with the potential for persistent threats to human health and the environment,
- A history of unabated significant spills and incidents that receive little to no federal government scrutiny or performance improvement.

This section of the Tribe's report will focus on these highly controversial issues not adequately considered for DAPL – Spill Risk, Worst Case Discharge, Leak Detection, Bakken Crude Hazards, and Emergency Response. These issues were raised by the Tribe and our experts during the NEPA process and litigation and need to be given a "hard look" by the Corps of Engineers during remand.

B. The Specific Hazards of Bakken Crude

The DAPL and Corps of Engineers documentation fails to effectively identify the specific hazards of Bakken crude oil and leaves human health and the environment vulnerable to harm if not addressed. These issues were raised by technical experts in litigation and in the

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[73] U.S. regulator orders inquiry, repairs after Sunoco's Permian Leak, Reuters, 9-15-16, (*available at*: https://www.reuters.com/article/us-pipeline-sunoco-logistics/u-s-regulator-orders-inquiry-repairs-after-sunocos-permian-leak-idUSKCN11L2CM) (last accessed 2-1-18).

[74] PHMSA Pipeline Operator Information, (*available at:* https://primis.phmsa.dot.gov/comm/reports/operator/Operatorlist.html?nocache=6063) (last accessed 2-1-18).

Standing Rock Sioux Tribe's EIS Scoping comments submitted to the Corps of Engineers on February 7, 2017 (Appendix C).[75]

The key starting point for any effective chemical safety risk assessment or emergency response planning effort is to understand and address the specific harm from the hazardous material(s) that may be released during storage, handling and transportation. Once the specific potential hazards are identified, the risk assessment and emergency response plans must identify the necessary controls to prevent and mitigate pipeline Bakken crude oil spills. This is necessary to protect the environment and public health and welfare on the Standing Rock Reservation.

Bakken crude oil is a deadly mix of highly toxic industrial chemicals. It is generally recognized as having physical and chemical characteristics that create elevated hazards of significant chronic and acute adverse health effects. These include cancer, endocrine disruption activity and developmental and reproductive toxicity. In addition to some serious health concerns, the crude oil and its components also pose safety risks (See Appendix D, GreenScreen for Safer Chemicals Assessment Report, DAPL Bakken Pipeline Crude)[76]

In the wake of a number of Bakken crude-related transportation incidents, including the 2013 Lac-Mégantic oil train disaster in Quebec, Canada that killed 47 victims, Bakken crude has been found to be more flammable with a higher Reid vapor pressure (RVP), and lower flash point (FP) and initial boiling point (IBP) than many types of heavier crude oil. The 72-tank car Lac-Mégantic oil train was carrying Bakken crude from New Town, North Dakota. Post-incident lab testing by the Canadian government found that the crude was highly volatile – "comparable to that of a condensate or gasoline product."[77]

In December 2014, the North Dakota Industrial Commission (NDIC) issued an Oil Conditioning Order to reduce the RVP of Bakken crude produced in the state.[78] In 2014, PHMSA issued an alert as well warning that crude oil from the Bakken region "may be more flammable than traditional heavy crude oil."[79] The PHMSA warning stated:

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[75] Standing Rock Sioux Tribe's NOI Comments, Dakota Access Pipeline *Preliminary Submission,* February 7, 2017, Appendix C).

[76] ToxServices, LLC, GreenScreen for Safer Chemicals Assessment Report, DAPL Bakken Pipeline Crude (December 2017).

[77] Transportation Safety Board of Canada, *TSB Laboratory Report LP148/2013*, (*available a:* http://www.tsb.gc.ca/eng/enquetes-investigations/rail/2013/R13D0054/lab/20140306/LP1482013.asp) (last accessed 2-1-18).

[78] North Dakota Industrial Commission, Oil Conditioning Order No, 25417, September 23, 2014, (*available at:* https://www.dmr.nd.gov/oilgas/Approved-or25417.pdf) (last accessed 2-1-18).

[79] PHMSA Safety Alert – January 2, 2014, (*available at*: http://osfm.fire.ca.gov/Hot_Topics/1_2_14 Rail_Safety_Alert.pdf) (last accessed 2-1-18).

> Based upon preliminary inspections conducted after recent rail derailments in North Dakota, Alabama and Lac-Mégantic, Quebec involving Bakken crude oil, PHMSA is reinforcing the requirement to properly test, characterize, classify, and where appropriate sufficiently degasify hazardous materials prior to and during transportation.

In 2017, PHMSA undertook advanced notice of proposed rulemaking (ANPRM) in response to recent transportation incidents and a petition from the state of New York to consider lowering the vapor pressure of lighter crudes such as from the Bakken region for all transportation modes.[80] In the ANPRM, PHMSA provides a table (Table 1) with elevated Bakken crude oil RVPs listed from several recent oil train serious incidents. The petition argues for a restriction on the transport of crudes with an RVP greater than 9 psi.[81]

Table 1. Listing of Several Serious Train Accidents and the Corresponding Elevated Bakken Crude Oil Reid Vapor Pressure.

Source	Reid Vapor pressure of Bakken crude oil
Lac-Mégantic, Quebec (July 6, 2013)	Average between 9.0 to 9.5 psi.[7]
Heimdal, North Dakota (May 6, 2015)	10.8 psi.[8]
PHMSA Operation Safe Delivery	Average of 12.3 psi.[9]
Mt. Carbon, West Virginia (February 16, 2015)	13.9 psi.[10]
Lynchburg, Virginia (April 2015)	Average of 14.3 psi.[11]

(Source: PHMSA ANPRM, 2017)

Although Bakken crude is typically found to be “sweet” crude - low in the toxic gas hydrogen sulfide (H_2S) - some Bakken fields have a higher concentration of H_2S and some

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[80] PHMSA, Advanced Notice of Proposed Rule Making, Docket No. PHMSA-2016-0077 (HM-251D), 1-18-2017, at III.A., (*available at*: https://www.federalregister.gov/documents/2017/01/18/2017-00913/hazardous-materials-volatility-of-unrefined-petroleum-products-and-class-3-materials - citation-13-p5502) (last accessed 2-1-18).

[81] *Id*.

Bakken wells have been observed to "sour" with more H_2S over time.[82] In 2013 the Federal Energy Regulatory Commission (FERC) approved an Enbridge Energy Partners emergency application to allow the company to reject shipments of crude containing more than five parts per million (ppm) of H_2S.[83] Vapor samples from Enbridge's Berthold, ND terminal crude storage tanks were determined contain more than 1200 ppm of H_2S – twelve times the level immediately dangerous to life and health (IDLH).[84]

Bakken crude due to it higher concentration of lighter hydrocarbons not only is extremely flammable but also can pose a greater health risk to responders, the public and the environment. The U.S government's National Oceanic and Atmospheric Association (NOAA) has issued responder guidance for Bakken crude oil spills. In the guidance NOAA states:

> Bakken crude oils (and similar shale oils) contain a higher percent of dissolved gases that pose a higher risk of ignition as well as the production of volatile organic compounds and benzene that pose risks to responders and the public shortly after a release, compared to other crude oils.[85]

Post-incident analysis of Bakken crude spills has found a higher concentration of toxic VOCs such as benzene.[86] Post-incident analysis of BTEX (benzene, toluene, ethylbenzene, and xylene) sampling of the ND Bakken crude from the Lac-Mégantic incident by Canadian Transportation Safety Board found:

> …reported benzene and other VOC contents well above these exposure limits in portions of the derailment site that were extensively contaminated with the spilled crude oil. This is consistent with the significant

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[82] *Toxic gas in Bakken pipeline points to sour well problem*, Reuters, May 29, 2013, (*available at*: https://www.reuters.com/article/column-kemp-bakken-pipelines/column-toxic-gas-in-bakken-pipeline-points-to-sour-well-problem-kemp-idUSL5N0EA3SU20130529) (Last accessed 2-1-18).

[83] Federal Energy Regulatory Commission, Enbridge Pipelines LLC, Order Accepting Tariff Filing, 143 FERC 61,221, June 6, 2013.

[84] *Id.* at 3.

[85] National Oceanic and Atmospheric Administration, BAKKEN CRUDE OIL AND SIMILAR SHALE OIL SPILLS: RESPONDER GUIDANCE, 2016, at 1, (*available at:* https://www.nrt.org/sites/70/files/11-2016.7_NOAA_Bakken-First-Responders-Guide.pdf)(Last accessed 2-2-18).

[86] National Oceanic and Atmospheric Administration, *Bakken Crude Oil Spill, Barge E2MS 303 Lower Mississippi River*, February 2014, p. 8, (*available at:* http://www.efsec.wa.gov/Tesoro Savage/Adjudication/Exhibits/Tesoro4A/Exhibit 5215-000013-TRB.pdf) (last accessed 2-2-18).

> concentrations of benzene and other VOCs measured in the occurrence crude oil samples…[87]

The elevated concentrations of benzene in Bakken crude oil poses significant negative human health and environmental impacts from environmental releases.[88] According to the World Health Organization (WHO) benzene is a well-recognized human carcinogen.[89]

The International Agency for Research on Cancer has classified benzene as *carcinogenic to humans* (Group 1). Benzene causes acute myeloid leukemia (acute non-lymphocytic leukemia), and there is limited evidence that benzene may also cause acute and chronic lymphocytic leukemia, non-Hodgkin's lymphoma and multiple myeloma. Individuals who have experienced benzene poisoning requiring treatment show a substantially increased risk of mortality from leukemia.[90]

The US EPA has established a health-based drinking water Maximum Contaminant Level Goal (MCLG) of zero, with the understanding that there is no safe exposure level for a carcinogen. The enforceable Maximum Contaminant Level (MCL) is set at 5 ppb for benzene based on decreased blood platelets (anemia) and cancer risks. In addition to the acknowledged cancer risks, benzene causes genetic defects and organ damage, and even short-term exposures can cause skin and eye irritation.

DAPL and the Corps of Engineers significantly underestimate the impacts to drinking water from a WCD of Bakken crude oil. The Corps of Engineers concluded in the Final EA that four (4) gallons was the most likely leak scenario for the DAPL pipeline crossing and unsurprisingly such a leak would not exceed the MCL.[91] However, a 4-gallon leak scenario is extremely unlikely for the 30-inch pipeline 90 to 108 feet under Lake Oahe. Once a pipeline starts leaking it typically continues until discovered.[92] A slow pipeline leak deep under the bed of Lake Oahe would be especially difficult to detect – "a leak from a buried line, especially a slow leak, can continue for a long time without being detected."[93]

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[87] Transportation Safety Board of Canada, *TSB Laboratory Report LP148/2013*, (*available at:* http://www.tsb.gc.ca/eng/enquetes-investigations/rail/2013/R13D0054/lab/20140306/LP1482013.asp) (last accessed 2-1-18).

[88] World Health Organization, *Exposure to Benzene: A Major Public Health Concern* (2010) (*available at:* (http://www.who.int/ipcs/features/benzene.pdf) (last accessed Feb. 2, 2018).

[89] *Id*. at 2.

[90] *Id.*

[91] U.S. Army Corps of Engineers – Omaha District, Environmental Assessment: Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Land, p. 47 (July 2016).

[92] Morgan Henrie et al, PIPELINE LEAK DETECTION HANDBOOK, p. 20 (2016).

[93] *Id*.

The other three spill release scenarios outlined in the Final EA are hypothetical spills of 100, 1000 and 10,000 bbls. Each scenario results in benzene concentrations in the Missouri River which exceed the regulatory maximum of 5 ppb. Those spills would result in benzene concentrations from 3.4 to 340 times the MCL. A WCD as estimated by the Tribe's experts could result in a benzene concentration over 1000 times the MCL. These spill scenarios are more realistic for a long slow leak as we have seen from the 2016 Sunoco/ETP Permian Express II 8600 bbls spill from a pinhole leak. Bakken crude oil toxic VOCs such as benzene are water soluble and can move quickly downstream.

In 2014, NOAA reported on a Bakken oil spill that released 800 bbls from a barge on the Mississippi River. NOAA concluded that the oil spread rapidly resulting in a 65-mile closure of the river for two days. A Lake Oahe spill using the three other more realistic scenarios can result in a significant impact on human health. Neither the Corps of Engineers nor DAPL have analyzed these more realistic spill scenarios for benzene concentrations. There is no analysis of downstream impacts of these scenarios on agricultural and drinking water intakes.

A WCD release would likely have serious consequences on human health and the environment for many miles downstream. The Tribe's experts are conducting our own spill modeling of Bakken crude with a more realistic WCD to more specifically evaluate impacts to human health, aquatic organisms, fish and wildlife, medicinal plants and areas of cultural significance.[94]

In addition to benzene, there are health concerns with many of the components of the Bakken crude oil, including acute and chronic non-cancer risks. It is necessary to assess the risks posed by Bakken crude oil exposures, including short-term exposures to high levels, and prolonged exposures to low levels. It is important to include an assessment of both cancer and non-cancer health harms. The impacts on vulnerable populations, including pregnant women, reproductive-aged men and women, infants, children and elders should receive special consideration. It is also important to consider the highest exposed populations, such as those with exposure through drinking water, cooking water, washing water, contaminated foods and direct contact. This is the reality of the risk facing our Tribal members from DAPL.

Benzene, ethylbenzene, n-hexane and naphthalene are all linked to cancer. Benzene, ethylbenzene, n-hexane, naphthalene and xylenes all can cause skin irritation. Benzene,

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[94] The Tribe will transmit the spill modeling and impacts to the Corps of Engineers upon completion. The Tribe will also address the issue of benzene and other Bakken crude VOCs concentration toxicity thresholds which are significantly underestimated in the EA.

ethylbenzene and n-hexane all cause similar neurotoxic effects.[95] Benzene can cause damage to the bone marrow, leading to anemia and damage to the immune system.[96] Hydrogen sulfide is linked to endocrine disruption. The other chemicals associated with Bakken crude have not been fully tested for potential endocrine effects.

Benzene, naphthalene and xylenes are developmental toxicants, posing risks to the developing fetus of women exposed during pregnancy. Naphthalene poses a risk of eye damage (cataracts and retinal damage), anemia in infants born to mothers that are highly exposed during pregnancy, and risk of systemic damage to liver and neurological damage.[97]

Certain polycyclic aromatic hydrocarbons found in Bakken crude oil are probable human carcinogens and are linked to adverse reproductive problems.[98] PAHs "have been shown to cause carcinogenic and mutagenic effects and are potent immunosuppressants."[99] PAHs are more persistent in the environment and can lead to toxic aquatic impacts. The State of Massachusetts in its Bakken crude-specific guidance cites NOAA's investigation on the 2014 Mississippi River Bakken oil spill the toxic impact of polycyclic aromatic hydrocarbons (PAHs):

> Bakken crude oil has a low viscosity and will quickly spread and evaporate. It will quickly adhere to suspended solids in the water column, forming unstable emulsions. Recoverable product may persist for only 4 to 8 hours, depending on size of spill. Its lighter components volatilize, posing human health hazard near spill location, and the low molecular weight PAHs (i.e., naphthalene to phenanthrene range) dissolve in the water column causing toxic aquatic effects (NOAA, 2014).[100]

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[95] National Center for Biotechnology Information, PubChem Compound Database: CID=7500, ethylbenzene (*available at*: https://pubchem.ncbi.nim.nih.gov/compound/7500) (Last accessed 2-13-2018); National Center for Biotechnology Information, PubChem Compound Database: CID=8058, n-hexane (*available at:* https://pubchem.ncbi.nim.nih.gov/compound/8058) (last accessed 2-13-2018).

[96] National Center for Biotechnology Information, PubChem Compound Database: CID=241, Benzene (*available at:* https://pubchem.ncbi.nim.nih.gov/compound/8058) (last accessed 2-13-2018).

[97] National Center for Biotechnology Information, PubChem Compound Database: CID=931, Naphthalene (*available at*: https://pubchem.ncbi.nim.nih.gov/compound/931) (last accessed 2-13-2018).

[98] Agency for Toxic Substances & Disease Registry (ATSDR), *Polycyclic Aromatic Hydrocarbons (PAHs) What Health Effects Are Associated with PAH Exposure?* (referencing EPA and IARC Carcinogenic Classification.) (*available at:* https://www.atsdr.cdc.gov/csem/csem.asp?csem=13&po=11) (last accessed Feb. 2, 2018).

[99] Thamaraiselvan Rengarajan et al., *Exposure on Polycyclic Aromatic Hydrocarbons with Special Focus on Cancer*, ASIA PACIFIC JOURNAL OF TROPICAL BIOMEDICINE, 5,(3), p. 1 (March 2015) (*available at: https://www.sciencedirect.com/science/article/pii/S2221169115300034*) (last accessed Feb. 3, 2018).

[100] CB&I Environmental and Infrastructure, Inc., *Bakken Crude Oil Spills – Response Options and Environmental Impacts,* Prepared for Commonwealth of Massachusetts Dept. of Environmental Protection, at

The crude oil characteristics and hazards section of April 2017 DAPL Emergency Response Action Plan (ERAP) and Facility Response Plan (FRP), Dakota Access Pipeline North Response Zone describes the DAPL product simply as "crude oil" and provides misleading hazard warnings.[101] The warnings associated with the chemical and physical characteristics in the body of the plan lack any references to Bakken crude and are contradicted in the hazard classifications in the Bakken Crude ConocoPhillips Safety Data Sheet (SDS) attached to the FRP as an appendix. The SDS fire hazard rating classifies Bakken crude as a category 1, "extremely flammable liquid and vapor" while both response plans state the "crude oil" is flammable, a lesser hazard rating.[102] The Final EA does not include an SDS or a reference to Bakken crude extreme flammability.

The response plans and Final EA list the crude oil health hazard as "slightly hazardous" and that it "may contain benzene, a carcinogen."[103] The SDS health hazard GHS classification lists Bakken crude as carcinogen category 1B, a presumed human carcinogen.[104] The Final EA and response plans do not list PAHs in the warnings of physical and chemical characteristics.[105] The Final EA discussion of Bakken crude on the environment is limited the impacts of benzene – toxic impacts of other VOCs and PAHs are not addressed.

The specific hazards of the Bakken crude oil that could be released is central to understanding the spill impacts but the Corps of Engineers and DAPL documentation is silent. Addressing the elevated hazards of Bakken crude in the risk assessment (spill consequences) and the dangers facing emergency responders is absolutely necessary to protect lives and harm to the environment. Neither the ERAP nor the FRP have any information in the plan text on Bakken crude specific hazards.

The Corps of Engineers' Final EA similarly lacks any discussion on the specific elevated hazards and safety precautions for Bakken crude. The classification warnings in the attached ConocoPhillips SDS are specific to Bakken crude oil but were ignored in the plan and other operative documents. The technical information provided in this report section and generally referenced by the Tribe prior to the remand should lead to the implementation of critical controls and precautions that are lacking in the DAPL plans and Final EA.

E-3; (June 2015) Citing the NOAA 2014. (*available at*: http://www.mass.gov/eea/docs/dep/cleanup/laws/bakken-crude-oil-spills-response-options-and-environmental-impacts.pdf) (last accessed 2-2-2018).

[101] Dakota Access Pipeline, Emergency Response Action Plan (ERAP) and Facility Response Plan (FRP), Dakota Access Pipeline North Response Zone, ERAP at 37, FRP at 51 (April 2017)

[102] *Id.* at 37 and Appendix A at 1.

[103] *Id*. ERAP at 37 and FRP at 51. EA at Appendix L at 52.

[104] *Id.* Appendix at 1.

[105] *Id.*; ERAP at 37 and FRP at 51.

C. Worst Case Discharge and Effective Leak Detection

Worst case discharge (WCD) calculations are a vital component of any environmental assessment but DAPL's methodology and calculations are seriously flawed. WCD calculations are an essential requirement under PHMSA regulations for use in developing a pipeline's facility response plans. Just as important, having accurate, supportable WCD calculations are critical data for the most important elements of the environmental assessment such as risk analysis, spill modeling, emergency response, ecosystem harm and environmental justice impacts.

The Tribe's experts have raised significant technical disagreements on WCD in expert declarations. DAPL's WCD calculations lack any documented methodology or supporting data. As different DAPL WCD-related documents leave out key elements and/or provide different and contradictory shutdown and response times, their offered results lack clarity and credibility. DAPL's approach severely underestimates the potential Lake Oahe WCD, leaving out key considerations from both the regulatory requirements and good practice safety guidelines.

PHMSA's regulatory required approach for WCD requires the operator provide the "methodology, including calculations used to arrive at the volume."[106] The regulation states the WCD is the largest foreseeable discharge in barrels (cubic meters) "including a discharge from fire or explosion, in **adverse weather** conditions."[107] Adverse weather conditions include ice, temperature extremes and visibility.[108] The first WCD option is the one selected by DAPL for the Lake Oahe crossing:

> (1) The pipeline's maximum release time in hours, plus the maximum shutdown response time in hours (based on historic discharge data or in the absence of such historic data, the operator's best estimate), multiplied by the maximum flow rate expressed in barrels per hour (based on the maximum daily capacity of the pipeline), plus the largest line drainage volume after shutdown of the line section(s) in the response zone expressed in barrels (cubic meters).[109]

In April 2016, DAPL's only WCD calculation for Lake Oahe was documented in correspondence with the Corps of Engineers. DAPL presented a 9-minute shutdown time

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[106] 49 CFR 194.105(a), Worst Case Discharge.

[107] 49 CFR 194.5, Definitions (emphasis added).

[108] *Id*.

[109] 49 CFR 194.105(b)(1), Worst Case Discharge

merely stating "the pump stations are designed to shut down in 9-minutes"[110] This communication took place in a 4-5-16 email and was not included in any formal report or project plan.[111] The calculation lacked any time to detect the WCD and associated variables, (such as interpret or verify data; check for false alarms, inaccurate pipeline SCADA indications, or transient effects; impacts of decision-making under the stress of a possible emergency shutdown; personnel discussions or trouble-shooting; etc.) or the time for shutdown of the emergency flow restriction devices (EFRDs) which are pipeline remotely operated valves on either side of Lake Oahe.[112]

DAPL's calculation did not evaluate the possibility of human error or equipment malfunction – key considerations for any worst case scenario. The DAPL calculation multiplied only the pump shutdown time by the maximum flow rate and added the drain down volume. DAPL concluded the WCD for Lake Oahe to be 12,501 bbls (3750 bbls for pump shutdown plus 8751 bbls drain down volume). The evaluation of DAPL's WCD calculations received concurrence by the Corps of Engineers who closed the issue on 4-7-16.[113]

In a different DAPL document dated 8-5-15 entitled *North Dakota Lake Oahe Spill Model Discussion*, a different shutdown time was presented. The model input parameters list a detection and shutdown time of 12.9 minutes – stating "the mainline pumps are shutdown within 9 minutes of detection, and the adjacent block valves are completely closed within an additional 3.9 minutes."[114] While the table used the wording that included "time to detect," like the April 2016 WCD email no actual detection time was provided or utilized. The document was created in 2015 and contained no WCD calculations. It is evident from the spill model document above that DAPL was aware that detection time and time to shut down the EFRD was relevant to calculating the WCD. The Lake Oahe spill model discussion document was issued for review but never approved or issued for use.[115]

PHMSA has stated they consider the time to detect a spill and close EFRDs to be part of the WCD calculation. In a 2016 PHMSA presentation "Is Leak Detection Possible" a formula was provided for calculating a pipeline WCD:

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[110] DAPL Environmental Analysis Correspondence in *ProjNet*, 2015-2016, at 93, USACE_DAPL0072253.

[111] *Id.*

[112] *Id.*

[113] *Id,*

[114] Energy Transfer Company, *Dakota Access Pipeline Project, North Dakota Lake Oahe Spill Model Discussion*, Wood Mustang Group, Issued for Review 8-5-15, p. 9.

[115] *Id.* at 1. In other DAPL spill model documents a 4-minute detection and shutdown time was listed for the relevant Johnsons Corner ND to Illinois pipeline segment.

$$WCD\ (bbls)=[(RT+ST)^{\circ}-FR]+DDV$$[116]

In the formula above RT is response time, ST shutdown time, FR flow rate and DDV drain down time.[117] While PHMSA has not published a guidance document on calculating the WCD, the rulemaking background provides more detailed information for performing the calculation. Pipeline response plans were first established in a 1993 Interim Final Rule that provided supplementary information concerning the regulatory language.[118] Although the Response Plan regulation wording in 49 CFR 194 was revised in 2005, the WCD language in 194.105 (b)(1) has not been altered. The 1993 information states:

> As used in this rule, a worst case discharge is the largest foreseeable discharge in adverse weather conditions that a pipeline could discharge in a response zone. It is based on a comparison between several factors. First it could result from the calculation of the rate of flow times the maximum time to detect the spill, plus the rate of flow times the time to shut-down the pipeline plus the drainage volume after shutdown of the pipeline. The operator must determine and utilize a realistic shutdown time based on the pipeline's operating and design characteristics, including leak detection and shutdown capability.[119]

Leak detection time is intended to be part of the WCD calculation formula. The formula in the 2016 PHMSA presentation lists an equation with response time in addition to shutdown time. In fact, the 2016 PHMSA presentation states "response times and shutdown times less than **10 minutes** raises red flags!" (emphasis in red added by PHMSA).[120] The DAPL 2016 calculation was less than 10 minutes and should have raised red flags with the Corps of Engineers, but did not.

The DAPL WCD approach and outcome have a number of serious issues that lead to a gross underestimation of the realistic maximum spill:

1. The DAPL Lake Oahe crossing lacks a description of the methodology as required by PHMSA and a formal documented and supported worst case discharge (WCD) analysis

[116] PHMSA, *Is Leak Detection Possible*, PHMSA Perspective, Pipeline Safety Trust Conference, October 20, 2016, at 7 (*available at*: http://pstrust.org/wp-content/uploads/2016/05/Kieba-Presentation.pdf) (last accessed 2-3-2018).

[117] *Id.*

[118] Response Plans for Onshore Oil Pipelines, 58 Fed. Reg. 244 (January 5, 1993), 49 CFR 194 Interim Final Rule.

[119] *Id*, at 249-250.

[120] PHMSA, *Is Leak Detection Possible*, PHMSA Perspective, Pipeline Safety Trust Conference, October 20, 2016, at 7 (*available at:* http://pstrust.org/wp-content/uploads/2016/05/Kieba-Presentation.pdf) (last accessed 2-3-2018).

in any project report or plan. The WCD calculations and methodology for Lake Oahe are not available to emergency responders in any Facility Response Plan or the Lake Oahe Geographic Response Plan.

2. DAPL stated without explanation in their Facility Response Plan that the "maximum historic discharge is not applicable for WCD covered by this plan." The Corps of Engineers asked DAPL why they did not use historic discharge in their WCD calculations but received no explanation.[121] Nowhere does DAPL explain why historic shutdown discharges from other Sunoco/ETP pipeline incidents are not discussed or relevant to the Lake Oahe WCD calculation. This is particularly important given the 12-day shutdown time for the 2016 Sunoco/ETP Permian Express II serious spill discussed above. How did Sunoco/ETP improve their corporate safety system leak detection capabilities to ensure a 12-day response time would not be repeated? Leak detection estimates to be realistic or scientific need to be based upon actual historic performance data. API Recommended Practice 1173, Pipeline Safety Management Systems, emphasizes the key role such data plays in its continuous assessment and improvement approach called "Plan-Do-Check-Act."[122]

3. Different DAPL documents provided different shutdown and response times (4 minutes, 9-minutes, 12.9 minutes) creating confusion and undermining the credibility of DAPL's WCD calculations.

4. **The DAPL WCD calculation 9-minute shutdown time limited to pump shutdown time is incomplete and grossly underestimates the WCD. As PHMSA stated this should have raised red flags and led to greater scrutiny and review. The DAPL WCD calculation fails to include necessary elements such as detection time (from the initiation of the leak to detection) and EFRD shutdown time.**

5. The 2005 PHMSA pipeline response plan final rule discussion of comments on 49 CFR 194.105 WCD states "The current definition of worst case discharge requires consideration of adverse weather conditions. Although we have not specified how these effects must be weighed, operators are required to consider the weather history for the area surrounding the pipeline and the effects of adverse weather on the time needed to shut down a pipeline."[123] DAPL does not address the adverse weather impact

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[121] DAPL Environmental Analysis Correspondence in *ProjNet*, 2015-2016, at 93, USACE_DAPL0072252.

[122] API RP 1173, Pipeline Safety Management System Requirements, p. 8 (2014).

[123] Pipeline Safety: Response Plans for Onshore Transportation-Related Oil Pipelines, 70 Fed. Reg. 8734 (February 23, 2005), 49 CFR Part 194 Final Rule, at 244.

on the WCD for the shutdown of the pipeline. Issues include harsh ND winter conditions, deep snow, ice cover limitations on oil spill sighting, extreme cold and the availability and operation of the EFRD shutdown valves in extreme environments.

6. Any determination of the harm suffered by the Tribe requires utilization of the Corps of Engineers' Reservoir System Simulation (ResSim) and HEC River Analysis System (HecRas) computer models, to estimate the impacts to water quality and wildlife habitat caused by an unintentional release of oil under various reservoir conditions. The amount of water in Lake Oahe and the velocity of the flow of the Missouri River vary significantly and will determine the dispersion capacity of the Missouri River. These models are utilized by the Corps to estimate environmental conditions in Lake Oahe based upon water releases at Garrison and Oahe Dams, snow melt and runoff, and water depletions. The record indicates that neither the Corps of Engineers nor ETP has utilized ResSim or HecRas to determine impacts on the Standing Rock Reservation. The failure to properly determine these impacts under different hydrological conditions increases the risk to the Tribe and demonstrates that ETP is unprepared to address an oil spill under different hydrological conditions at Lake Oahe.

7. The WCD and risk assessment fails to consider other credible alternative scenarios such as a smaller leak below the detection limit. As we can see from the 2016 Sunoco/ETP Permian Express II spill a pinhole leak with a prolonged 12-day detection and shutdown time can lead to a serious 361,000 gallons (8600 bbls) crude oil spill. DAPL has asserted an extremely low 1% leak detection limit. The Corps must verify that detection limit claim with performance and testing data. Using that stated detection limit of 1% with maximum flow, leaks under 6000 bbls a day could not be detected. Similar to the 2016 Sunoco/ETP Permian Express II incident, such a leak could flow for days without detection. Given the requirement of no more than 21 days between visual observation overflights, 126,000 bbls potentially can be released before a spill is spotted visually. This discharge volume could be greater if the spill is not visible under ice or given the specific release path of the hydrocarbon plume 92-feet or more under Lake Oahe. The DAPL and Corps of Engineers risk assessment documentation also does not address the varying flows in the Oahe Dam system, the possible need to shut off the dam downstream of the pipeline, and the potential impacts on the Master Manual and Missouri River system many miles downstream if a leak is not detected in a timely way as with the Permian Express II.

8. **WCD estimates that lack actual realistic data such as DAPL's run contrary to known, well-regarded studies of actual industry performance and grossly underestimate WCD.**

a. **A 2012 PHMSA comprehensive leak detection study found one type of leak detection systems—supervisory control and data acquisition, or SCADA — detected hazardous liquid leaks 28 percent of the time.**[124]

b. **Another type of system, called computational pipeline monitoring or CPM, had a detection rate of 20 percent.**[125]

c. **Additionally, for hazardous liquid pipelines, "SCADA or CPM systems by themselves did not appear to respond more often than personnel on the ROW or members of the public passing by the release incident."**[126]

d. **There is no known study of actual performance or industry benchmarks that support a 9-minute timeframe from leak initiation to shutdown.**

e. **If workers or members of the public are more likely to detect spills than leak detection systems such as SCADA and CPM, reasonable detection times that are measured from the initiation of the leak until discovery should be estimated in hours rather than minutes.**

9. While data indicates leak detection systems such as SCADA and CPM can be unreliable, other leak detection methods for Lake Oahe may also be ineffective or unavailable. Visual observation overflights are limited to 26 flights a year with a possible three-week interval between flights. Lake Oahe is in a remote location with little pedestrian traffic to observe potential spills. For 3-4 months in the winter Lake Oahe can be covered in ice making or adverse weather could render visual observation of a spill unlikely.

10. The Lake Oahe site lacks external leak detection that has advantages over SCADA and CPM and can be used in addition to software systems. The EPA recommended external leak detection for the Keystone XL pipeline in sensitive environmental areas, similar to the Lake Oahe high consequence area (HCA).[127] One external leak detection device, hydrocarbon sensing tubes can detect vapors from an oil spill and can operate in

[124] Pipeline and Hazardous Materials Safety Administration, *Final Report 12-173, Leak Detection Study*, p. 2-11 (2012)

[125] *Id.*

[126] *Id*.

[127] *Keystone XL Shuns Infrared Sensors to Detect Leaks*, Bloomberg, January 18, 2013 (*available at*: https://www.bloomberg.com/news/articles/2013-06-17/keystone-xl-pipeline-shuns-high-tech-oil-spill-detectors) (last accessed 2-4-18)

continuous mode.[128] The implementation of this type of real-time hydrocarbon monitoring would provide additional needed protection in an HCA for the tribe as other leak detection systems have serious weaknesses.

11. DAPL fails to apply good industry standards and practices to demonstrate a high degree of reliability and availability of the SCADA operator actions and shutdown valve functioning – all necessary to minimize crude oil spills and provide a credible WCD estimate. Examples of an industry standards to improve the availability of the operator actions and EFRD function include: ANSI/ISA 84, Safety Instrumented Systems and IEC 61511-1, Functional Safety, Safety Instrumented Systems (*See* Appendix E, *Standing Rock Sioux Tribe Technical Team Fatal Flaw Analysis Lake Oahe HCA Pipeline Crossing Safety Instrumented Systems Report*). DAPL also fails to consider the automation of the Lake Oahe EFRD that could improve equipment availability over a remotely activated valve that relies upon the fallibility of human performance.

12. **DAPL's informal WCD calculations take a "best case" approach and grossly underestimate the likely volume of Bakken crude oil released. Other more realistic performance-based approaches would show a much greater WCD. For example, one large multi-national oil company uses for WCD planning purposes a one-hour release time before shutdown. Also note the Final EA's analysis of benzene concentration in one hypothetical spill scenario is based upon "the release of benzene over a one hour period." Using some of the assumptions in the Corps of Engineers/DAPL correspondence, that would result in a release over 33,751 bbls [25,000 BPH * one-hour shutdown time = 25,000 bbls + 8751 bbls DDV = 33,751 bbls. This is more than 2½ times the DAPL WCD calculation. Without the demonstrated effective implementation of human factors standards and ISA 84, a realistic calculation could not take credit for the EFRD functioning or timely human performance which would even more significantly increase the WCD.**

D. Spill Risk Assessment

With the specific elevated hazards of Bakken crude oil not identified and the WCD grossly underestimated, key components of the DAPL risk assessment are seriously flawed from the onset. Much of the DAPL and Corps of Engineers' analysis adopts a "check-the-box" approach to risk assessment, focusing on generic pipeline risks and mitigations. This outdated approach minimizes risk and fails to apply company integrity management data and system safety performance metrics to the risk assessment. More rigorous modern industry safety standards developed in response to the ongoing occurrence of serious pipeline incidents are

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[128] Henrie et al, Pipeline Leak Detection Handbook, at 158.

not applied. These technical and scientific shortcomings have been raised in expert declarations and the Tribes EIS scoping comments in the litigation and NEPA process.

Risk is typically described as the probability of failure and the magnitude of consequence. Risk assessment such as DAPL's are often performed to support an outcome – here the construction and operation of the Dakota Access Pipeline. But the real benefit in risk assessment is to find ways to reduce risk with actions such as additional protective safety barriers, application of more stringent standards or route alternatives. API RP 1173, Pipeline Safety Management System Requirements states "pipeline risk management steps are undertaken to reduce risk and support achieving a goal of zero incidents."[129] While DAPL and the Corps' documentation uniformly assign low risk to stated pipeline threats, they acknowledge the consequences are high:

> In the event that a pipeline failure occurs, and product is released into the Missouri River at either crossing, the worst-case consequence scenario is ranked high because several drinking water intake High Consequence Areas (HCAs) and multiple ecologically sensitive HCAs could be impacted.[130]

The DAPL Facility Response Plan also designates the North Response zone that includes the Lake Oahe crossing as having the potential for "significant and substantial harm" with the potential for a worst case discharge.[131]

Assertions of low pipeline spill risk based upon generic pipeline frequency statistics by DAPL is misplaced. Risk assessment must evaluate real risk including available performance data and project specific hazards. Major hazardous material incidents – large spills and toxic releases, fires, and explosions, etc. – are described in industry safety guidelines as low frequency, high consequence events. Even though these major incidents are infrequent, because of the potential for catastrophic consequences, risk evaluation and treatment for these events must receive high priority.

As we know from well-known major oil industry accidents such as the BP Texas City oil refinery (2005) and Deepwater Horizon (2010), pre-incident risk analysis that minimizes incidents with catastrophic potential based upon misperceptions of incident frequency leaves the organization vulnerable to disaster. By PHSMA definition and acknowledged in the Final EA, the Lake Oahe DAPL crossing is a High Consequence Area (HCA). Citing low frequency

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[129] API RP 1173, at 10.

[130] EA at 94.

[131] Dakota Access Pipeline, ERAP at 2-3, FRP at 2-3.

to downgrade risk when all major incidents have that characteristic misses important opportunities for implementing needed risk reduction measures for high risk projects.

Moreover, threats examined by the risk assessment need to be much broader than the typical index model focusing almost exclusively on a handful of integrity management issues. DAPL and the Corps of Engineers using the pipeline risk assessment process "from the W. Kent Muhlbauer Relative Index Methodology (2004)" examined nine integrity management issues but no other threats.[132] A recent PHMSA study concluded there were "serious documented issues with index scoring models" that may lead to "undermining" spill prevention.[133] API RP 1173 however emphasizes the importance of a broader review that was not done for the Dakota Access Pipeline:

> The term "threat" can be applied broadly in a PSMS[134], such as a threat to a safety culture (NEB Statement on Safety Culture), or a threat to the knowledge and experience of an organization through retirements and attrition. These threats can be assessed using risk assessment and managed with prevention and mitigation measures.[135]

The more modern approach to major accident prevention would have the operator assess all threats and take all necessary measures to prevent a major accident where a catastrophic potential is present. More importantly, relying on generic industry statistics is also misplaced where - as with Sunoco/ETP - there is ample data available related to its own incident performance. Sunoco/ETP incident record is abundantly replete with spill incidents and reflects increasing serious events over the last two years. Sunoco has also experienced high profile release incidents just in the last several months that resulted in a number of government enforcement actions, shutdowns and remedial action orders.

For example, Sunoco Pipeline has experienced 291 hazardous liquid pipeline incidents from 2006 to 2017, the most of any pipeline operator for that period. These incidents led to $56,590,698 in property damage from the release of 28,479 in gross barrels with more than 40% of the net crude lost.[136]

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[132] U.S. Army Corps of Engineers. Environmental Assessment: Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands, at 92.

[133] Rick Kowalewski, *Pipeline Integrity Management, A Report to the Secretary of Transportation*, October 31, 2013, at 67 (*available at:* http://pstrust.org/wp-content/uploads/2015/10/Kowalewski-IM-PE_Report.pdf) (Last accessed 2-4-18)

[134] Pipeline Safety Management System

[135] API RP 1173 at 10.

[136] PHMSA Pipeline Operator Information, (*available at:* https://primis.phmsa.dot.gov/comm/reports/operator/Operatorlist.html?nocache=6063#) (last accessed 2-4-18).

From 2006 to 2017 for all of Sunoco/ETP including pipelines wholly owned or with controlling interest,[137] hazardous liquid incidents numbered 421 with $90,698,676 in property damage from 59,343 bbls of crude oil spilled.[138] For the 12-year period, ETP/Sunoco experienced approximately **three spills a month**. The single operator with the next largest number of incidents was Enterprise Products with 284.[139]

Sunoco experienced the unprecedented regulatory enforcement action of shutting down operations on four occasions in three states related to environmental spills in the last year. In Pennsylvania, the Department of Environmental Protection (DEP) Secretary noted "a permit suspension is one of the most significant penalties DEP can levy,"[140] HDD drilling operations were reported shutdown by FERC on the Rover Pipeline in Ohio related to the release of nearly 150,000 gallons of drilling fluid. A spill of 2,000,000 gallons of drilling fluid occurred at the same site in April 2017.[141] The Mariner 2 East pipeline was shutdown January 3, 2018 by the Pennsylvania DEP for leaks and spills that were described as "egregious and willful violations" of law.[142] West Virginia DEP reportedly ordered the halt to Sunoco's Rover Pipeline Construction in July 2017 due to environmental violations.[143]

ETP/Sunoco with a documented poor incident safety performance record has an obligation under good practice guidelines to apply more rigorous safety standards and practices that go beyond minimal compliance. Application of more rigorous approaches with stronger safeguards are needed where company data and indicators show incidents, system deficiencies and higher risk. Using their own safety record and data as the best evidence of real risk, rather than generic industry statistics (including leading indicators and smaller spills that are often precursors to major accidents) is more effective and is consistent with good safety practice. Such an approach would lead to an evaluation of unacceptable risk for the DAPL project based

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137 Energy Transfer Crude Oil Pipeline website, (*available at:* http://www.sunocologistics.com/Customers/Business-Lines/Crude-Oil/253/) (last accessed 2-6-18).

138 PHMSA Pipeline Operator Information, (*available at:* https://primis.phmsa.dot.gov/comm/reports/operator/OperatorList.html) (last accessed 2-4-18)

139 *Id.*

140 *Sunoco to resume work pay $12.6 million for Mariner East 2 Pipeline Violations*, NPR Pennsylvania State Impact, February 8, 2018, (*available at:* https://stateimpact.npr.org/pennsylvania/2018/02/08/sunoco-to-resume-work-pay-12-6-million-for-mariner-east-2-pipeline-violations/) (last accessed 2-8-18)

141 *FERC again orders drilling halt on Rover Pipeline site after another spill*, Ecowatch, January 5, 2018, (*available at:* https://www.ecowatch.com/rover-pipeline-ferc-2528592582.html) (last accessed 2-4-18)

142 *Pennsylvania DEP says enough is enough, halts work on Mariner East 2 pipeline*, Philly Voice, January 3, 2018, (*available at:* http://www.phillyvoice.com/pennsylvania-dep-says-enough-enough-halts-work-mariner-east-2-pipeline/) (last accessed 2-4-18)

143 *DEP Orders Halt to Rover Pipeline Construction*, Charleston Gazette Mail, July 25, 2107 (*available at:* https://www.wvgazettemail.com/business/dep-orders-halt-to-rover-pipeline-construction/article_f3b3c8b1-7158-55a3-86c1-9de295596373.html) (last accessed 2-4-18)

upon a poor safety spill record and minimum compliance approach and require the more rigorous application of safeguards and layers of protection provided in more modern good practice and standards.

DAPL and the Corps of Engineers have failed to apply recognized industry safety good practice to the DAPL design, construction and operation. The Final EA asserts that: "To prevent pipeline failures resulting in inadvertent releases, Dakota Access would construct and maintain the pipeline *to meet or exceed industry and governmental requirements and standards."* **However, DAPL failed to cite or apply key recent more rigorous relevant industry standards – as discussed below.**

- API RP 1173, Pipeline Safety Management System Requirements (2014) establishes pipeline safety requirements for managements systems such as risk management, incident investigation, and safety assurance that are critical for preventing incidents such as loss of containment. In response to recommendations from the NTSB and GAO, API developed API RP 1173 Pipeline Safety Management System Requirements. The issuance of 1173 has been hailed as a critical step forward for incident prevention in the pipeline sector. The standard was developed 20 years after similar management system standards were issued by API in upstream exploration and production and downstream in crude oil and petrochemical processing.

- API 1173 is applicable to pipeline operations including designing, constructing, operating, maintaining and managing the pipeline to prevent major accidents and continually improve pipeline safety. API RP 1173 requires risk reduction and continuous improvement to prevent pipeline incidents:[144]

> Review processes and progress to reduce risk, including communicating incident investigation findings and lessons learned; construction progress—scope, schedule, and cost; efficiency and productivity enhancements; progress on employee and contractor safety programs; and review of leading indicators and their meanings.

- API RP 1173 also requires safety data gathering and the evaluation of risk management and safety performance using leading and lagging key performance indicators.[145]

- API RP 1133, Guidelines for Onshore Hydrocarbon Pipelines Affecting High Consequence Floodplains (reaffirmed 2010) establishes criteria for the safe design, construction, operation, maintenance, etc. in high consequence floodplains. API RP

[144] API RP 1173 at 9.
[145] *Id*. at 10, 16.

1133 includes, for example, criteria for block and check valves to minimize loss of containment in floodplains. Issues raised by the RP include the location of the valves based upon a risk analysis, the pipelines elevation profile, and access and availability of utilities during flood conditions. None of these issues are properly evaluated in DAPL or Corps of Engineers' planning documents.

- API RP 1175, *Pipeline Leak Detection Program Management*, states explicitly that the standard has been developed in response to mandates and recommendations from Congress and the NTSB to improve identified weaknesses in pipeline leak detection.[146] It should be noted that the Final EA states that Dakota Access is implementing SCADA and CPM to address leak detection making it critical that the Corps of Engineers address system performance. The recently adopted API RP 1175 includes guidance on the selection of leak detection systems and establishing performance criteria for system effectiveness. The Final EA lacks any meaningful discussion on the actual implementation of SCADA and CPM and fails to reference the use of any performance metrics to assess effectiveness. This is particularly important where - as with the Lake Oahe crossing - some other means of leak detection such as visual observations and over-flights will be ineffective given the remote location, ice conditions and HDD construction *92 feet under the lake.*

Implementing the minimal compliance of PHMSA regulations alone creates unacceptable risk to DAPL pipeline operations. Congress and federal agencies have consistently highlighted that the number and severity of pipeline incidents, including those for hazardous liquid pipelines are unacceptable. The finding that current pipeline regulations are inadequate has been identified in numerous recent government reports, recommendations, studies and Congressional action.

The DOT Inspector General (IG) recently found that PHMSA's response to these recommendations and mandates was untimely and insufficient.[147] As a result, major oil companies have recognized the need to move beyond minimal compliance and have developed more rigorous pipeline standards such as API RP 1173, *Pipeline Safety Management System Requirements* to manage risk and prevent spills and releases. This key standard is not referenced in DAPL or Corps of Engineers' documents. The oil industry and good practice safety guidelines universally recognize that strong safety management system performance is

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[146] API RP 1175, Pipeline Leak Detection Program Management, p. 4 (2015)

[147] U.S. Department of Transportation, Office of Inspector General, Insufficient Guidance, Oversight, and Coordination Hinder PHMSA's Full Implementation of Mandates and Recommendations, Report Number: ST-2017-002, at 1 (Oct. 2017) (available at: https://www.oig.dot.gov/sites/default/files/PHMSA%20Progress%20Implementing%20Mandates%20and%20Recommendations%20Final%20Report%5E10-14-16.pdf) (last accessed Feb. 4, 2018).

the key to preventing major accidents.[148] Some companies such as PG&E and Williams have gone further and determined that even more rigorous process safety management approaches are necessary.

In the wake of the catastrophic San Bruno pipeline incident PGE is actively implementing process safety guidelines and standards from industry associations such as the Center for Chemical Process Safety (CCPS) to prevent future incidents. These approaches go beyond a focus on equipment and encompass vital elements such as human factors, root cause incident investigation, implementing effective safeguards that are verified as available and effective, safety culture analysis and effective supervision and management control – elements lacking in the Environmental Assessment and other DAPL planning documents. Central to the development and implementation of these more rigorous approaches is that minimal compliance – as described in the Final EA and related documents – is insufficient to prevent major pipeline incidents.

The risk analysis in the Final EA examines nine threats and finds all low risk in a brief discussion.[149] This index scoring-type approach utilized by DAPL as reflected in the Final EA and related documents has recently been criticized by the NTSB in the San Bruno report and as noted herein by a 2013 DOT/PHMSA study conducted in response to an NTSB San Bruno related recommendation.[150] The DOT study found that utilizing such an approach can lead to underestimating spill risk. The report summarized three issues:

> In the report of investigation on the San Bruno pipeline explosion, NTSB raised three concerns with the risk models pipeline operators are using:
>
> - the quality and completeness of the records that are used;
> - the extent to which operators are incorporating leak, failure, and incident data in evaluation of their risk models; and
> - the weighting of risk factors

The DAPL risk assessment information appears to be the scoring conclusions of the assessment rather than the details of the report itself. The Muhlbauer analysis claimed to be utilized by DAPL is very detailed and requires all relevant information to be included. There

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148 The Center for Chemical Process Safety (CCPS), GUIDELINES FOR INVESTIGATING CHEMICAL PROCESS INCIDENTS, 2nd Ed., p. 9 (2003).

149 U.S. Army Corps of Engineers. Environmental Assessment: Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands.

150 Rick Kowalewski, Pipeline Integrity Management, A Report to the Secretary of Transportation at 67.

are many subcategories for different risk elements that don't appear in the DAPL documentation to be captured, explained or the assumptions and rational provided. Some of the scoring requires a safety factor which is not provided by DAPL. The Muhlbauer scoring published in 2004 appears dated and does not capture the use of performance data, recent key elements of API standards and good major accident prevention practices such as human factors and safety instrumented systems. Lack of more rigorous standards leads to erroneous assumptions in the DAPL analysis – for example lack of mechanical integrity data such as failure rates and other key indicators.

Another example is the corrosion discussion that lacks any discussion of internal, external and subsurface damage mechanisms that could be translated into the corrosion index. The list of corrosion safeguards is generic and not project-specific giving the appearance of a "check the box" exercise. A project-specific damage mechanism review would be good practice and part of the risk analysis report in any sector of the oil industry – however, this was not done.

Good practice risk assessments also include a robust discussion of previous incidents and corrective actions. Why previous spills occurred, what were the weaknesses in the company's safety systems, and how long was the detection and spill response times in previous leaks – these are key elements that must be included in the risk analysis. With respect to prior reported incidents, the reasons that ETP and Sunoco's monitoring systems were unable to detect those leaks, as well as the steps taken to correct their safety management practices, should all be part of the DAPL risk analysis. This is particularly important given the oil spill record of ETP and Sunoco. Nevertheless, none of these factors have been taken into account.

There are other deficiencies in the spill modelling discussion. The DAPL and Corps of Engineers documentation lacks an actual detailed technical spill model. Only examining a complete "guillotine" pipeline rupture on the surface of Lake Oahe is not a factual scenario. A leak 92-feet under Lake Oahe needs to be modeled as it presents additional elevated hazards and challenges such as delayed leak detection and unanticipated release location(s). A smaller leak below a reasonable detection limit and its impact on the water intakes and sensitive receptors also needs to be modeled and included in the risk assessment given the difficulties of detection. Water soluble Bakken crude oil VOCs such as benzene can more easily flow in groundwater.[151] Any discussion of such a leak and plume modeling requires a sophisticated technical analysis that doesn't appear in any project documentation.

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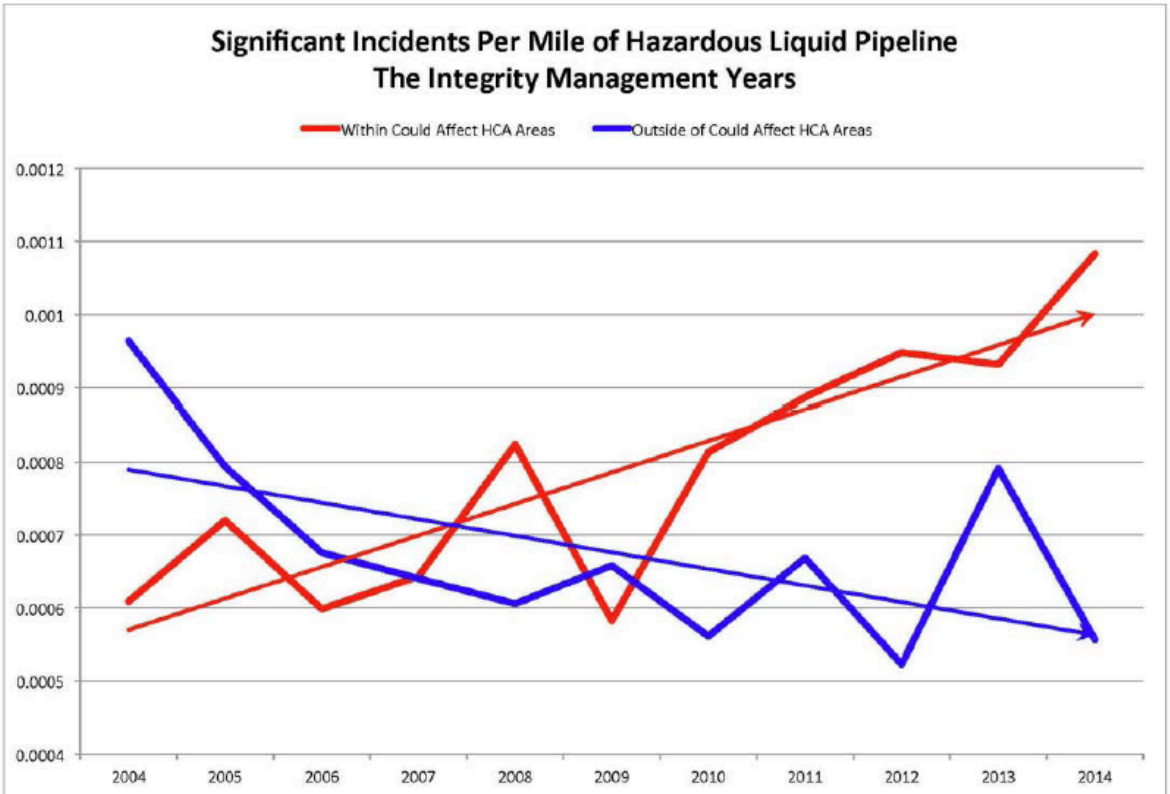
[151] Transportation Safety Board of Canada, *TSB Laboratory Report LP148/2013*, (*available at:* http://www.tsb.gc.ca/eng/enquetes-investigations/rail/2013/R13D0054/lab/20140306/LP1482013.asp) (last accessed 2-1-18).

The DAPL risk model assumes good practice integrity management is well understood and current industry approaches to risk are performing well. However, the Pipeline and Hazardous Materials Safety Administration ("PHMSA") minimum compliance requirements are dated and significant oil spill incidents are increasing. Incidents have risen even in areas designated as High Consequence Areas by PHMSA with additional integrity management requirements. The well-respected Pipeline Safety Trust has noted that "[r]ecent incident data that suggest there is something fundamentally wrong with the integrity management program as implemented today: significant incidents on hazardous liquid lines *within HCAs* are on a rising trend over the past several years" (*See* Figure 1).[152]

[152] *PST Comments regarding Hazardous Liquid Pipeline Safety*, docket number PHMSA-2010-0229, at 1 (Jan. 7, 20160 (*available at:* http://pstrust.org/wp-content/uploads/2015/10/US-Docket-PHMSA-2010-0229-PST-comments-20160107.pdf) (last accessed Feb. 4, 2017).

Figure 1. Significant Incidents Per Mile of Hazardous Liquid Pipeline.

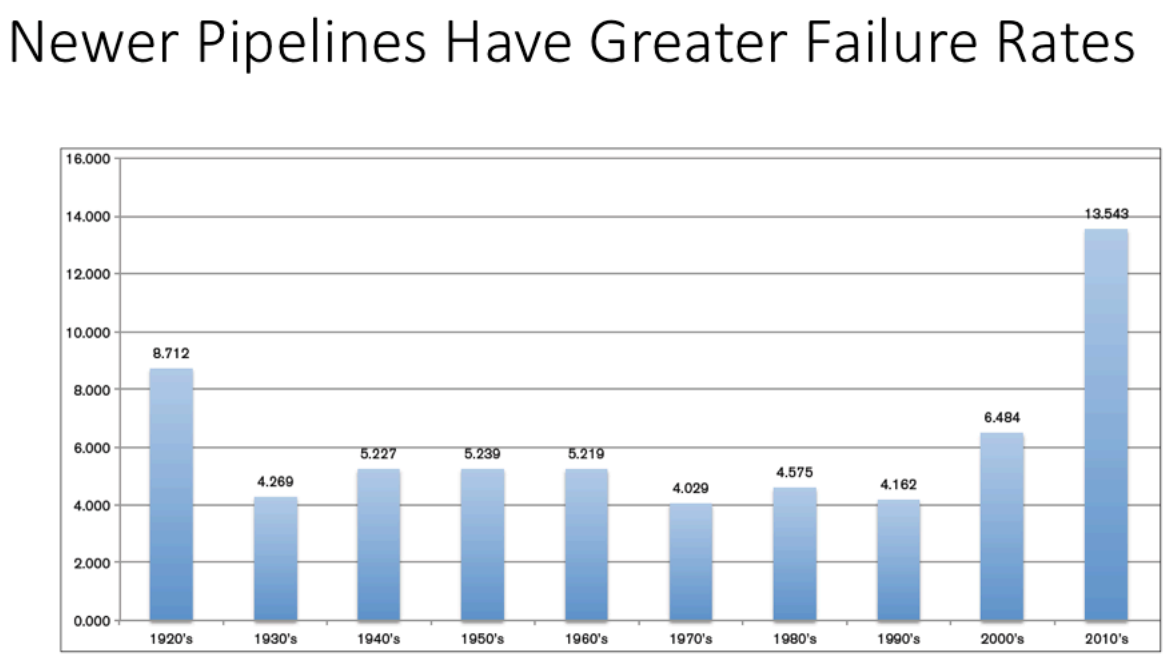


Source: Pipeline Safety Trust, 2015

Moreover, data presented by the Pipeline Safety Trust challenges the assumption that newer pipelines are safer (*See* Figure 2). The graph below highlights that more recent pipelines have greater failure rates.[153]

[153] Pipeline Safety Trust, *Are Older Pipelines Really More Dangerous: Pipeline Safety*, Spring 2015 (*available at:* http://pstrust.org/wp-content/uploads/2013/03/Incidents-by-age-of-pipes-PST-spring2015-newsletter-excerpt.pdf) (Last accessed 2-4-18).

Figure 2. Pipeline Safety Trust Graph, "Are Old Pipelines Really More Dangerous," Safe Pipelines Spring 2015. Number of Incidents per 10,000 Miles of Onshore Hazardous Liquid Pipeline by Decade of Pipe Installed.



Source: Pipeline Safety Trust, 2017

The DAPL planning documents also fail to effectively assess the serious threat of landslides and the appropriate mitigation. The Tribe commissioned a study of the DAPL landslides in the specific DAPL geographic location of the Lake Oahe crossing by South Dakota School of Mines and Technology Professors Emeritus Perry H. Rahn, Ph.D., P.E. and Arden D. Davis, Ph.D.[154]

The technical report concludes:

> The area of the crossing has landslide-prone geologic material from the exposed Fox Hills Formation. The Pierre Shale, which also consists of unstable material, is the bedrock directly beneath the Fox Hills Formation. The steep slopes and unstable soils at the crossing have resulted in landslides in the past. Numerous landslides from previous slope

[154] *See* Appendix F. Perry H. Rahn, PhD., P.E. and Arden D. Davis, Ph.D. *Landslides in the Vicinity of the Dakota Access Pipeline Crossing of the Missouri River Near the Standing Rock Sioux Reservation.* Prepared for the Standing Rock Sioux Tribe (December 2017).

> failures have been mapped in the area, and more are predicted to occur. Future landslides and reactivation of old landslides pose a serious risk of rupturing the pipeline. A leak in this area would threaten the water supply for the Standing Rock Sioux Tribe and cause pollution to groundwater, surface water, environmental resources, and ecological systems downstream.[155]

The report notes that the steep slopes leading down to the Missouri River in the vicinity of the DAPL Lake Oahe crossing include the Fox Hill Formation. This geology is "nearly flat lying Cretaceous sedimentary rocks" consisting of "mostly of clay, shale, silt, and fine-grained sandstone," which are "prone to landslides, especially where they contain bentonite within the clay and shale."[156] The report includes geologic maps that show the Fox Hills Formation "is exposed along the Missouri River at the pipeline crossing near the town of Cannon Ball."[157] The report notes that under the Fox Hill Formation at the Lake Oahe DAPL crossing is Pierre Shale "which contains shale and bentonite, and also is prone to landslides."[158]

The landslide report prepared for the Tribe details how prevalent landslides are in such formations in North Dakota along the Missouri River including landslide maps for the Cannon Ball area.[159] The report finds that geologic formations in the DAPL crossing "are prone to slope failures. Landslides will continue to occur in the future. Older slope failures also could be reactivated, especially during wet periods."[160]

The report concludes that "the Dakota Access Pipeline could not withstand a landslide without rupturing, because of the great force of the weight of moving soil during a slope failure…We conclude that landslides pose a serious risk to the Dakota Access Pipeline where it crosses the Missouri River north of the Standing Rock Indian Reservation"[161]

Attempts may be made to downplay or dismiss such a serious risk by attempting to create the impression that engineering approaches (e.g. thicker pipe, shielding, etc.) may mitigate such quick acting massive force abnormal loading threats. A simple evaluation of the possible impact of thousands, if not millions of tons, of force on a steel tube should readily

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[155] *Id.* at 1.
[156] *Id.* at 2.
[157] *Id.*
[158] *Id.*
[159] *Id.* at 3.
[160] *Id.*
[161] *Id.*

demonstrate such mitigation claims are without merit. Massive landslide can place quick acting forces on pipelines that most likely result in pipeline rupture, large, high rate oil releases.

DAPL and the Corps of Engineers must more effectively evaluate the potential for a massive landslide not only on the federal easement crossing Lake Oahe, but also whether such landslide risks can occur on nearby, off federal easement lands, where a pipeline release from possible landslide could result in oil reaching Lake Oahe. If massive landslide risks also exist for such nearby proposed right-of-way, the pipeline route needs to be changed to a route where such a landslide threat is not present.

The DAPL risk assessment has not effectively addressed the issue of pipeline coating damage from HDD construction and the difficult challenges of monitoring cathodic protection to prevent external corrosion in an HDD crossing. As noted in a recent technical article by a major pipeline operator, "monitoring CP through a HDD section is extremely challenging, if not impossible, due to the depth of pipe installation and access challenges presented by the physical obstruction which necessitated the HDD."[162] HDD pipelines are more likely to experience damage to the external coating during the construction process:

> Pipelines installed by horizontal directional drilling (HDD) have an increased likelihood of experiencing coating damage than those constructed through conventional open trench techniques. Current methods for identifying damaged coating regions on buried pipe cannot always provide absolute or accurate information on the location, size and geometry of the holidays. Cathodic protection monitoring at HDD locations is typically limited to the entry/exit extremities, with protection levels in the intervening span either assumed or speculated. There are situations where cathodic protection of a HDD pipeline may not be accomplished, although anticipated.[163]

The Corps of Engineers and DAPL documentation include no examples of similar HDD applications involving crude oil as a product fluid in a large diameter pipe (30" pipe in a 48" open borehole assembly) over a long well bore (7500') under a fresh water lake. A preliminary investigation did not uncover examples anywhere in the world in operation and certainly no long term operational examples. The Envy report assessing the HDD risks to the Dakota Access Pipeline determined that the unprecedented length would produce enormous

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[162] Krissa, L. J., Baeté, C., & DeWitt, J., CP Effectiveness at Horizontal Directionally Drilled Crossings, p. 1 (2016).

[163] *Id.* at 2.

stresses and potential construction damage for the 30-inch pipeline.[164] The report concluded the longer the HDD, the higher the risk.[165] These risks were not addressed by the Corps of Engineers and DAPL and if left unaddressed elevate the risk of external corrosion to the Lake Oahe HDD pipeline.

The Final EA Finding of No Significant Impact (FONSI) is incorrect on the facts and technical conclusions; the DAPL pipeline Lake Oahe crossing represents a significant risk to people, the environment, important Tribal natural and cultural resources and environmental justice. Applying outdated risk management approaches and safety standards where the operator has a demonstrated poor safety record creates an unacceptable risk for the Lake Oahe pipeline crossing designated a high consequence area. An Environmental Impact Statement process is the only mechanism to adequately address these deficiencies.

E. Emergency Response Planning

The identification of the specific hazards of Bakken crude, a realistic worst case discharge calculation and a technical spill model for Lake Oahe are all essential for emergency response planning, but are seriously flawed or lacking completely in the DAPL and Corps of Engineers documentation. These deficiencies weaken oil spill response and place emergency responders in harm's way. In failing to provide the specific hazards of Bakken crude, DAPL's Facility Response Plan does not effectively identify the necessary methods, equipment, personal protective equipment, and precautions necessary to respond to a Bakken crude release.

Moreover, DAPL and the Corps of Engineers have failed to effectively consult with the Tribe and provide vital information. Good emergency planning practice and federal regulations require operators to communicate and share needed planning documentation such as unredacted facility response plans, geographical response plans, spill models, WCD calculations, etc., but this has not been done. The Tribe's technical expert declarations and DAPL EIS scoping comments have addressed key emergency planning issues with scientific and technical positions in conflict with the Corps of Engineers and DAPL.

The DAPL and Corps of Engineers documentation lacks a detailed technical spill plan or an accurate WCD calculation – both are essential for effective emergency response planning. A realistic worst case discharge calculation is required under PHMSA regulations

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[164] Envy Report, Technical Engineering and Safety Assessment: Routing, Construction, and Operation of the Dakota Access Pipeline in North Dakota, p. 11-13 (January 5, 2016).

[165] *Id*. at 14.

to ensure the necessary emergency response capability is available.[166] PHMSA also encourages operators to plan for other specific release scenarios that are less severe than the WCD.[167] Spill modeling is necessary for emergency response planning and activities as it provides estimates of the potential locations, concentrations, and timing of crude oil spill impacts.[168] The WCD and spill modeling deficiencies have the following negative impacts on DAPL emergency planning and response:

1. The project lacks a formal technical spill model which prevents identification of potential spill impacts on sensitive environmental areas, locations sensitive to aquatic organisms and wildlife, areas with tribal cultural significance.

2. The lack of a realistic WCD calculation leads to an underestimation of the resources needed to respond to a WCD Lake Oahe spill and the impacts from the accurate crude oil volume and concentration to specific areas.

3. DAPL uses a spill modeling scenario of a guillotine rupture on the surface of Lake Oahe that is not factual. This flaw underestimates the potential hazards from a release 92-feet or more under Lake Oahe. A guillotine rupture in the actual pipeline location under the lake bed presents a much more complex response scenario. The geotechnical/hydrogeological movement of the Bakken crude in the formations under the lake bed, the potential for movement in the groundwater, likely release locations and timing of crude entering the lake environment all could lead to delayed leak detection, ineffective emergency response activities and greater spill impacts.

4. The DAPL Geographic Area Response Plan states that "based on the current Spill Model, the first oil from an unabated release of this volume would take an estimated 6.7 hours to travel downstream before reaching Intake 1," an agricultural water intake.[169] The 2015 Lake Oahe Spill Model Discussion document asserted that the total travel time for responders and equipment to arrive on site was 6 hours.[170] Less than 45 minutes is an insufficient safety margin to protect water intakes. Moreover, the lessons learned from recent Bakken spills indicate that timely response is critical as the oil will

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166 Response Plans for Onshore Oil Pipeline, 58 Fed. Reg. 244, 246 (January 5, 1993), 49 CFR 194 Interim Final Rule.

167 *Id*. at 247.

168 Macay, RPS ASA, Properties of Crude Oil Shipments and Environmental Impacts of Releases: Oil and Chemical Spill Impact and Modeling (*available at:* http://onlinepubs.trb.org/onlinepubs/petroleum/FrenchMcCay051216.pdf) (last accessed 2-5-18).

169 DAPL Geographic Response Plan Pipeline Crossing at the Missouri River, Emmons County North Dakota, p. 4 (April 2017).

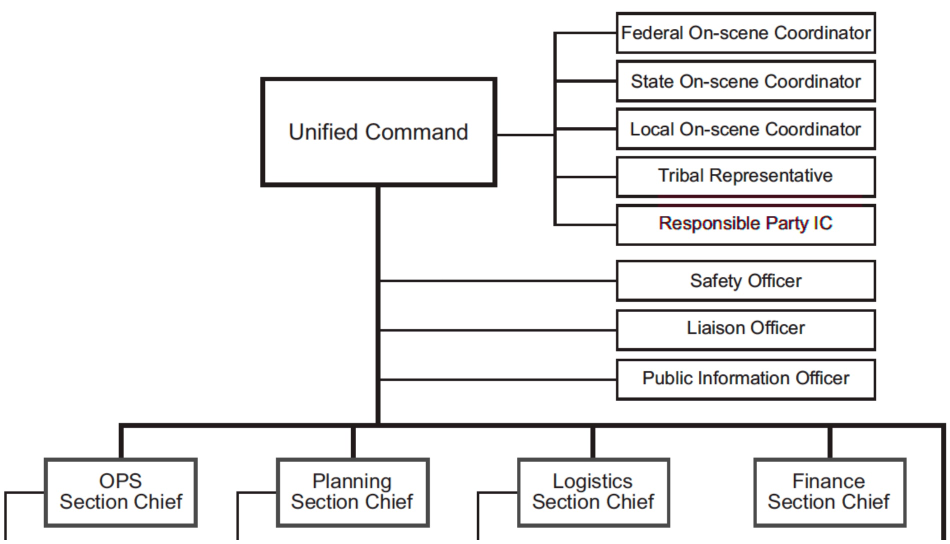
170 Energy Transfer Company, Wood Mustang Group, *Dakota Access Pipeline Project, North Dakota Lake Oahe Spill Model Discussion*, Issued for Review 8-5-15, at 9.

spread quickly.[171] Given realistic larger WCD volumes and the rapid spread of Bakken crude the time to reach sensitive receptors would likely be much shorter than the DAPL estimates.

5. The most recent geographic response plan (GRP) for Lake Oahe lacks WCD or spill modeling results for use by emergency responders. DAPL has stated it will not include the WCD calculations in the geographic response plans.[172] The GRP is merely a tactical document addressing necessary equipment and the deployment of booms, boats, etc. and does not justify or correlate the response planning with a WCD or spill model. This leaves responders vulnerable to more serious hazards and increases the likelihood that Lake Oahe resources will be insufficient.

6. API RP 1174, Recommended Practice for Onshore Hazardous Liquid Pipeline Emergency Preparedness and Response,[173] identifies the emergency response Incident Command structure as including Tribal Representatives in the Unified Command (*See* Figure 3 below).

Figure 3. The Unified Command Structure Provided as an Example from API RP 1174 Showing the Inclusion of Tribal Representatives but Lacking in the DAPL Facility Response Plan.



[171] National Oceanic and Atmospheric Administration, *Bakken Crude Oil Spill, Barge E2MS 303 Lower Mississippi River*, p. 8 (February 2014) (*available at*: http://www.efsec.wa.gov/Tesoro Savage/Adjudication/Exhibits/Tesoro4A/Exhibit 5215-000013-TRB.pdf) (last accessed 2-2-18).

[172] DAPL Environmental Analysis Correspondence in *ProjNet*, 2015-2016, at 89, 93, USACE_DAPL0072252.

[173] API RP 1174, Recommended Practice for Onshore Hazardous Liquid Pipeline Emergency Preparedness and Response, p. 37 (2014).

However, the DAPL Facility Response Plan lacks any listing or reference to the inclusion of tribal representatives in the Unified Command.[174] API RP 1174 recommends that response plans include the role of tribal on-scene coordinators and responsibilities of tribal agencies.[175] The standard also recommends tribal pre-planning and tactical response scenarios when a spill can impact tribal lands.[176] Operators also must account for the preparedness requirements of tribal agencies.[177] API RP 1174 states external parties including tribal first responders and government agencies should receive the following critical information:[178]

> The operator shall share critical information so first responders can analyze the situation and plan their response. Critical information should include product type, anticipated volume release, hazards, actions to be taken, etc.

DAPL and the Corps of Engineers stated in the Final EA that they would follow the requirements in API RP 1174.[179] It must be emphasized here that DAPL has fulfilled none of those provisions thus undermining tribal response planning and threatening its first responders despite the fact that the response zone is within the boundary of the Standing Rock Sioux Tribe. In particular, DAPL has failed to share the critical information listed above including realistic anticipated volume release, spill model or an unredacted facility response plan.

The spill response and remediation for the realistic WCD 92-108 feet under the Oahe lakebed in not addressed in the Corps of Engineers and DAPL documentation. The impact from such a release at such depths on the timeliness of spill response, downstream impacts, extreme difficulties of spill cleanup, repair of the pipeline, and the likelihood of a persistent toxic contamination of the soil, groundwater, and lake are not addressed. Also, not addressed by the Corps of Engineers and DAPL is the fact that typically most crude oil from spills is not recovered. Nor do they examine on-going impacts from the likely lingering toxic

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[174] Dakota Access Pipeline, Emergency Response Action Plan (ERAP) and Facility Response Plan (FRP), Dakota Access Pipeline North Response Zone, FRP see Appendix D (April 2017)

[175] API RP 1174, Recommended Practice for Onshore Hazardous Liquid Pipeline Emergency Preparedness and Response, p. 8 (2014).

[176] *Id*. at 15.

[177] *Id*. at 7.

[178] *Id*. at 25.

[179] U.S. Army Corps of Engineers, Environmental Assessment, Dakota Access Pipeline Project, Crossings of Flowage Easements and Federal Lands, at 50.

contamination. **Of the 59,343 bbls spilled by ETP/Sunoco pipelines from 2006 to 2017, 30,991 bbls (52 percent) were never recovered.**[180]

As discussed herein, specific elevated hazards of Bakken crude are not identified in the facility response documentation for DAPL or the geographic response plan for Lake Oahe. The plans fail to identify issues such as the elevated hazards of Bakken crude toxicity, extreme flammability, carcinogenic impacts or the possible presence of hydrogen sulfide. By failing to provide this key hazard data, the DAPL plans fail to effectively provide appropriate guidance for mitigation efforts and needed resources. State and Federal agencies have recently provided detailed guidance on responding to Bakken crude emergencies. These guidance documents have presented vital emergency response precautions and lessons learned from recent Bakken crude incidents lacking in the DAPL plans that include:

1. The recent guidance emphasizes the importance effective respiratory protections given the elevated toxic VOCs in Bakken crude including as necessary the use of self-contained breathing apparatus (SCBAs). Detailed response planning guidance from the State of Massachusetts states: "Due to the potential for toxic and flammable hazards associated with a Bakken crude oil, fire personnel should wear protective clothing consisting of self-contained breathing apparatus and full turn-out gear during initial Size-Up activities, evacuation and firefighting activities."[181]

2. Given the extreme flammability of Bakken crude special precautions for LEL monitoring and keeping all sources of ignition from the spill area is critical. The Massachusetts Guidance states "Due to the flammability of Bakken crude, the elimination of sources of ignition (e.g., static electricity, pilot lights, mechanical/electrical equipment, and electronic devices) and the use of explosion-proof electrical equipment is recommended and may be required depending on the relevant fire codes (Conoco, 2014)."[182] The DAPL geographic response plan applicable to Lake Oahe states for spills on water that motorized boats, skimmers, pumps and vacuum trucks may be used in spill response activities but does not provide sufficient precautions to conduct LEL testing or eliminate sources of ignition in the area of the

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[180] PHMSA Pipeline Operator Information, (*available at:* https://primis.phmsa.dot.gov/comm/reports/operator/OperatorList.html#) (last accessed 2-4-18). A variable percentage of the unrecovered oil was lost due to vaporization depending on the characteristics of the crude.

[181] CB&I Environmental and Infrastructure, Inc., *Bakken Crude Oil Spills – Response Options and Environmental Impacts,* Prepared for Commonwealth of Massachusetts Dept. of Environmental Protection, at E-2; (June 2015). (*available at*: http://www.mass.gov/eea/docs/dep/cleanup/laws/bakken-crude-oil-spills-response-options-and-environmental-impacts.pdf) (last accessed 2-2-2018).

[182] *Id*. at 7.3.

spill.[183] Needed special precautions on avoiding the use of powered watercraft or other sources of ignition to conduct LEL testing on water or land where extremely flammable hydrocarbons vapors are likely to be present is missing.

3. Guidance recommends the possible use of vapor suppressing foam as necessary and to ensure adequate foam supplies are available.[184] The geographic response plan lacks foam totes staged near the Lake Oahe location.[185]

EPCRA requirements, EPA guidance and the recent Executive Order 13650 (largely in response to the West Fertilizer incident) address communication, coordination and data sharing requirements between the feds, state agencies (SERCs), LEPCs and includes Tribal Emergency Response Committees (TERCs) and Tribal Emergency Planning Committees (TEPCs). Although pipelines are exempt from some provisions of EPCRA, they are covered related to emergency response and planning. The DAPL and Corps of Engineers documents do not effectively address these important authorities and obligations, which currently leave the Tribe extremely vulnerable to increased impacts from DAPL spills. There is an overall lack of effective monitoring, notification, coordination of response and protection of people and the environment.

The Tribe has not been adequately consulted and provided information that would aid in its emergency response planning activities through its TEPC. The Tribe lacks sufficient information related to unredacted spill modeling, response plans (including a realistic WCD), and the most recent risk analysis that were required to be developed by DAPL as noted in the Final EA.[186] This information is vital to adequately respond to specific scenarios both in terms of having adequate remediation and monitoring equipment available as well as adequate preparation for training and drills.

This is especially important as Lake Oahe response activities will necessarily take place within tribal boundaries. For example, the anticipated volume of the worst-case spill will dictate the resources and equipment needed to respond effectively. The Tribe has consistently argued that the WCD information generated by DAPL likely underestimates the WCD volume and has likely then led to an inability to respond rapidly with sufficient resources. For a lesser release below the detection limit of leak current technologies, real time monitoring of the water below the pipeline HDD crossing and other locations is important to protect the Tribe. The

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[183] DAPL, *Geographic Response Plan Pipeline Crossing at the Missouri River, Emmons County North Dakota*, p. 3, April 2017. This document addresses geographic response activities the Lake Oahe crossing.

[184] *See supra* note 60 at E-3

[185] *See supra* note 62 at 5.

[186] U.S. Army Corps of Engineers, Environmental Assessment, Dakota Access Pipeline Project, Crossings of Flowage Easements and Federal Lands, at 4.

chance identification of a spill in the lake by occasional overflights or random observation by members of the public is an unacceptably weak safeguard for the Tribe, the ecosystem, their cultural heritage and waters upon which they depend.

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IV. An Environmental Impact Statement is Necessary to Remedy Flaws in the DAPL Route Selection and Pipeline Alignment Process

A. Introduction

The Standing Rock Sioux Tribe questions whether ETP's Dakota Access Pipeline underwent a rigorous route selection process that adequately considered appropriate and viable alternatives. Spatial information plays an important role in the pipeline route selection process. ETP and the Corps of Engineers have failed to provide sufficient information to allow the Tribe, as well as the public, to understand why alternative routes, including routes north of Bismarck, were deemed infeasible. The Corps of Engineers must re-evaluate potential routes north of Bismarck and other viable non-pipeline transportation modes.

Given the significant potential impacts of the pipeline on treaty hunting and fishing rights, inadequate spill risk assessment, and a deficient environmental justice assessment, the Corps of Engineers cannot comply with Judge Boasberg's remand directive except through a more comprehensive route analysis. As such, the only appropriate path is to also prepare an environmental impact statement (EIS) which would more fully discloses analysis methods, impacts, and risk.

B. Energy Transfer Partners/Dakota Access Pipeline Route Selection Methodology and Analysis is Unsubstantiated and Requires an EIS

A robust geo-processing suitability model is necessary to determine the best route for a pipeline, or any linear transportation facility. There are many engineering, environmental, social, regulation variables and constraints to consider when identifying the route of a pipeline like: topography (slope of terrain, elevation), urban areas, protected areas, environmentally sensitive areas, culturally sensitive areas, accessibility (roads), precipitation, geology, etc. ArcGIS technologies are used to process input information; a suitability geo-processing model is the framework to determine areas suitable for a pipeline route, where a linear route is automatically generated.

Normal collaborative protocol would have output results shared among stakeholders using alignment sheets and web mapping based on ArcGIS. A repetitive iteration cycle approach is used, so output possible routes are shared and evaluated by end users, and later feedback is used to adjust data or parameters and re-run the model to obtain and share new results. The loop would continue until resulting pipeline routes are accepted.

In the Final EA, DAPL and the Corps of Engineers stated:

> Although this EA is limited to the pipeline placement on federal real property interests administered by the Corps, major route alternatives were evaluated for the pipeline route as a whole. During the DAPL Project fatal flaw analysis and early routing process, Dakota Access utilized a **sophisticated and proprietary** Geographic Information System (GIS)-based routing program to determine the pipeline route based on multiple publicly available and purchased datasets. Datasets utilized during the Project routing analysis included engineering (e.g., existing pipelines, railroads, karst, powerlines, etc.), environmental (e.g., critical habitat, fault lines, state parks, national forests, brownfields, national registry of historic places, etc.), and land (e.g., fee owned federal lands, federal easements, dams, airports, cemeteries, schools, mining, tribal lands, and military installations, etc.).
>
> Each of these datasets was weighted based on the risk (e.g., low, moderate, or high based on a scale of 1,000) associated with crossing or following certain features. In general, the route for the pipeline would follow features identified as low risk, avoid or minimize crossing features identified as moderate risk, and exclude features identified as high risk. For example, the existing pipelines dataset was weighted as a low risk feature, so that the routing tool followed existing pipelines to the extent possible to minimize potential impacts. An example of a high risk feature is the national park dataset. Since national parks were weighted for the DAPL Project as high risk, the GIS routing program excluded any national parks from the pipeline route to avoid impacts on these federal lands. In addition, the routing program established a buffer between the proposed route and certain types of land, such as maintaining a 0.5-mile buffer from tribal lands.[187]

The Final EA also states that 60 data sets were used and that the "ranking system" was based on "a scale of 1,000," an unclear and unsubstantiated ranking system (Table 2).[188] The criteria that was utilized to assign weights to the various features in the GIS analysis was not explained. The publicly-accessible North Dakota GIS Hub Data Portal and is an open source data platform with over 500 datasets provided by 13 North Dakota state agencies, yet ETP/DAPL only incorporated 60 data sets without justification for selecting these datasets and excluding others.

[187] U.S. Army Corps of Engineers, Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands, at 7 (emphasis added).

[188] U.S. Fish and Wildlife Service, Final Environmental Assessment; Grassland and Wetland Easement Crossings, Dakota Access Pipeline Project, Appendix A. (May 2016).

Table 2. List of Datasets Utilized in the GIS Routing Program for the Dakota Access Project.

Weighting is between 0 - 1000. 0 = Preferred Routing (Low Risk, 500 = Avoided Routing (Moderate Risk), 1000 = Excluded Routing (High Risk) [Source: Final Environmental Assessment, Grassland and Wetland Easement Crossings, Dakota Access Pipeline Project. U.S. Fish and Wildlife Service. Appendix A. (May 2016)]

Engineering Datasets	**Feature Type**	**Weight**	**Buffer (ft.)**
Existing Pipelines	Polyline	Preferred- Collocate as much as possible without adding significant pipe length	50
Karst	Polygon	Avoid	N/A
Railroads	Polyline	Avoid	25
Roads	Polyline	Avoid	TBD
Side Hill Slope	Raster	0-20%= 1 ; 20-30% = 100 ; 30-40% = 200 ; >40% = 1000	N/A
Alignment Slope	Raster	0 = 1 ; -1 & 1 =100 ; -2 & 2 = 500 ; -3 & 3 = 1000	N/A
Powerlines	Polyline	Preferred- Collocate as much as possible without adding significant pipe length	50
Environmental Datasets	**Feature Type**	**Weight**	**Buffer**
EPA 303 d & EPA 303 c Waterbodies	Polygon	Avoid	N/A
Sole Source Aquifers	Polygon	Avoid	N/A
Fault Lines	Polyline & Polygon	Avoid	1250
Coal Beds	Polygon	Exclusion	N/A
Coal Fields	Polygon	Exclusion	N/A
FEMA Floodplain- 100 Year Floodplain	Polygon	Crossing Table Only- Do not use for routing	N/A
Critical Habitat / T&E Species (Defined within project study area)	Polygon	Exclusion	N/A
Conservation Easements	Polygon	Avoid	N/A
National Registry of Historic Places (SHPO)	Point	Exclusion	500
NHD Flowlines	Polyline	Artificial Path = 30; Canal/Ditch = 30; Connector = 30; Intermittent Stream = 25; Perennial Stream = 30	Typical Routing. Identify detailed buffers after first iteration.
NHD Waterbodies	Polygon	Lake/Pond/Swamp/Marsh = 100; Major Reservoir = Avoid	N/A
NWI Wetlands	Polygon	Avoid PFO / PSS. PEM at 50	Strong Avoidance from major forested wetland crossings
PHMSA Navigable Waterways	Polygon	Avoid	N/A
PHMSA Unusually Sensitive Areas- Drinking Water	Polygon	Avoid	N/A

Table 3. List of Datasets Utilized in the GIS Routing Program for the Dakota Access Project (continued).

PHMSA Unusually Sensitive Areas- Ecological Areas	Polygon	Avoid	N/A
SSURGO Soils (Pending Project Requirements)	Polygon	Crossing Table and Review Only- Did not use for routing.	N/A
STATSGO Depth to Bedrock (Statistical coverage if required)	Polygon	Avoid- Review Minimum for Avoidance	N/A
State Forest Ownership Boundaries	Polygon	Avoid	N/A
State Parks and Natural Area Preserves	Polygon	Avoid	N/A
Wild and Scenic Rivers	Polyline	Avoid	Buffer Setback so the HDD is not visible from the river
Wilderness Areas	Polygon	Exclusion	N/A
Wildlife Management Areas	Polygon	Avoid	N/A
National Forest	Polygon	Exclusion	N/A
National Parks	Polygon	Exclusion	N/A
Land Datasets	**Feature Type**	**Weight**	**Buffer**
Airports	Polygon	Exclusion	N/A
Bridges	Point	Avoid	500
Cemeteries	Point	Exclusion	1000
Churches	Point	Avoid	250
Dams	Point	Exclusion	1000
Golf Courses	Polygon	Avoid	N/A
Government Buildings	Point	Exclusion	200
PHMSA Highly Populated Areas	Polygon	Review based on coverage- Avoid	N/A
Hospitals	Point	Avoid	1000
Institutions	Point	Avoid	Polygonal Review
Land Ownership (Federal, State, & Private)	Polygon	Federal & Tribal = Exclusion ; Unclassified Protected Areas = Exclusion ; State = Avoid ; Private (Interpolated) = Preferred	N/A
Landmarks	Polygon	Exclusion	TBD
Local Identified Structures	Point	Exclusion	150
Military Installations	Polygon	Avoid	N/A
PHMSA Other Populated Areas	Polygon	Review based on coverage- Avoid	N/A
Parks and Recreation	Point	Avoid	500
Schools	Point	Exclusion	1000
Transportation Terminals	Point	Exclusion	500

Table 4. List of Datasets Utilized in the GIS Routing Program for the Dakota Access Project (continued).

Oil & Gas Wells	Point	Exclusion	110
Water Wells	Point	Exclusion	150
Superfund Sites	Polygon	Exclusion	N/A
Landfills	Point	Exclusion	1250
Hazardous Waste Dump Sites	Point	Exclusion	1250
EPA Facilities of Interests	Point	Avoid	100
Further Data Download- From State GIS Websites	**Feature Type**	**Weight**	**Buffer**
Hunting Leases / Club	Polygon	Avoid	N/A
Brownfields	Polygon	Exclusion	N/A
Sink Holes	Point	Exclusion	1000
Mining Boundaries	Polygon	Exclusion	N/A
Socioeconomic	**Feature Type**	**Weight**	**Buffer**
TIGER Census Data	Point, Polyline, & Polygon	Did not utilize for this routing exercise. Review after first iteration.	Did not utilize for this routing exercise. Review after first iteration.

After the spatial datasets are compiled, the dataset list should have been reviewed in consultation with the Corps of Engineers and the Tribe, to ensure all relevant spatial information has been accounted for and was a true and representative collection of the constraints (risks) and opportunities (benefits) present within the broad geographic area that encompasses potential pipeline alternatives. The next step should have been to assess each spatial dataset and clearly identify risk or benefit weightings of each and decide whether then what appropriately-sized buffer was required to best represent the feature. Typical benefit and risk values are assigned using a flowing ranking scale: high benefit (1); medium benefit (2); low benefit (3) low risk (4); medium risk (5); and high risk (6). The applied rating indicates the relative risk (i.e. constraint) or benefit (i.e. opportunity) of a dataset in relation to the project's objective and the physical project area.

Within each spatial dataset, it is often necessary to separate different categories of data that have a different level of risk or benefit. For example, within the wetlands dataset, there may several different categories. Therefore, within the one spatial dataset, there may actually be two, three, or more individual datasets which are used as input into the spatial analysis, one for each wetland category. In other instances, the same risk or benefit ranking can be applied to the whole dataset.

The Final EA stated, "the company carefully considered possible route alternatives in the EA."[189] However, the Final EA fails to disclose anything about the methodology as to how this analysis was done, much less the basis on which the conclusions were reached. Under NEPA, it is not up to the applicant to choose the route "with the least impact"; rather, it is the federal agency's responsibility. What the project proponent considers as having the "least impact" is subjective and should never be determinative of an agency action.

Tables 2-1 and 2-2 of the Final EA are heavily relied upon to justify the route for DAPL, using what appears to be a subjective ranking of key elements.[190] However, there is virtually no explanation of these elements in the Final EA and their relationship to the weighted 0 to 1,000 rankings for elements listed in Table IV-1 above. Similarly, Table 2-2 of the Final EA relies heavily on the comparative construction costs to Energy Transfer Partners, but fails miserably at quantifying the social and environmental costs to the Tribe in the event of a spill.

As discussed in Section III., Spill Impacts, there is considerable risk of a serious landslide that could result in a rupture to the Dakota Access Pipeline at the Lake Oahe

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[189] U.S. Army Corps of Engineers, Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands at Appendix J 1 of 19 (Table).

[190] *Id.* at 9-11.

crossing.[191] This contradicts the Final EA. The Final EA relied on a gross-scale map developed by the USGS to illustrate the regional potential for the occurrence of landslides and was used by ETP/Dakota Access Pipeline to evaluate landslide incidence and susceptibility[192] Specifically, "Portions of the Project Area within the Corps flowage easements are moderately susceptible to landslides." (Final EA at 26). Landslide factors were not attributed risk values in the route selection analysis and omitted as dataset to better evaluate risks and constraints (*See* Table IV-1). This is a serious error in the route selection analysis. This is made more serious as the discussion regarding the risk of landslides is further downplayed in the Final EA. That discussion largely focuses on the potential landslide impacts from workspaces, while failing to address potential short- and long-term risks of landslide that would result in a catastrophic spill:

> On the west side of Lake Oahe, 1.2 acres of the HDD workspace (exit point) and 13.1 acres of the pipe stringing area are designated as having a high incidence for landslides. Additionally, the stringing area encompasses approximately 1.8 acres of land that is classified as highly susceptible to landslides. Approximately 0.9 acre within the stringing area has slopes exceeding 25%. Approximately 1.2 acres of the HDD entry point workspace on the east side of Lake Oahe is designated as having a high incidence of landslides, but there are no slopes within either the east or west HDD workspace that exceed 25%.

The Corps of Engineers must incorporate landslide risks in additional route selection modeling and analysis as they have failed to fully appreciate how significant landslide risks would impact the Tribe's treaty-protected hunting and fishing rights and has a high potential for disproportionately impacting the Tribe and its sole water source. Because these are potentially significant impacts, the Corp of Engineers must prepare of an EIS.

C. Feasible Alternatives Have Not Been Properly Considered

An EIS should include a comprehensive analysis of a "trucking transportation alternative" and a "rail transportation" alternative. Currently, Bakken Crude is being

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[191] *See* Appendix F. Perry H. Rahn, PhD., P.E. and Arden D. Davis, Ph.D. *Landslides in the Vicinity of the Dakota Access Pipeline Crossing of the Missouri River Near the Standing Rock Sioux Reservation.* Prepared for the Standing Rock Sioux Tribe (December 2017).

[192] D.H. Radbruch-Hall, R.B. Colton, W.E. Davies, I. Lucchitta, B.A. Skipp, and D.J. Varnes. 1982. Landslide Overview Map of the Conterminous United States, USGS Landslide Hazards Program. (*available at:* http://landslides.usgs.gov/hazards/nationalmap/)

transported by rail and truck, as well by other means that should also be discussed.[193] Without adequate discussion of both the rail and trucking alternatives, DAPL and the Corps have provided insufficient baseline information to adequately understand the current use of trucks and rail to transport Bakken Oil.

DAPL and the Corps of Engineers have not disclosed sufficient information relating to the north of Bismarck route. The Final EA dismissed this route at the outset based on its proximity to "several wellhead source water protection areas" and to "protect areas that contribute water to municipal water supply wells."[194] The Final EA also states that this route would require additional waterbody and wetland crossings, as well as "other populated PHMSA high consequence areas ("HCAs"), that are not present on the preferred route."[195]

However, no information is provided to support these assertions. Moreover, the reasons for rejecting the route north of Bismarck apply equally to a pipeline crossing just upstream from the Standing Rock Reservation. Yet there is no discussion or comparison of the spill and leak risks associated with the Bismarck route, versus the spill and leak risks associated with the significant horizontal directional drilling ("HDD") drilling and placement of the pipeline under Lake Oahe.

In short, the north of Bismarck route is summarily rejected with little justification, especially given the presence of similar facts and potential for higher risks associated with the Lake Oahe route. An EIS would re-examine and fully evaluate the feasibility of the north of Bismarck route in light of the high risk of a spill at Lake Oahe (see Section II. Spill Impacts for detailed discussion). As discussed above, DAPL and the Corps of Engineers rely heavily on the information contained in Tables 2-1 and 2-2 of the Final EA to substantiate selection of the route crossing Lake Oahe, while failing to disclose the methods and datasets used to select, rank and analyze important engineering, environmental, land use, and socio-economic impacts used to make the final route selection. Without full disclosure of the methods and data sets used, the route selection process is fatally flawed. We remind the Corps of Engineers that they have not equally weighted and given serious consideration to the elements of the Tribe's MISSOURI RIVER HIGH CONSEQUENCE AREA ASSESSMENT.

The ranking of alternatives as minus (-) or plus (+), as in Table 2-1 of the Final EA, may be generally acceptable for comparing simple differences, such as the number of miles of

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[193] U.S. Department of Energy, Memorandum to Members of the Public from Quadrennial Energy Review Task Force Secretarial and Energy Policy Systems Analysis Staff, "*QER Public Stakeholder Meeting: Infrastructure Constraints in the Bakken*" at 4 (Aug. 8, 2014).

[194] U.S. Army Corps of Engineers, Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands, at 8 and Appendix B.

[195] *Id.*

collocated pipe, or the number of waterbodies crossed. However, such a ranking was done in the route selection analysis for DAPL, without any attention to weighting the value of certain selection criteria. A more rigorous pipeline selection process may well have determined that the Lake Oahe crossing route is worst potential alternative for DAPL.

D. Environmental Justice Considerations in the Selection of the DAPL Route

The Corps of Engineers concluded that the route crossing Lake Oahe is the more preferable alternative, as compared to the route north of Bismarck. The conclusion was reached, in large part, based on the comparative lower overall costs that ETP/DAPL estimated ($**232,556,008 v. $255,122,888**) for Lake Oahe and North of Bismarck crossings.[196] The Corps of Engineers failed to adequately evaluate the route alternatives by omitting the potential catastrophic risks and high costs that could result from operational failures due to an accident, leak or spill. Based on the figures presented in Table 2-2 in the Final EA, the overall cost difference between the Bismarck and Lake Oahe alternatives is 9.2 percent; an insignificant amount when weighed against the disproportionately higher environmental and social risks of pipeline failure at Lake Oahe.

Ultimately, the impacts of spills and leaks on the Tribe's communities have not been properly addressed for environmental justice issues. While Dakota Access Pipeline and the Corps of Engineers have relied heavily on a comparison of construction costs between the existing route and the route north of Bismarck to justify their route selection,[197] they have failed to adequately quantify and evaluate the social costs of the pipeline's proximity to Standing Rock Indian Reservation.[198]

There are 567 Federally recognized Tribal Nations today, with an American Indian/Alaska Native population totaling 5.2 million (1.7% of the total U.S. population), with 2.9 million of those (.9% of the total U.S. population) identifying solely as AI/AN.[199] American Indians and Alaska Natives rank among the lowest on the socio-economic scale. The overall poverty rate of American Indians and Alaska Natives is the second highest (16%) among all minorities.[200] The high school dropout rate for American Indians and Alaska Natives is the

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[196] U.S. Army Corps of Engineers, Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands, at 11, Table 2-2.

[197] *Id.*

[198] Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 54 Fed. Reg. 7629 (Feb. 11, 1994).

[199] U.S Census, 2010 Census Redistricting File. (*available at:* http://www.pewresearch.org/fact-tank/2014/06/13/1-in-4-native-americans-and-alaska-natives-are-living-in-poverty/)

[200] *Id.*

second highest of all minorities (11%).[201] At Standing Rock 19% of the population has less than a high school degree. The poverty rate on the Standing Rock Reservation is conservatively estimated at 43%.[202]

Significantly, the Tribe relies heavily on water from Lake Oahe for all domestic, municipal and rural water needs. The water from Lake Oahe provides drinking water to almost all homes on the Reservation, as well as the schools, community centers, hospital and tribal and federal government buildings. It is the source of water for the Tribe's business enterprises (casinos and hotel) and the source of water for irrigation. In the event of a catastrophic spill or even a long slow leak of oil from the pipeline, the Tribe would be without water. The Tribe's Municipal, Rural and Industrial ("MR&I") program estimates that if its intakes on Lake Oahe are shut down due to an oil spill, the Tribe would have 3-days maximum of drinking water.

There are no alternative sources of water. Moreover, an oil spill in Lake Oahe would damage or destroy wildlife, plants and soil. This can have long-term adverse impacts on Tribal health, as it relates to not only exposure to oil chemicals and contaminants in the water, but also to the food chain.

The Corps of Engineers must fully examine the short-term and long-term impacts of an oil spill on the Standing Rock Reservation. There must be express recognition that our Reservation suffers the disproportionate adverse effects of a potential oil spill from the Dakota Access Pipeline.

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[201] *Id.*

[202] *Id.*

V. The Economics of DAPL and the Standing Rock Sioux Tribe: A Preliminary Assessment of Environmental Justice

Economics is the study of the efficient allocation of scarce resources. Decision making in the face of scarcity is simply a fact of life and, because resources are scarce, it is necessary to choose how to produce, distribute, and consume those resources. To allocate resources efficiently economists generally agree that it is important to consider not just the benefits of decisions, but also the costs.

In some instances, such as with DAPL, decision makers must also consider the negative impacts that an organization's activities might impose on other organizations, the community as a whole, or other nations. Such negative impacts are referred to in the economics literature as externalities—an impact, either positive or negative, to an outside party. In the case of DAPL, the construction, and now operation, of the pipeline both have clear negative implications for the Tribe.

Environment justice considerations have been put in place to ensure that when negative externalities are present, such negative externalities do not impose a disproportionate burden on low-income or vulnerable populations. Such precautions are put in place for good reason. The Standing Rock Sioux Tribe has experienced abuses historically by the Corps of Engineers of Engineers and, more generally, the United States government.[203]

In order to implement environmental justice considerations in a meaningful way, both the benefits and costs of an activity must be taken into account, and attempts must be made to understand what costs exists, what their magnitudes are, and whom they impact. In the case of DAPL, clear and obvious costs have been simply ignored and others have been grossly understated. As such, no one knows if the economic benefits of constructing and operating the pipeline exceed its full (private and social) cost. Further, given the reality that the pipeline has already been constructed, no one knows if the benefits of operating the pipeline exceed its full costs. In contrast, we do know that the Tribe is disproportionately impacted by the pipeline, even if the true magnitude of the negative impacts has yet to be quantified.

Basic economics instructs us that, for an activity to be socially optimal, the full benefits of the activity must outweigh the full costs. In the case of DAPL, substantial costs associated

[203] *See*, for example, Peter Capossela, *Impacts of the Army Corps of Engineers' Pick-Sloan Program on the Indian Tribes of the Missouri River Basi*n, JOURNAL OF ENVIRONMENTAL LAW AND LITIGATION, 30(143), pp. 143-217 (2015).

with operating the pipeline have not been quantified and are currently unknown. From an economic efficiency standpoint, therefore, no one knows if the pipeline should be operating. From an environment justice standpoint, however, DAPL clearly violates standard protocols as the Tribe disproportionately bears the burden of the pipeline.

A. Economics and Environmental Justice

Economics is the study of the efficient allocation of scarce resources. In an economic sense, a resource is scarce when demand or wants exceeds the available supply. Very few resources would not be considered scarce—sand in the desert or seawater at the beach are two examples. Because resources are scarce, it is necessary to choose how to produce, distribute, and consume those resources.

Such decision making in the face of scarcity is simply a fact of life. Each household, city, and state has a limited supply of scarce resources (e.g., labor, land, knowledge, energy), and each entity decides how to allocate their resources.[204] The Tribe, too, has scarce resources—clean water, land, infrastructure—which they hold in trust for their members, and just as each household, city, and state has to decide how to allocate their resources, so does the Tribe.

To allocate resources efficiently economists generally agree that it is important to consider not just the benefits of decisions, but also the costs. In most cases in the United States, local economies allocate scarce resources via markets and prices. In general, producers want to sell their goods at the highest price possible and consumers want to buy their goods at the lowest price possible. A price must be acceptable to both producers and consumers for an exchange to occur because each party has the freedom not to participate in the exchange.

Economists generally refer to the market-clearing or equilibrium price as one that satisfies two conditions: 1) the price enables producers to cover their costs and 2) the price satisfies consumers' willingness to pay given their preferences. A price below the market-clearing price will result in too many consumers willing to buy and too few producers willing to sell (excess demand) and a price above the market-clearing price will result in too few consumers willing to buy and too many producers willing to sell (excess supply). Price adjustments help ensure a match between supply and demand and an efficient allocation of scarce resources.[205]

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[204] Mankiw, G., PRINCIPLES OF MICROECONOMICS (2015); Samuelson, P. and W. Nordhaus, ECONOMICS (2005); Hall, R. and M. Lieberman, *Microeconomics: Principles and Applications* (1998).

[205] Mankiw, G., Principles of Microeconomics.

A challenge arises when a producer's actions impose a cost on another person or organization. For example, a chemical plant operating upstream from a farmer could pollute the river and negatively impact the farmer's ability to grow crops. Such negative impacts are referred to in the economics literature as externalities—an impact, either positive or negative, to an outside party. Negative externalities can be addressed in many ways—by regulating a polluter, by imposing fines on a polluter, by taxing a polluter, or by reaching a market-based solution in which the polluter works with the affected party to achieve a mutually-agreeable outcome. All of these options are ways to have the polluter internalize the negative costs associated with their activities.

In some instances, it is difficult if not impossible to structure a system by which a producer will internalize the negative implications of their actions. Government intervention may be necessary in these cases to ensure that certain groups are not wrongfully impacted by the actions of a producer, and that, if a producer's actions will have detrimental impacts, that these impacts are not borne disproportionately by a vulnerable population. Environmental justice (EJ) is one such precaution that our government has adopted to protect vulnerable populations—in this case, the Standing Rock Sioux Tribe—who might be unfairly treated by a powerful market player — in this case, Energy Transfer Partners and DAPL.

Environmental Justice is "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."206 Fair treatment means that, "no group of people should bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies."207

A 2016 Promising Practices Report for EJ methodologies in NEPA reviews by the Federal Interagency Working Group on Environmental Justice (EJ IWG) identifies guiding principles for: meaningful engagement, scoping process, defining the affected environment, developing and selecting alternatives, identifying minority populations, identifying low-income populations, impact analysis, disproportionately high and adverse impacts. A key part of these EJ methodologies are that the potential environmental impacts encompass both the natural and physical environment and can include ecological, aesthetic, historic, cultural,

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[206] United States Environmental Protection Agency, *Environmental Justice* (2018). (*available at:* https://www.epa.gov/environmentaljustice).

[207] United States Environmental Protection Agency, *Draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis* (2013); (*available at*: https://yosemite.epa.gov/sab/sabproduct.nsf/0/0F7D1A0D7D15001B8525783000673AC3/$File/EPA-HQ-OA-2013-0320-0002%5B1%5D.pdf).

economic, social, or health impacts to minority populations and low-income populations in the affected environment. NEPA requires that agencies consider three types of impacts: direct effects, indirect effects, and cumulative effects. Further, an agency's assessment of significant impacts can be informed by considering whether a proposed action may result in an impact with a low probability of occurrence, but with catastrophic consequences (i.e., low probability, high impact event).208

DAPL presents the quintessential example of a negative externality, and an obvious concern when it comes to environmental justice. The pipeline's operations negatively impact the Tribe and by and large ETP presently has no incentive to internalize these costs.

Negative Externalities Can Lead to Socially Suboptimal Outcomes

In order to achieve socially optimal and fair outcomes a full assessment of negative impacts needs to take place. Generally speaking, the presence of a negative externality leads to the overproduction of a good at too low a cost. Consider the case where the marginal social cost of producing a good is higher than the marginal private cost. In the case of DAPL, the cost to ETP of constructing the pipeline and operating the pipeline is the private cost. The social cost is this amount plus all negative externalities associated with the pipeline, such as the probability of a spill and the cost of cleaning up the spill should one occur. The pipeline might have positive externalities, such as the pipeline's contribution to energy independence for the United States as a whole; however, is the impact of DAPL on overall energy independence in the United States minimal. Cleary the externalities story associated with DAPL is one of negatives not positives.

Figure 4 shows the case where the marginal social cost of production exceeds the marginal private cost by a modest amount. In this case, if the negative externality is not taken into account, the equilibrium level of production is at point B (before), with quantity, Q_{before}, produced at price, P_{before}. Because the negative externality is not taken into account the good is overproduced at a price that is too low. When the negative externality is taken into account, however, less is produced at a higher price, for the socially optimal outcome.

One critical point in the analysis of negative externalities, however, is that it is not necessarily the case that *any* positive quantity should be produced. Consider the case shown in Figure 5. Here the marginal social cost of producing the good is substantially higher than the marginal private cost of producing the good. With the high marginal social cost, the

[208] United States Environmental Protection Agency, Promising Practices for EJ Methodologies in NEPA Reviews: Report of the Federal Interagency Working Group on Environmental Justice & NEPA Committee (2016) (*available at:* https://www.fws.gov/environmental-justice/pdfs/nepa_promising_practices_document_2016.pdf.

socially optimal amount to be produce is *zero*. In the case of DAPL, with such high costs not taken into account, it is reasonable to at least consider the possibility that the socially optimal level of oil to flow through the pipeline is zero.

Figure 4. Geographical Depiction of Price and Quantity When a Market Negative Externality Exists.

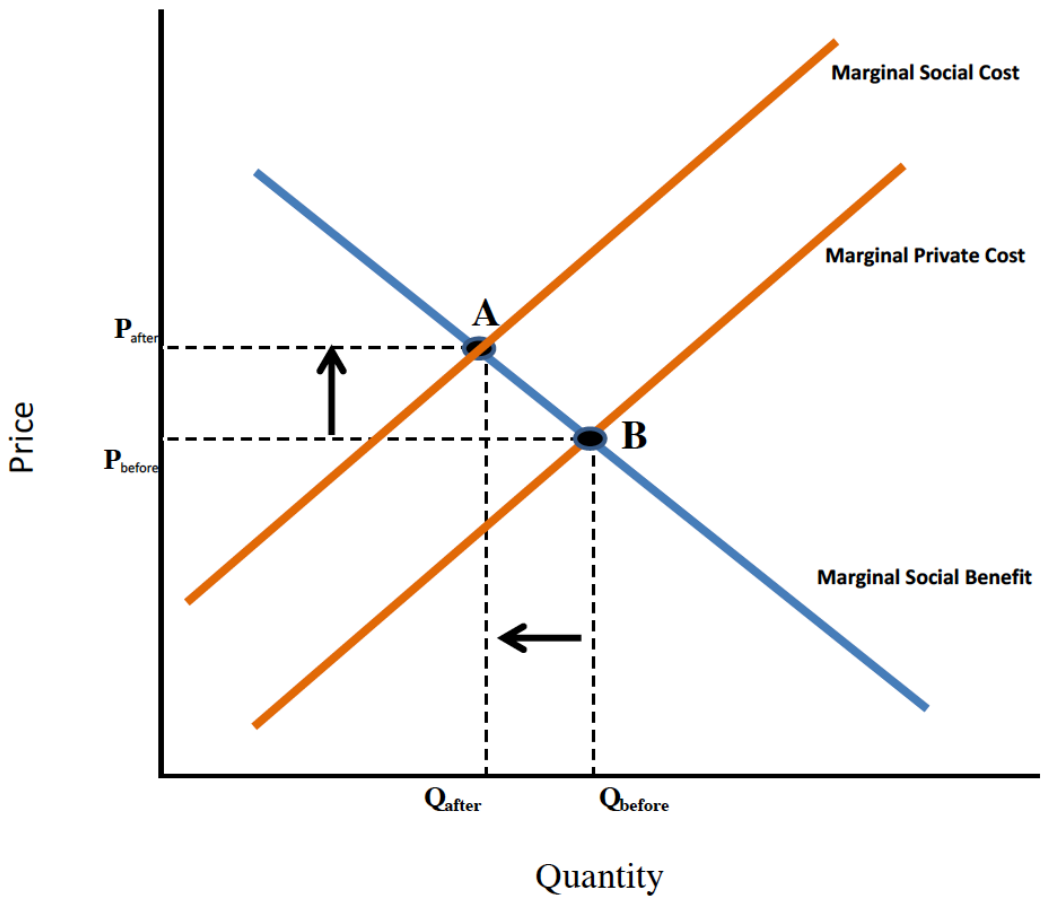
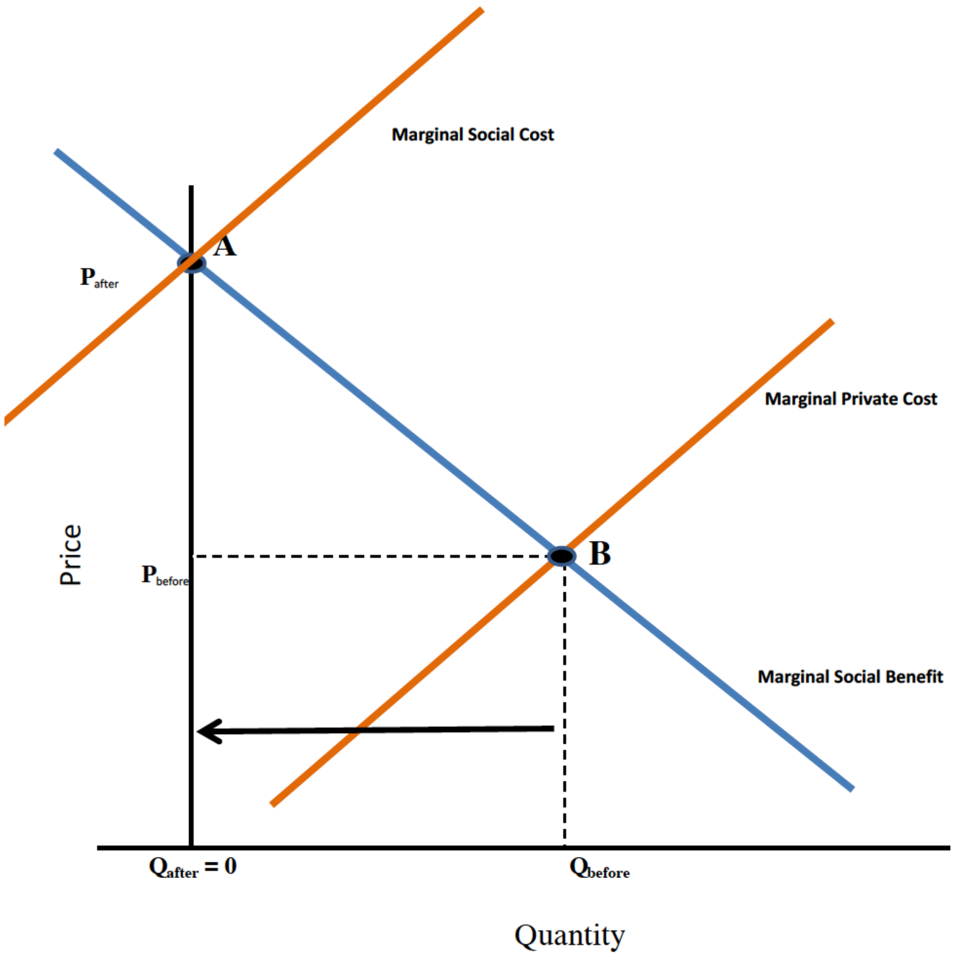


Figure 5. Geographical Depiction of Price and Quantity When a Substantial Externality Exists.



A Thorough Economic Assessment of Costs and Benefits is Critical to Ensuring a Socially Optimal Outcome

In order to achieve the socially optimal outcomes shown in Figures 4 and 5 the marginal social cost of producing the good must be known. This process requires that specific costs be identified and, to the extent possible, quantified. Further, such costs can include expected or anticipated costs.

The expected cost associated with a spill, for example, is equal to the probability of the spill occurring multiplied by the costs associated with the spill in the event that the spill happens. Social costs also include all costs associated with monitoring the pipeline – by all

potentially affected parties—as well as any costs, pecuniary and non-pecuniary, that come with pipeline operations. These costs must be taken into account in order for the efficient outcome to be known.

Another critical component of the socially optimal outcome is the role of equitable outcomes, as well as efficient ones. Equitable outcomes pertain to who reaps the benefits of an activity and who bears the costs. Just as full information is necessary to achieve the efficient outcome, full information is necessary to achieve an equitable outcome. This is a key component of environmental justice. In the case of DAPL, an inequitable outcome has occurred because so many costs to the Tribe have been ignored.

Ignoring or Suppressing Known Costs Can Lead to Inefficient Outcomes

As noted above regarding Figure 4, if the amount produced is based on the marginal private cost of production, then the price is set below the social optimum and too much of the good is produced. This leads to a "deadweight loss" in the form of an external cost shouldered by an outside party.

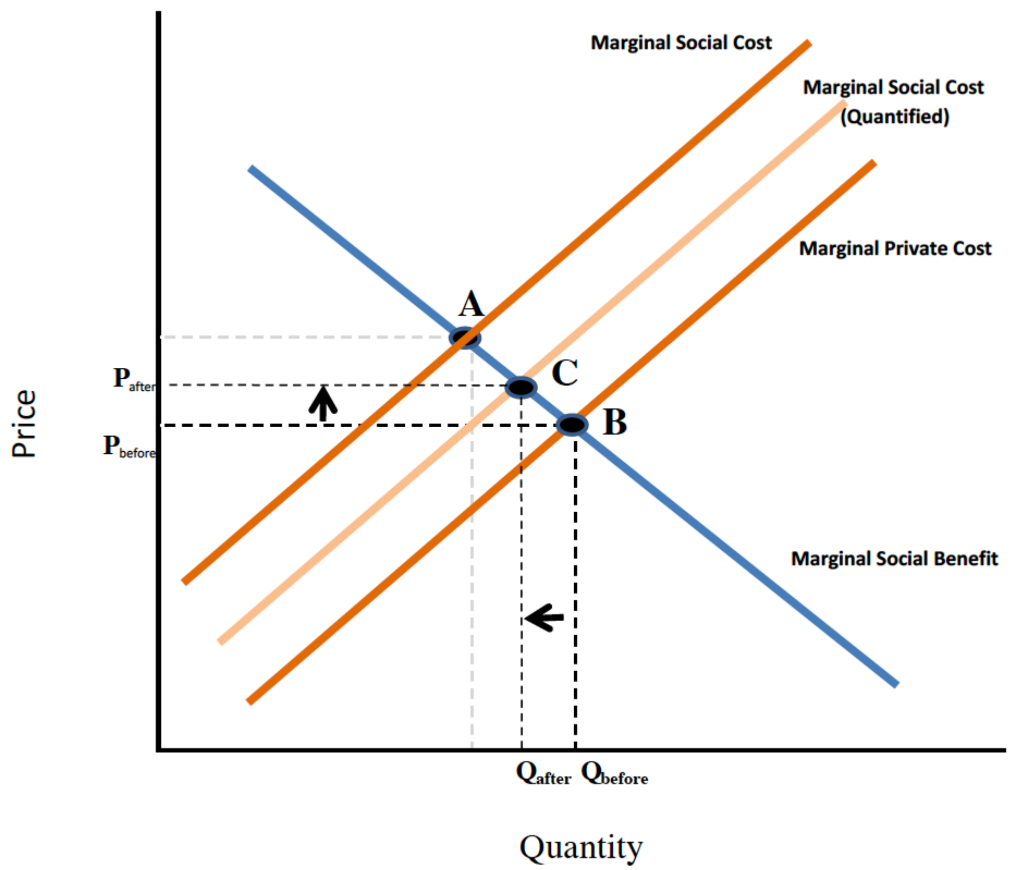
Consider the case when information about costs is suppressed, as shown in Figure 6. The light orange line represents the marginal social cost of production based on some quantified amount, which is assumed to capture only a fraction of the true social cost of production. As shown in the exhibit, the fact that some social costs are quantified reduces quantity and increases price from Point B (before) to Point C. However, because the full social cost is not taken into account, the amount produced at Point C is still higher than the socially optimal amount (Point A). In this way, only a partial accounting of cost leads to a suboptimal outcome.

Ignoring or Suppressing Known Costs Can Mask Inequitable Outcomes

In addition to leading to inefficient outcomes, ignoring or suppressing information about costs can lead to inequitable outcomes. Figures 4-6 do not distinguish between social costs borne by different groups within a population, but the same logic applies.

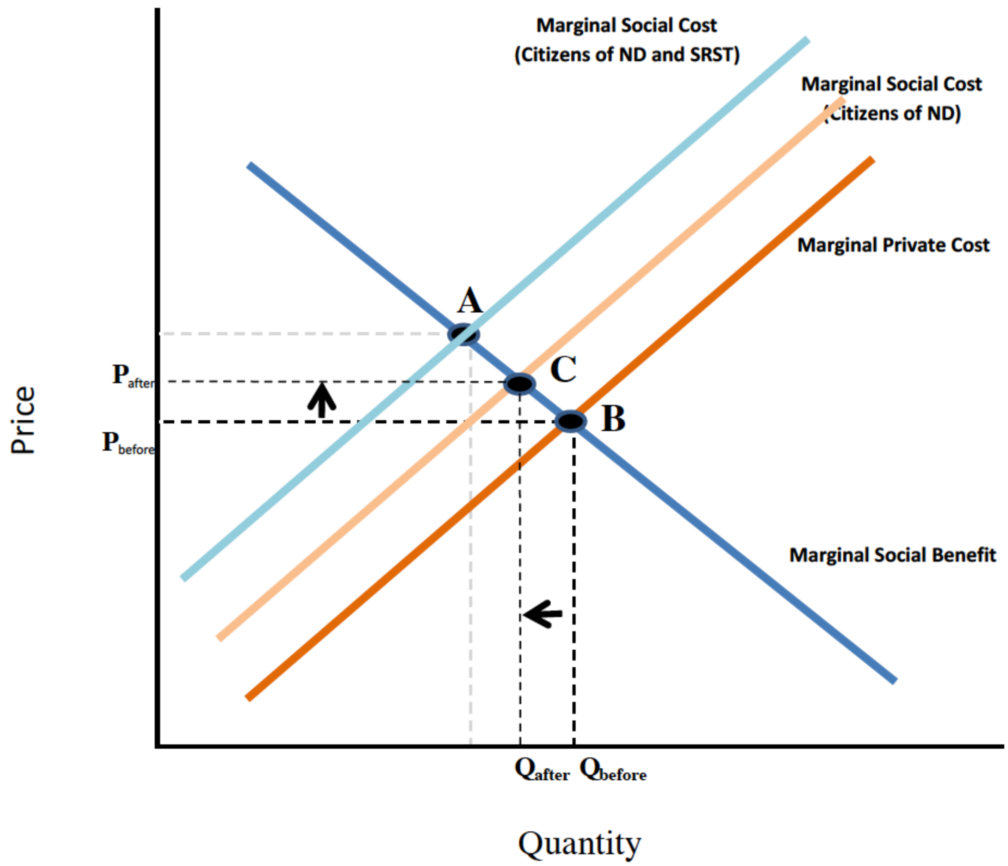
Figure 7 presents a similar analysis but stratifies the marginal social cost into the marginal social cost for citizens of North Dakota (light orange line) and the marginal social costs for the citizens of North Dakota plus those for the Standing Rock Sioux Tribe (light blue line). If the marginal social costs to the citizens of North Dakota are taken into account but the costs to the Tribe are not (or if the costs to the Tribe are not quantified in full) the outcome becomes Point C instead of the socially optimal Point A. This outcome is inefficient because too much is produced at too low a cost, and inequitable because the deadweight loss—that is, the cost of overproduction—are borne solely by the Tribe.

Figure 6. Graphical Depiction of Price and Quantity When A Modest Externality Exists but Costs Are Not Fully Quantified.



The key takeaway is that when negative externalities are present and not taken into account for certain subgroups market forces can lead to inefficient and inequitable outcomes. The next section documents the many costs to the Tribe from DAPL that have not been taken into account, leading to an inefficient and inequitable outcome.

Figure 7. Graphical Depiction of Price and Quantity When a Modest Externality Exists but Costs Are Not Fully Taken into Account.



B. A Plethora of Known Costs to the Standing Rock Sioux Tribe Are Being Ignored by the Corps of Engineers

The previous section describes a microeconomic analysis of negative externalities and how full information on social costs are necessary to achieve a socially optimal outcome. Many costs to the Tribe from DAPL have been overlooked and not properly quantified. This section documents what these costs are. The implication is that, without a proper identification of these costs, and an assessment of their magnitude, the socially optimal outcome has not occurred. More specifically, the Tribe has been treated unfairly because many known costs to the Tribe have not been taken into account and, as a result, the deadweight loss associated with DAPL is being born by the Tribe.

Costs can occur from nearby activity. In the example noted above, the chemical plant operating upstream of the farmer can still have a negative impact on the farmer even if the plant is not located directly on the farmer's property.

Similarly, the fact that the pipeline is so close to the Tribe's land (0.55 miles), and that the pipeline runs just upstream from Lake Oahe, has obvious negative implications to the Tribe. The Corps of Engineers' conclusion that, "The pipeline route expressly and intentionally does not cross the Standing Rock Sioux Reservation and is not considered an Environmental Justice issue,"[209] is inconsistent with the microeconomic theory outline above and, from a common-sense perspective, nonsensical.

Pipeline Construction Costs to the Tribe Have Been Ignored

The construction of the pipeline resulted in a key road closure that negatively impacted the Tribe. In September 2016, after ETP began preparations and construction of the DAPL Lake Oahe crossing and protests developed, the North Dakota Highway Patrol ordered the closure of N.D. Route 1806. This road constitutes the main arterial road from the Standing Rock Reservation to Bismarck, North Dakota, a regional center of commerce. Tribal members routinely travel from the Standing Rock Reservation to Bismarck, to commute for work, and for medical appointments, grocery shopping, etc.

Ex-post, the impact is clear in that members of the Tribe were required to drive approximately 20 additional miles each way in order to obtain provisions. Unlike many American cities, there is no Wal-Mart or Target store on the reservation or even close by, nor are there multiple routes that would allow for a minor detour in the event of a single road closure. The road closure associated with the construction of DAPL essentially sealed off the main route between the reservation and Bismarck, and the additional travel time required to navigate the road closure, and the associated expenses, are tangible costs to the Tribe.

The psychological impact to Tribal members of having their main road sealed off is also a negative impact that should have been included in any environmental justice analysis. Importantly, *ex-anti*, the road closure could have jeopardized the lives of Tribal members, as the additional time for an ambulance to reach medical attention could have been the difference between life and death. This is a tangible cost suffered by the Tribe as a direct result of the approval of a poorly planned, controversial pipeline at the Reservation boundary.

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[209] U.S. Army Corps of Engineers, Environmental Assessment: Dakota Access Pipeline Project Crossings of Flowage Easements and Federal Lands at 86. Oddly, the Corps of Engineers actually goes further by implying that the Tribe has experienced a *windfall gain*: "Additionally, the holders of the mineral rights and landowners in the region, including particular tribes and tribal members, have witnessed a recent windfall from oil and gas development" (p. 107).

The construction of the pipeline has adversely affected revenues generated by the Prairie Knights Casino (PKC), which are used in no small part for the provision of social services on the reservation. The road closure had a clear and foreseeable negative impact on net revenues. In fact, my understanding based on discussions with the Tribe is that PKC revenues were reduced by more than *two thirds* as a result of the road closure and subsequent negative publicity (discussed below). There has been no quantification of these negative impacts on the Tribe.

The construction of the pipeline has resulted in diversion of management costs. These costs can include the time that Tribe personnel has spent dealing with any activity associated with the construction of DAPL that otherwise would not have been necessary. The time allocated to DAPL was substantial and, further, that no effort has been made to quantify this amount.

The construction of the pipeline has deepened hostilities against the Tribe among the general population in North Dakota. ETP has been promoting DAPL publically in North Dakota. One implication of this PR campaign is that it paints opponents, including the Tribe, in a negative light. The negative perceptions of the Tribe painted by ETP expose decades of hostility between residents of North Dakota and Tribal members, and it is perplexing that the environmental justice analyses conducted to date are silent in this regard. The construction of the pipeline has resulted in the willful destruction of the Tribe's historical sites, none of which have been quantified.

Pipeline Operation Costs to the Tribe Have Been Ignored

The current operation of the pipeline has had and continues to have a negative impact on the Prairie Knights Casino. As noted above, PKC revenues have been down by two thirds since before DAPL construction began, and this decline has strained the social services available to Tribal members. The reduction in revenue has not reversed in recent months. As such, in order to have a complete assessment of the costs of DAPL on the Tribe, one must conduct an economic analysis that quantifies the present discounted value of the reduced stream of future PKC profits. A key issue is that the reduction in revenue is not simply a one-time event, but either a permanent reduction in revenues or a significant reduction in revenues for the foreseeable future.

The current operation of the pipeline has had and continues to divert the management activities of Tribal staff from their everyday efforts. An obvious example of these costs are the staff resources devoted to the ongoing efforts to address DAPL and the staff resources devoted to developing precautions in the event of a spill. The opportunity costs of these resources are no doubt substantial. Tribal staff are already overburdened with their existing work assignments, a burden that is exacerbated by the impacts to PKC revenues, noted above.

The current operation of the pipeline implies that the Tribe's population *every day* has to live with the prospects of spill that could occur at *any time*. The stress that this imposes on the Tribal population is real and substantial. No attempt has been made to quantify this impact. At a minimum, an expert in the field of psychology should be retained to help understand this impact. Based on this expert's opinions, an economic analysis should be conducted to examine, for example, how the psychological burden impacts economic productivity on the Reservation. Ignoring this impact wrongfully implies a zero-dollar value to the stress of dealing with the pipeline, which is incorrect.

The current operation of the pipeline and Tribe's justified objections to it continues to feed anti-Indian sentiments among the general population in Bismarck. The negative perceptions adversely impact the casino revenues, as noted above, but also impact how Tribal members are viewed when they enter town. Such negative impacts are real and need to be taken into account. Impacts to racial relations are critical when examining environmental justice issues.

Pipeline Spill Costs to the Tribe Have Been Ignored

There is widespread disagreement among experts regarding the probability of a spill and the magnitude of such a spill. Economists are frequently confronted with situations in which experts disagree about the likelihood and magnitude of potential impacts. In such situations, it is necessary to examine outcomes associated with all reasonable conclusions proposed by experts. The Final EA by the Corps of Engineers inexplicably completely ignores any economic implications associated with a spill.

Such an approach violates standard practice in the field of applied microeconomics, because a spill would negatively impact the Tribe's water resources. The Tribe has numerous water intakes on the Missouri River and, immediately downstream from the Lake Oahe crossing of DAPL, numerous private wells near the river. Tribal-member households, livestock, and irrigation pivots are all served by these intakes and wells. No attempt has been made to quantify the negative impact of a spill on these intakes and wells, which no doubt could have disastrous economic impacts. That means, to date, a *zero-dollar value* has been placed on this potential destruction which, to put it mildly, is incorrect.

A spill would negatively impact the Tribe's cultural and historical sites. The Tribe has historical camps and ceremonial sites throughout the pipeline route, and especially within the areas that would be impacted by a spill. The impact of a spill on these sites has never been assessed to my knowledge. This potential loss needs to be quantified.

A spill would negatively impact any future agricultural potential on the reservation. To the extent that intakes and wells could help foster agriculture on the reservation, a spill could

potentially eliminate this possibility. The loss of optionality in the event of a spill is a cost to the Tribe that should be quantified.

A spill would negatively impact plant and wildlife on the reservation. An expert biologist has not been retained to assess the impacts of a spill, especially the worst-case discharge scenario. As such these negative impacts have not been quantified, but need to be. A spill would negatively impact the Tribe's hunting and fishing activities, a logical conclusion from the paragraph above. No such impacts have been quantified to date.

A spill would result in the diversion and management of the Tribe's staff. As noted in the previous two sections, diversion of management is a tangible economic cost. In the event of a spill, especially the worst-case discharge scenario, diversion of management costs would likely be very high. Moreover, in such a situation, the Tribe might need to hire additional staff to help with the spill and hire a litigation team to ensure that ETP treats the Tribe fairly (a concern that is highly warranted given ETP's failures to quantify costs to date).

Finally, and perhaps most importantly, a spill could permanently alter the Tribe's way of life. Sustainable development is a belief of the Tribe that will most certainly be compromised in the event of a spill, possibly resulting in the decimation of the Tribal way of life. Such an outcome is not beyond the realm of possibility and the fact that such an outcome could come to pass is a fundamental concern from an environmental justice standpoint. The fact that this outcome has not been addressed is nothing short of a tragic failure to apply sound economic reasoning to a pressing public policy concern.

C. DAPL'S Economic Justification is Questionable While Its Environmental Justice Violations are Clear

Decision makers must consider the full breadth of negative impacts to the Tribe from DAPL in order to achieve the socially-optimal outcome. Quantifying the impact of negative externalities on a given community or nation can be complicated, with experts differing in their views, and the challenges in doing so illustrate why it is important for a thorough assessment as to what the costs are, as well as their magnitude. Only until these costs are quantified can any reasonable attempt at a socially-optimal solution be identified.

From an Efficiency Standpoint, the Failure to Quantify DAPL's Full Cost Means that No One Knows if the Pipeline Should Be Operating

As a basic economic principle, organizations like ETP will deploy a pipeline in areas that are profitable to the organization. One way to increase the profitability of a project is to reduce its cost, as profits are equal to revenues minus costs. Negative externalities are costs but, importantly, these costs are not borne by the organization, as explained above. Therefore,

one way to make a project profitable, or increase the profitability of a project, is to ignore the costs associated with negative externalities.

Such is the case with DAPL. From their actions, it can be ascertained that the *private* benefits of operating DAPL exceed the *private* costs of operating DAPL. No one knows, however, if the *social* benefits of operating DAPL exceed the *social* costs. Until the full social costs associated with DAPL are quantified, from a social optimum standpoint, no one knows if DAPL should be operating.

From an Equity Standpoint, DAPL Violates Environmental Justice Protocols

There is an incomplete understanding of the risks associated with the current operation of DAPL, and the costs associated with these risks. What is known, however, is that a vulnerable population is bearing the burden of the pipeline – its construction, its operations, and its potential failure. The magnitude of the burden is uncertain, but the direction of the impact is not. As such, the construction and operation of DAPL is problematic from an environmental justice standpoint.

Moreover, it is important to note that different communities and nations might differ with respect to the impacts of a negative externality. ETP might view a spill as a nuisance that will impact profitability and require resources for a cleanup. The Tribe views a spill as an affront to their way of life, polluting the very water that they hold sacred.

These differences of opinion are not trivial and cannot be overlooked, as they currently are. Indeed, the NEPA process is in place for just this type of situation: to prevent the clear environmental justice abuses that DAPL is imposing on the Tribe. The fact that environmental justice concerns have been dismissed outright by the Corps of Engineers in its 2016 Final EA is extremely troubling.

It is also worth noting that ETP is a for-profit corporation. Ideally, one way that companies can address negative externalities is to work with those who are affected. There are many ways that organizations can compensate those who are negatively impacted by their activities. If the cost of doing so is prohibitive (a likely outcome in this case given what is at stake), then the market is sending a strong signal to ETP to seek an alternate route for the pipeline. This would be considered a market-based solution. The fact that ETP did not seek an alternate route suggests that *ETP opted for a nonmarket-based solution* to solve its challenges (i.e., a Presidential order).

D. Conclusion

Basic economics instructs that, for an activity to be socially optimal, the full benefits of the activity must outweigh the full costs. In the case of DAPL, substantial costs associated

with operating the pipeline have not been quantified and are currently unknown. From an economic efficiency standpoint, therefore, no one knows if the pipeline should be operating. From an environment justice standpoint, however, DAPL clearly violates standard protocols. The Tribe disproportionately bears the burden of the pipeline.

Standing Rock Sioux Tribe

Impacts of an Oil Spill from the Dakota Access Pipeline on the Standing Rock Sioux Tribe

Appendices

February 21, 2018

Appendix A

Standing Rock Sioux Tribe Game and Fish Department

Missouri River High Consequence Area Assessment: Establishing Baseline Ecological Information and Impacts to Hunting and Fishing from the Proposed DAPL Pipeline in the Event of an Oil Spill in the Missouri River in North Dakota Adjacent to the Standing Rock Reservation

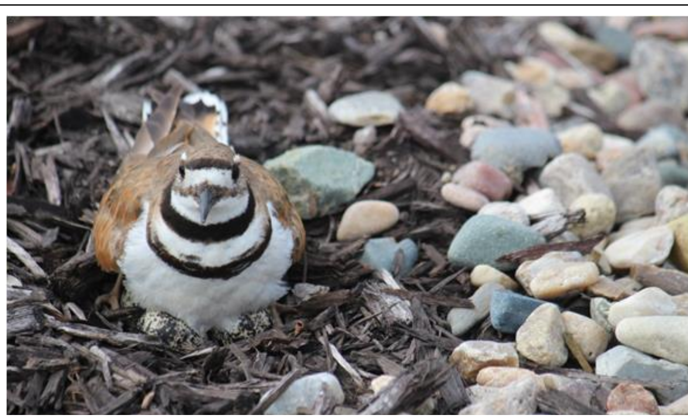
2017

2017

Missouri River High Consequence Area Assessment

BASELINE ECOLOGICAL INFORMATION AND PROFESSIONAL OPINIONS REGARDING IMPACTS ON SUBSISTENCE HUNTING AND FISHING IN THE EVENT OF AN OIL SPILL FROM THE DNPL PIPELINE IN THE MISSOURI RIVER IN NORTH DAKOTA ADJACENT TO THE STANDING ROCK INDIAN RESERVATION

Attorney-Client Privilege, Attorney Work Product



Standing Rock Game & Fish Department

New Century Environmental LLC

8/11/2017

FINAL REPORT DRAFT
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Missouri River High Consequence Area Assessment

ESTABILISHING BASELINE ECOLOGICAL INFORMATION AND IMPACTS TO HUNTING AND FISHING FROM THE PROPOSED DNPL' PIPELINE IN THE EVENT OF AN OIL SPILL ON THE MISSOURI RIVER IN NORTH DAKOTA ADJACENT TO THE STANDING ROCK INDIAN RESERVATION

~Current Insights on SRST Environmental Conditions and Subsistence Hunting and Fishing below the DNPL Pipeline Crossing~

Prepared for the
Standing Rock Indian Reservation

Prepared by
SR Game & Fish tribal biologists
August 11, 2017

Executive Summary

The Standing Rock Indian Reservation consists of approximately 2,300,000 acres located in Sioux County North Dakota, and Corson County, South Dakota. Rolling hills, woodlands, river valleys and lakes dominate the reservation. The Missouri River, which forms the east boundary of the Reservation, runs for about 95 miles, providing baseline data collection for animals observed, habitat assessment, biodiversity insight and recommendations for sustainability within the reservation ecosystem. Dakota Access proposes to build a pipeline just above the reservation and cross underneath the Missouri River. The purpose of this effort was to develop and implement a baseline effort that establishes current data necessary to formulate impacts and infer and/or predict damage scenarios to eco-assets in the event of a pipeline breach or spill. This information can provide 1) baseline ecological monitoring information that would be needed, and 2) provide the tribe with potential impacts on subsistence hunting and fishing in the event of a spill going forward. None of this data has ever been collected by the tribe, up to this point. There are approximately 40,000 acres of varying wetland types in the 30 miles below the pipeline crossing adjacent to Standing Rock Indian Reservation. The most vulnerable wetlands appear to be in reaches 1 through 4(upper 12-15 miles) based on flora and fauna found in those areas. Our inventory documented almost 80 flora species, 24 fish species (~1000 fish collected) and 41 bird species (3366 observations) and documentations of numerous mammals found within the study area. Subsistence hunting and fishing would be negatively impacted in the event of an oil spill from the DNPL pipeline project if constructed. Wildlife species would be impacted through direct and indirect pathways based on spills in other locations. The tribe is deeply concerned with potential threats to their water quality in the Missouri River and the subsequent impacts on surviving fish and wildlife species.

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Acknowledgements

We wish to thank the Standing Rock Indian Tribe for funding this important baseline effort to illustrate potential impacts on subsistence hunting and fishing and then establish through current ecological conditions what a general baseline is below the proposed DNPL crossing. We thank Mark Holzer for his excellent boat captain skills, use of his water craft and understanding of the Missouri River in the reach adjacent to the reservation. We thank Gary Goodrich for his extensive time and effort during the field data collection effort and Director Jeff Kelly (Standing Rock Game & Fish) for his leadership and support of this important and historical endeavor. I also wish to thank the SR tribal biologists; Chris Shank,

Madeline Franks, and Kurt Tooley for the work they expended in getting this deliverable produced in a timely fashion. We appreciate the data supplied by state and federal environmental resource agencies and other data supplied by the tribe (Sid Bailey, Larry Brown). We are confident this will heighten awareness of all who need to know and stimulate management efforts that will help preserve and sustain natural resource integrity for those tribal members not even born yet in this important ecosystem.

Introduction

In early July, under the leadership and direction of Game & Fish Director, Jeff Kelly, the tribal council approved funding to take a closer look at the ecology of the river and identify potential impacts of how an oil spill could affect subsistence hunting and fishing. The focus will be on the west (tribal side) portion of the river. Areas where tributaries enter the river, along with water intakes and other infrastructure areas, will be given special attention in the 30 miles below the pipeline crossing. This information can provide 1) baseline ecological monitoring information (tribal specific) that would be needed, and 2) formulate an on the ground opinion in the event of a spill, what the impacts of an oil spill would be on subsistence hunting and fishing. None of this data has ever been collected by the tribe.

Objective

Establish and implement a baseline effort that gathers data necessary to help infer impacts and damages to eco-assets in the event of a pipeline breach or spill. This will maintain compliance with the Standing Rock Indian Reservation Wildlife Code Section 9-105. This effort assists the tribal council, wildlife commission and Game & Fish Department to preserve the unique social, cultural and religious values of the tribe and to protect the treaty rights of all members of the tribe to hunt, and fish for subsistence purposes and such tradition and custom shall be given "due regard" in all decision making, program operation and implementation of tribal wildlife policy.

The scope of our efforts, were to assess:

Ecology Overview

A) Vulnerable and sensitive habitat assessment of the High Consequence Areas (HCA); it is important the tribe is aware of all areas where sensitive aquatic habitats are located below the Dakota Access crossing to ascertain potential future impacts on,

1) Characterize shoreline habitats;

a- *Wetland flora Inventory* – in the littoral zone and present in the wetland fringe. Document any unique plant species noted. Community habitats will be generally described and assigned wetland classification and type if possible. Areas with well-established aquatic macrophytes should be documented so baseline resulting eco-asset damages to those areas are well established.

b- *Identify potential depositional areas*, in the event of a breach, hydrocarbon spills may accumulate in habitats important to fish, reptiles, amphibians and wading shore birds. Compile any specific threats to the benthic community. Identification of unique riverine wetland fringes and wildlife micro-refugia should be noted as well. Important locations will be marked by GPS coordinates.

c- *Representative fish communities*- this includes forage fish (seining) and adult fish (observed) within the major (and minor) tributaries.

d- *General notes on all wildlife and subsistence species*. Close attention will be given to deer use (record total number of bucks, does, fawns) in wetland fringe and adjacent upland sites. Terns & plovers and raptor use will also be noted. Any upland game bird use, along with waterfowl will also be recorded during river inventory.

e- *Water quality observations*- Water turbidity will also be assessed while doing river assessment. Construction and post construction activities may increase turbidity; pre-construction secchi disc measurements would be helpful in drawing comparisons or trends or impact.

Subsistence Hunting and Fishing Impacts

B) Formulate an opinion of potential impacts of an oil spill on tribal subsistence hunting and fishing based on the ecology overview and best professional judgment as employees of SR Game & Fish

a- Provide some relevant overview of how other oil spills can impact fish & wildlife.

b- Provide potential concerns of an oil spill on Standing Rock Indian Reservation and what could be impacted.

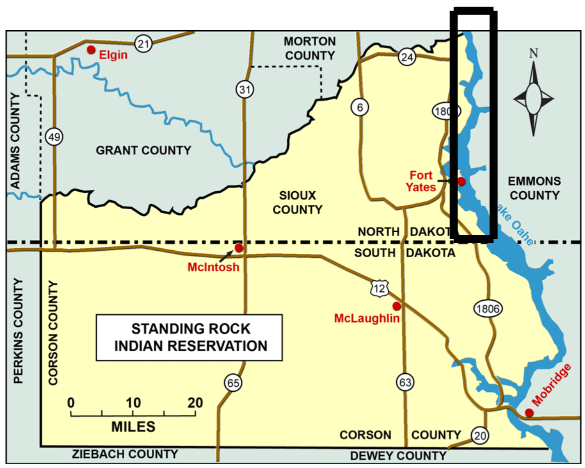

Figure 1. Location of Missouri River HCA assessment in North Dakota conducted by SR Tribal biologists (NCE).

Methods

The most resource and time effective means of gathering the data for this type of assessment was by boat. Mark Holzer of Integrated Software Technologies, also a Missouri River fishing guide, offered his services to access all the aquatic locations necessary to collect the data for this study effort. Mark is very knowledgeable regarding boat navigation and fishery insights in this reach of the river. Field surveys commenced on June 16th and ran through July 20th (5 days) in the 30 mile study area. Numerous back and forth trips from only 2 boat ramps (Prairie Knights Marina and Ft. Yates boat ramp) resulted in 110 boat miles traveled to complete our surveys. There were numerous passes through the reaches to confirm initial notes and observations of all flora and fauna.

A thorough desktop analysis was conducted of all the flora and fauna species occupying the area. Limited or no data could be found for many of the land parcels owned by the tribe on the reservation, so, much of this information is firmly baseline and groundbreaking for such an effort. Wetland type and acreage were determined by National Wetland Inventory maps on Wetlands Mapper. Much of the fisheries information was gathered from reports compiled by the North Dakota Game and Fish Department from the region. Bird information was gathered from the North Dakota Game and Fish Department.

Flora observations were continuous with all boat travel up and down the river. In some cases flora was vouchered where taxonomy for positive identification was unsure. Knowledge of the wooded draws and adjacent riparian was very helpful in correctly recording our observations.

Field observations for birds and mammals were recorded on a single data form with all observations continuous while on the boat either in transit or stationary. Birds observed were recorded to the lowest taxonomic level and in some cases reference confirmation was conducted as needed.

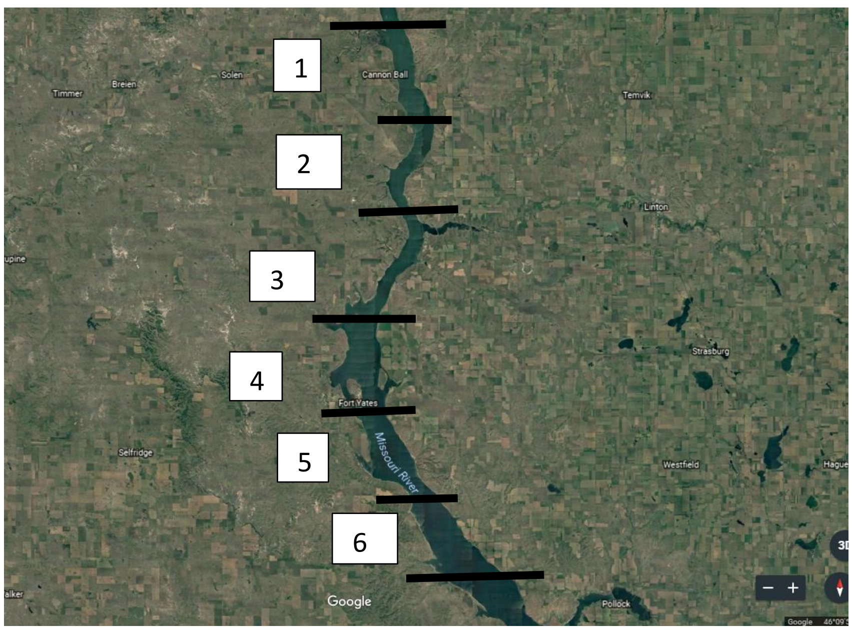

Figure 2. Map showing approximate reach locations.

Reach 1- Pipeline crossing to 2 miles below Cannonball ND
Reach 2- Two miles below Cannonball ND to PKC Marina bay boat ramp
Reach 3- PKC Marina to just north of Porcupine Creek Bay
Reach 4- Porcupine Creek Bay to Ft. Yates water intake
Reach 5 – Ft. Yates water intake to just below 4 mile bay
Reach 6- Just below 4 mile bay to ND-SD state line

Data gathering protocol involved going to the top of each reach and performing 3 seine hauls (50 feet) and setting 3 gill nets while fish seining was conducted. Seining and gill netting were conducted in representative and/or unique areas conducive to the most effective sampling observation. The seine was

30 feet long and contained 5 mm mesh. The gill nets were 100 feet long and 4”, 2” and 2” mesh respectively.

Secchi disc measurements were taken at all our fish sampling locations to establish water clarity conditions for future reference and potential sampling replications.

ECOLOGY OVERVIEW

Results and Discussion

Wetland and Flora Inventory

A desktop wetland inventory was conducted before going to the field to ascertain wetland types and associated acreage we were tasked to assess on the 30 mile section of the river (Table 1). Almost 40,000 acres of wetlands were documented by National Wetland Inventory maps from the pipeline crossing to the North Dakota-South Dakota state line adjacent to Standing Rock Indian Reservation.

	L1UBGh	L1UBHh	L2ABFh	L2ABGh	L2USCh	PEM1A	PEM1C	PEM1Ch	PEM1F	PFOCh	PFOFh	R4SBC	PFO/ABFh	PEM1Ah	PEM1Cx
Reach 1	4658.36			2262.56	525..91	7.55		15.83	13.3	14.38	1456.41	0.4			
Reach 2	3431.22	1500	179.26		442.74		6.9	3.85		16.68		0.11			
Reach 3	3267.63		386.74		346.12	1.62	0.82	0.89			93.87	2.72	18.14	2.5	
Reach 4	4659.79		3110.95		2695.35	49.39									
Reach 5		3722.99	673.57	1820.22		3.46	2.83	44.26							2.16
Reach 6	3000	1413.5						0.62				9.18			
	19017	6636.49	4350.52	4082.78	3484.21	62.02	10.55	65.45	13.3	31.06	1550.28	12.41	18.14	2.5	2.16
	*39,338.87 acres														

Table 1. Associated wetlands within each reach within the study area, wetland type, and acreage.

The bottom or benthic zone of standing or flowing water bodies with varying wetland types (descriptions of wetland types found in Table 2), which are often comprised of silt, sand or gravel substrate, serve as homes to many worms, insects, and shellfish (benthos). These specific habitats also serve has a breeding ground and food source for these organisms and higher animals. Oil in sediments may be very harmful because sediment traps the oil and affects the organisms that live in or feed off the sediments. In the open water or pelagic zone, oil can be toxic to the frogs, reptiles, fish, waterfowl, and other animals that occupy these areas.

"Oiling" of plants and grasses that are rooted or float in the water can also occur, harming both the plants and the animals that depend on them for food and shelter. Fisheries located in freshwater also are subject to the toxic effects of oil. In the shoreline habitats of lakes and other bodies of standing water, cattails (Typha spp.) and other emergent species provide many important functions for life in and around the water. They serve as food sources, shelter for small mammals, and nesting grounds for many types of animals. Oil spills can coat these areas, affecting the plants and the organisms that depend on them. Wetland environments are among the most sensitive freshwater habitats to oil spills due to the minimal water flow. Oil spills have a widespread impact on a host of interconnected species. For example, wetland vegetation is used as nurseries for shellfish and fish, as a food source for many organisms, and a home for fish, birds, and mammals (EPA, 2017).

Wetland Type Descriptions					
L1UBGh		**PEM1Ch**		**PFOFh**	
L	Lacustrine	P	Palustrine	P	Palustrine
1	Limnetic	EM	Emergent	FO	Forested
UB	Unconsolidated bottom	1	Persistent	F	Semipermanently flooded
G	Intermittently exposed	C	Seasonally flooded	h	Diked/impounded
h	Diked/impounded	h	Diked/impounded	**R4SBC**	
L1UBHh		**PEM1F**		R	Riverine
L	Lacustrine	P	Palustrine	4	Intermittent
1	Limnetic	EM	Emergent	SB	Streambed
UB	Unconsolidated bottom	1	Persistent	C	Seasonally flooded
H	Permanently flooded	F	Semipermanently flooded	**PEM1A**	
h	Diked/impounded	**PFO/ABFh**		P	Palustrine
L2ABGh		P	Palustrine	EM	Emergent
L	Lacustrine	FO	Forested	1	Persistent
2	Littoral	AB	Aquatic bed	A	Temporary flooded
AB	Aquatic bed	F	Semipermanently flooded	**PEM1Ah**	
G	Intermittently exposed	h	Diked/impounded	P	Palustrine
h	Diked/impounded	**PFOCh**		EM	Emergent
L2ABFh		P	Palustrine	1	Persistent
L	Lacustrine	FO	Forested	A	Temporary flooded
2	Littoral	C	Seasonally flooded	h	Diked/impounded
AB	Aquatic bed	h	Diked/impounded	**PEM1Cx**	
F	Semipermanently flooded	**PEM1C**		P	Palustrine
h	Diked/impounded	P	Palustrine	EM	Emergent
L2USCh		EM	Emergent	1	Persistent
L	Lacustrine	1	Persistent	C	Seasonally flooded
2	Littoral	C	Seasonally flooded	x	excavated
US	Unconsolidated shore				
C	Seasonally flooded				
h	Diked/impounded				

Table 2. Descriptions of wetland types found within the SR Missouri River study area.

Eco-region Description

Standing Rock Indian Reservation’s Missouri River corridor occupies the Northwestern Great Plains ecoregion.

The Northwestern Great Plains ecoregion encompasses the Missouri Plateau section of the Great Plains. It is a semiarid rolling plain of shale, siltstone, and sandstone punctuated by occasional buttes and badlands. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Agriculture is limited by erratic precipitation patterns and limited opportunities for irrigation. Our study area comprises two Level IV ecoregions; Missouri Plateau (43 a) and River Breaks (43 c) (Bailey, et al, 1994).

On the Missouri Plateau (43 a), west of the Missouri River (where Standing Rock Indian Reservation is located), the landscape opens up to become the “wide open spaces” of the American West. The topography of this ecoregion was largely unaffected by glaciation and retains its original soils and complex stream drainage pattern. A mosaic of spring wheat, alfalfa, and grazing land covers the shortgrass prairie where herds of bison, antelope and elk once grazed. On Standing Rock, buffalo are located south of the Prairie Knights Casino and Marina in a large pasture adjacent to the river. Antelope still can be seen from the river within our study area.

The River Breaks (43 c) form broken terraces and uplands that descend to the Missouri River and its major tributaries. They have formed particularly in soft, easily erodible strata, such as Pierre shale. The dissected topography, wooded draws, and uncultivated areas provide a haven for wildlife. Riparian gallery forests of cottonwood and green ash persist along major tributaries such as the Moreau and Cheyenne rivers, but they have largely been eliminated along the Missouri River by impoundments.

Bunch grasses grow in distinct clumps and include species such as green needlegrass (*Nassella viridula*), needleandthread (*Hesperostipa comata*), little bluestem (*Schizachyrium scoparium*), Junegrass (*Koeleria macrantha*), and Sandberg bluegrass (*Poa secunda*). Rhizomatous grasses produce shoots from lateral root systems and grow as a continuous carpet of vegetation. Common rhizomatous grasses include western wheatgrass (*Pascopyrum smithii*), thickspike wheatgrass (*Elymus lanceolatus*), and blue grama (*Bouteloua gracilis*). The vast majority of the prairie in western South Dakota is dominated by western wheatgrass.

The area also contains numerous forbs and several species of cacti. The most common forb families are asters, legumes, and mustards. Several species of prickly pear cacti and two species of pin cushion cacti are present. Yucca (*Yucca glauca*) is common on loamy to sandy soils, especially on ridges and river breaks. The second most common vegetation type within the area is shrub dominated.

There are some areas of juniper dominated river breaks as shrub dominated, where other areas of juniper show up as tree dominated. This vegetation type may also contain some riparian areas that contain willow or other woody draw and floodplain plant species. Common upland shrubs include big sagebrush (*Artemisia tridentata Nutt. ssp. wyomingensis)* and skunkbush sumac (*Rhus trilobata*). Less common upland shrubs include rubber rabbitbrush (*Ericameria nauseosa*), sand sagebrush (*Artemisia filifolia*), and mountain mahogany (*Cercocarpus montanus*). Riparian areas and woody draws may contain chokecherry (*Prunus virginiana*), hawthorn (*Crataegus spp.*), buffaloberry (*Shepherdia argentea*), and sandbar willow (*Salix interior*).

Floodplains often contain silver sagebrush (*Artemisia cana*) or greasewood (*Sarcobatus vermiculatus*). Floodplains may have trees such as boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and plains cottonwood (*Populus deltoides*). The flora of northwestern South Dakota is unique because it contains the only extensive population of big sagebrush in the state.

Common non-native vegetation includes smooth brome (*Bromus inermis*), crested wheatgrass (*Agropyron cristatum*), Kentucky bluegrass (*Poa pratensis*), common dandelion (*Taraxacum officinale*), salsify (*Tragopogon dubius*), field brome (*Bromus arvensis*), and downy brome (*Bromus tectorum*). Field brome and downy brome are considered cheatgrass throughout this document.

According to the Plant Communities of the Midwest (2001) the diagnostic description for the area is as follows;

Pascopyrum smithii - Hesperostipa comata Central Mixedgrass Herbaceous Vegetation

Western Wheatgrass - Needle-and-thread Central Mixedgrass Herbaceous Vegetation
Wheatgrass - Needle-and-thread Mixedgrass Prairie CEGL002034

DESCRIPTION: The dominant vegetation in this community is mid grasses. The vegetation may be moderately open to dense. The most abundant species are *Pascopyrum smithii* and *Hesperostipa comata* (= *Stipa comata*). Other
graminoids that may be present to abundant are *Aristida purpurea*, *Aristida basiramea*, *Bouteloua gracilis*, *Koeleria*

macrantha, *Calamovilfa longifolia* (on sandy soils), *Hesperostipa spartea* (= *Stipa spartea*), *Schizachyrium scoparium*, *Carex filifolia*, and *Carex duriuscula* (= *Carex eleocharis*). Common forbs include *Tragopogon dubius*, *Helianthus petiolaris*, *Amorpha canescens*, and *Artemisia campestris*. Shrubs are rare in this community. Scattered *Rosa arkansana*, *Artemisia frigida*, and occasionally *Symphoricarpos occidentalis* may be present.

This community occurs on many different topographic and soil types. It can be on upland slopes, ridgetops, plateaus,
stream terraces, and rolling sandhills (Steinauer 1989, USFS 1992). The soils are fine- to medium-textured (clay to
sandy loam) and moderately deep to deep. They are derived from a variety of materials across this community's
range. These include eolian sand, sandstone, shale, siltstone, loess, or alluvium.

COMMENTS: 2, MCS. This type may not occur in Nebraska (Steinauer and Rolfsmeier 2000). This type is somewhat conceptually vague. It potentially includes stands that have more moderately coarse-textured and somewhat drier soils than other *Pascopyrum smithii* types, but not dry enough to shift the dominance toward *Hesperostipa comata* (= *Stipa comata*) types. A major review of published material is needed in central North and South Dakota to clarify this type. In particular it would be worth examining whether or not more western Great Plains species are absent from the central mixed grass region, and where this type is most common.

CONSERVATION RANK: G4. The total number of occurrences is unknown, but 13 have been documented in North Dakota. The community is also reported from Manitoba, Saskatchewan, South Dakota, and maybe Nebraska. It occurs in five ecoregional sections. One out of 9 ranked occurrences is A or B.
DISTRIBUTION: This mixedgrass prairie community type is found throughout the north-central Great Plains of the
United States and possibly Canada, ranging from Manitoba and possibly Saskatchewan, south to northern Nebraska.
USFS ECOREGIONS: 251Aa:CCC, 331E:CP, 331F:CC, 332A:CC, 332B:CC, 332D:CC, M334A:CC
CONSERVATION REGIONS: 25:C, 26:C, 34:C, 35:C
STATES: ND NE SD PROVINCES: MB SK
MIDWEST HERITAGE SYNONYMY: NE northern sand/gravel prairie =
OTHER SYNONYMY: *Pascopyrum smithii* - *Stipa comata* Habitat Type (U.S. Forest Service (USFS) 1992) =
USNVC HIERARCHY: PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (V.A.5.N.

Field Inventory of Flora

Family	Genus-species	Common name	R- 1	R-2	R-3	R-4	R-5	R-6	Lakota cutural
Submergent									
Ceratophyllaceae	Certatophyllum demersum	coontail	X						
Hydrocharitaceae	Elodea canadensis	water weed	X						
Potamogetonaceae	Potamogeton pectinatus	sago pondweed	X			X	X		
Potamogetonaceae	Potamogeton foliosus	slender pondweed	X						
Potamogetonaceae	Potamogeton filiformis	pondweed	X						
Potamogetonaceae	Potamogeton crispus	curly leaf pondweed	X	X	X	X	X	X	
Potamogetonaceae	Zanichellia palustric	horned pondweed	X			X			
Potamogetonaceae	Potamogeton zosteriformis	flat-stemmed pondweed		X					
Ranunculaceae	Rannuculus longirostris	white water crowfoot	X			X	X		

Figure 3. Submergent floral species within each reach of the study area.

Submergent flora community

Nine submergent macrophtyes were documented within the study reach and appeared most diverse in Reach 1, the upper most reach. The Cannonball River provided a shallow, river delta opportunity for a unique submergent flora expression where it joined the Missouri River (Lake Oahe). The water clarity was sufficient to provide conditions necessary for benthic photosynthesis. No culturally important plants of the Lakota were noted in the submergent flora observed. The majority of the *Potamogeton* species began to dissipate once we were in R-2. However a unique observation of *P. zosteriformis* was made in R-2. *P. crispus* was most common.

Notable fragments of submergent macrophytes were observed in the water column almost continuously in R-1 while setting nets, making observations of birds, and traversing through the Cannonball delta area below the crossing. Hook and line catch per unit effort diminished in the mouth area where the *Potamogeton* (submergent) beds were located as fishing lines would coagulate vegetation fragments. *Elodea canadensis* at one point in the mouth area of R-1 was in 5-10 cm fragments surrounding the boat. Flora that broke free from the bottom comprised the majority of our submergent observations.

The impact of an oil spill on this submergent macrophyte community could be significant to the local benthic community. These are organisms that are larger than 250-500 microns which are called macroinvertebrates; these include insect larvae (*Ephemeroptera*, *Plecoptera*, and *Diptera* being the most common), annelids (oligochaetes and leeches), molluscs, crustaceans, and miscellaneous groups such as flatworms, nemerteans and cnidarians.

Vigorous and diverse colonies of aquatic plants are usually a sign of healthy and stable aquatic environments. In fact, the plants themselves stabilize the shorelines, underwater soils, and water chemistry. Waters rich with aquatic plants are rich with aquatic animals and waterfowl, which find cover, breeding habitat, and abundant food (Gutzmer and Kaul, 2001). Zonation in aquatic plants in the littoral zone is caused by more than one factor, however. Water chemistry is important, as are wave action and chemical and physical properties of the substrate. Globally, macrophytes are found in waters with temperatures ranging from 0° to 50° (Symoens, 1988, Harris and Gutzmer 1996). There is a correlation between depth distribution and the inherent photosynthetic ability of some species of Potamogeton (Cole, 1983).

Emergent			R- 1	R-2	R-3	R-4	R-5	R-6	Lakota cutural
Alismataceae	Sagittaria latifolia	arrowhead	X		X				
Cyperaceae	Schonoplectus tabernaemont	bulrush	X		X	X			
Cyperaceae	Scirpus validus	bulrush	X		X	X			
Poaceae	Phragmites australis	Reed grass	X	X					
Poaceae	Phragmites communis	Reed grass			X	X			
Polygonaceae	Polygonum amphibium	water smartweed	X	X					
Polygonaceae	Polygonum coccineum	smartweed	X						
Polygonaceae	Polygonum pennslyvanicum	Pennsylvanica smartwee	X					X	
Typhaceae	Typha latifolia	broad leaf cattail	X	X	X	X	X		
Typhaceae	Typha angustofolia	narrowleaf cattail			X				

Figure 4. Aquatic emergent vegetation within each reach of the study area

Emergent Flora Community

Twelve emergent flora species where observed along the study reaches during our inventory. Where cattle grazing impacts were minimal, emergent stands of cattails, bulrushes and sedges were prominent in the many shallow bays, backwaters and side channels observed. Six of these eleven species were found to be culturally important plants of the Lakota. These emergent hydrophyte communities are vulnerable to any potential oil spill that occurs above the Cannonball River. The delta/mouth area may be very susceptible. *R. fueginus*, golden dock, was prevalent on the sand bar islands within the mouth of the Cannonball River.

Shoreline fringe			R- 1	R-2	R-3	R-4	R-5	R-6	Lakota cutural
Amaranthaceae	Amaranthus spp.		X						
Asteraceae	Helianthus annuus	annual sunflower	X	X	X	X	X	X	
Asteraceae	Lactuca serriola	wild lettuce			X				
Asteraceae	Achillea millefolium	Western yarrow	X	X	X	X	X	X	
Asteraceae	Ambrosia artemisifolia	annual ragweed	X	X	X	X	X	X	
Asteraceae	Artemisia ludoviciana	cudweed sagewort	X	X	X	X	X	X	
Asteraceae	Cirslum arvense	canada thistle	X	X	X	X	X	X	
Asteraceae	Taraxacum officinale	dandelion	X	X	X	X	X	X	
Brassicaceae	Brassica juncea	mustard					X	X	
Convolvulaceae	Convolvulus arvensis	bindweed	X	X	X	X	X	X	
Cyperaceae	Carex spp.	sedge	X		X	X	X		
Cyperaceae	Eleocharis spp.	spike rush	X		X		X		
Equisetaceae	Equisetum hyemale	horsetail	X						
Fabaceae	Melilotus officinalis	Yellow sweet clover	X	X	X	X	X	X	
Fabaceae	Melilotus albus	white sweetclover	X	X	X	X	X	X	
Poaceae	Hordeum jubatum	japanese barley	X	X	X	X	X	X	
Poaceae	Phalaris arundinacea	reed canary grass	X	X	X	X	X	X	
Polygonaceae	Rumex crispus	curly dock	X	X	X	X	X		
Polygonaceae	Rumex altissimus	water dock		X	X				

Figure 5. Shoreline fringe floral species within each reach of the study area.

Shoreline Fringe

Nineteen species of flora were commonly observed in the fringe area (within 50 m of shore). It appears 13 species within the fringe were culturally important plants of the Lakota. The most dominant flora species appeared to be foxtail barley (*Hordeum jubatum*), which is located extensively across the landscape on disturbed areas along the shorelines. This native perennial bunchgrass prefers disturbed areas. Foxtail barley is utilized as forage, but its awns can cause mechanical injury to mouths and eyes of grazing animals, especially upon drying. These barbed awns can even penetrate the thin skin of sheep.

The shoreline fringe in all reaches had significant invasions of both yellow and white sweetclover (*M. officinalis* and *M. albus*). Cudweed sagewort and buffalo berry were dominant species at many of the locations where we sampled fish during our surveys. Where cattle were not present, the shoreline vegetation was intact. In all reaches there were parcels where cattle (herds >100) were allowed to water in the river and vegetation trampling was evident.

Riparian			**R- 1**	**R-2**	**R-3**	**R-4**	**R-5**	**R-6**	**Lakota cutural**
Aceraceae	Acer glabrum	rocky mountain mapl	X						
Aceraceae	Acer negundo	boxelder	X		X	X	X	X	
Adoxaceae	Sambucus canadensis	elderberry	X	X	X				
Asteraceae	Artemisia cana	silver sagebrush						X	
Betulaceae	Alnus incana	gray alder		X					
Cannabaceae	Celtis occidentalis	Hackberry			X				
Caprifoliaceae	Symphoricarpos occidenta	western snowberry	X	X	X	X	X	X	
Cornaceae	Cornus sericea	redoiser dogwood	X	X	X				
Cucurbitaceae	Echinocystis lobata	wild cucumber		X		X			
Moraceae	Morus alba	white mulberry			X	X			
Poaceae	Poa pratensis	Kentucky bluegrass	X	X	X	X	X	X	
Rosaceae	Prunus viginiana	chokecherry	X		X				
Rosaceae	Prunus americana	wild plum	X	X	X	X	X	X	
Salicaceae	Salix bebbiana	Bebb willow	?						
Salicaceae	Salix drummondiana	Drummond's willow				?			
Salicaceae	Salix exigua	Narrowleaf willow	X	X	X	X	X	X	
Salicaceae	Salix lutea	yellow willow	X						
Salicaceae	Populus deltoides	eastern cottonwood	X	X	X	X	X	X	
Salicaceae	Salix ambylgoides	peachleaf willow	X	X	X	X	X		

Figure 7. Vegetation within the riparian areas within each draw

Riparian Flora Community

Riparian flora are the species observed that went beyond the shoreline fringe and seemed to persist in the flatter basins adjacent to the river that would be considered riparian. Many of the species found in the riparian areas are also found in the wooded draws if ample moisture is present. Green ash is the typical woody species in upland draws. Eight of the nineteen species observed were found as culturally important plants of the Lakota. In addition to being part of the understory of ash and cottonwood forests, buckbrush occurs as scattered thickets in which it is the primary species. Buckbrush grows on a variety of soils, from fine textured to coarse, gravely substrates, but in the sites where it grows the

moisture situation is more favorable than in the adjacent grassland sites. Buffaloberry (*Shepherdia argentea*) also forms thickets and was commonly observed in all reaches.

With ninety-nine percent of the original tall-grass, mixed-grass and wetland prairies plowed for agriculture or used for grazing, populations of many once-common native flora species are now drastically reduced. Agriculture and urbanization have significantly altered the landscape for many species. As land-use disturbances continue at a rapid rate, bottomland floras are now more diverse, heterogeneous mixes of plants than in pre-settlement times. The absence of frequent prairie fires and the invasion of many exotics threaten remaining fragments of native prairie and original bottomland forests (Gutzmer and Kaul, 2008).

Upland draws			**R- 1**	**R-2**	**R-3**	**R-4**	**R-5**	**R-6**	**Lakota cutural**
Asclepidaceae	Asclepias syriaca	common milkweed							
Asteraceae	Artemsia frigida	fringed sagewort		X			X	X	
Betulaceae	Corylus americana	American hazelnut				X			
Betulaceae	Ostrya virginiana	hophornbeam	X	X					
Cupressaceae	Juniperus horizontalis	Creeping juniper	X	X	X		X		
Elaeganaceae	Shepherdia argentea	silver buffaloberry	X	X	X	X	X	X	
Fagaceae	Quercus macrocarpa	bur oak	X	X	X	X	X		
Juglandaceae	Juglans nigra	black walnut	X	X					
Oleaceae	Fraxinus pennsylvanica	Green ash	X	X	X	X	X	X	
Poaceae	S. scoparium	little bluestem	X	X	X	X	X	X	
Poaceae		crested wheatgrass	X	X	X	X	X		
Poaceae	Bromus inermis	smooth brome	X	X	X	X	X	X	
Rosaceae	Rosa woodsii	Woods' rose	X	X	X	X		X	
Rosaceae	Crataegus succulenta	fleshy hawthorn	X	X					
Ulmaceae	Ulmus americana	American Elm	X		X				
Ulmaceae	Ulmus pumilla	Siberian elm	X	X	X	X	X	X	

Figure 8. Vegetation in the upland portion within each reach.

Upland Draws

Woodlands follow the drainage patterns where runoff from adjacent slopes provides the extra moisture needed for tree growth within this ecoregion. Other representative hardwoods are present and listed above. Chokecherry (*Prunus virginiana*) is present and a once common shrub in the understory but is most abundant near the edges of forested stands where the light intensity is greater. Juneberry (*Amelanchier alnifolia*) is also found near the edges of woods but generally only on north facing slopes. Buckbrush (*Symphoricarpos occidentalis*) is also common in the undergrowth, as is woods rose and poison ivy (*Rhus trilobata*). Common forbs include northern bedstraw (*Galium boreale*), catchweed bedstraw (*Galium aparine*), bergamot (*Monarda fistulosa*), early meadow rue (*Thalictrum venulosum*), spreading dogbane (*Apocynum androsaemifolia*) and false Solomonís seal (*Smilacina stellata*). Disturbance from cattle is common in woody draws and adjacent pastures; this has allowed for the introduction of weedy species like burdock (*Arctium minus*) and dandelion (*Taraxicum officinale*). However white (*M. albus*) and yellow sweetclover (*M. officinale*) appear to be the most common in our observations. Some of the more common grass (understory) species are western wheatgrass (*Pascopyrum smithii*) and needle and thread (*Hesperostipa comate*) (= *Stipa comate*).

Seven of the eighteen species observed were determined to be culturally important plants to the Lakota.

Spill Event Depositional Area –Sensitivity Map

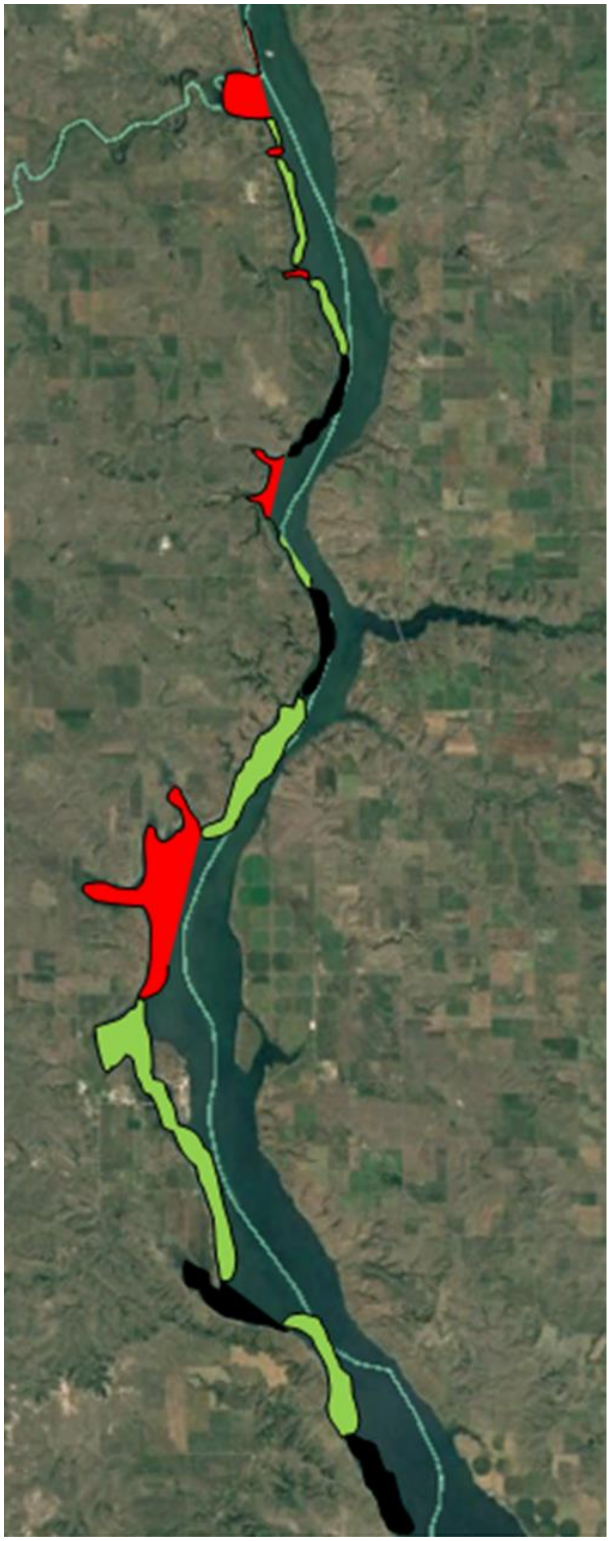

Figure 6. Map indicating vulnerability of oil spill relative to environmental sensitivity to the land/river.

Depositional Area Overview

Best professional judgment (over 80 years of combined experience) determined whether an area was high (3- red), medium (2- green) or low (1-black) sensitivity. For an area to be high sensitivity the area had to have ample fish spawning substrate; gravel, rocky cobble and in some cases boulder supplement areas. Aquatic macrophyte beds and dead trees adjacent to the spawning area, which created valuable nursery, and escape from fish predators, was also taken into consideration for assignment of a 3 or high sensitivity area.

If only a subset of these characteristics were evident a 2 or medium (green) sensitivity was assigned. If degraded conditions or cattle were present, most often a 1 or low (black) sensitivity code was assigned.

It was obvious that the delta/mouth to the major rivers and streams on the reservation were most sensitive. The Cannonball River, Porcupine Creek, bay and associated islands and off reservoir backwaters are most susceptible.

Representative Fish Communities

Impoundment of the MRS (Missouri River System) has transformed the aquatic environment into a biologically diverse community of both native and non-native fishes. Forty-three native species and 22 non-native (including unknown patronization) species of fish have been identified by the North Dakota Game and Fish Department (NDGFD) during sampling of North Dakota's MRS since 1956 (this does not include any sub-basin tributary sampling). In 2009 alone, forty-six species were documented in North Dakota including six introduced cold water species.

North Dakota's MRS contains the states only federally listed endangered species, the pallid sturgeon. Additionally, 7 MRS fishes are identified in the North Dakota Wildlife Action Plan (Hagen et al. 2005) as 'Species of Conservation Priority". The following species are considered Level 1 in the state of North Dakota: Sturgeon Chub, Sicklefin Chub and Blue Sucker. The following species are considered Level II in the state of North Dakota: Paddlefish, Northern Redbelly Dace and Flathead Chub. Only one species is considered Level III in the state of North Dakota, the flathead catfish. During the study, there were no fish species of concern that were documented from the survey effort. The following results capture the number of fish species sampled by reach from each survey method.

Missouri River Fish Survey Reach Totals								
Species		**Reach #**						
Common name	**Taxonomic name**	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**	**Reach 6**	**TOTAL**
Bigmouth buffalo	*Ictiobus cyprinellus*	0	4	0	18	0	0	22
Black crappie	*Pomoxis nigromaculatus*	5	0	1	10	1	0	17
Channel catfish	*Ictalurus punctatus*	0	0	4	0	4	0	8
Common carp	*Cyprinus carpio*	4	3	0	2	3	0	12
Common shiner	*Luxilus cornutus*	0	0	0	21	0	0	21
Drum	*Aplodinotus grunniens*	0	0	0	0	1	0	1
Emerald shiner	*Notropis atherinoides*	12	256	23	0	199	0	490
Fathead minnow	*Pimephales promelas*	0	5	0	0	0	0	5
Gizzard shad	*Dorosoma cepedianum*	0	0	0	31	0	0	31
Goldeye	*Hiodon alosoides*	0	0	8	1	1	0	10
Johnny darter	*Etheostoma nigrum*	4	0	5	0	2	0	11
Northern pike	*Esox lucius*	1	0	0	0	2	0	3
Pumpkinseed	*Lepomis gibbosus*	1	0	0	0	0	0	1
Red shiner	*Cyprinella lutrensis*	0	0	0	5	0	0	5
River carpsucker	*Carpiodes carpio*	0	0	0	1	0	0	1
Sand shiner	*Notropis stramineus*	26	0	0	54	0	40	120
Short headed redhorse	*Moxostoma macrolepidotum*	0	2	0	0	0	0	2
Smallmouth bass	*Micropterus dolomieu*	0	0	0	0	1	2	3
Spottail shiner	*Notropis hudsonius*	7	7	0	11	64	34	123
Walleye	*Sander vitreus*	3	4	21	18	8	0	54
White bass	*Morone chrysops*	0	1	1	15	1	0	18
White sucker	*Catostomus commersonii*	2	0	0	0	0	0	2
Yellow perch	*Perca flavescens*	4	0	2	1	1	0	8
TOTAL								968

Figure 9. Results of total fish survey methods by reach.

Our sampling effort on the Missouri River certainly confirmed a viable and thriving fishery.

The catch per unit effort (CPUE) of our fish sampling regimen[16 hours-hook & line; 3-fifty foot seine hauls within each reach, 2 –hundred foot, 2 inch mesh, 1- hundred foot-4 inch mesh] was successful in sampling 24 different species found the Lake Oahe-Missouri River reach. CPUE's were not calculated by our biologists, but can be as more data is incorporated. Our sampling methods were selective for larger fish in the more sensitive habitat areas we evaluated; however, we also observed potential YOY fish species in backwaters and shoreline areas with the use of a seine. As expected, where the major tributaries emptied into the Missouri River shoreline locations higher in diversity and abundance of larval and juvenile fish species were present. Even though no rare fish were observed, several common species that play an important role in the reservoir fish community comprised our samples while on the river.

The likely depositional areas in the tributaries will certainly be the highest sensitivity for impact going forward as we found extensive reproduction of several fish species in these locations. Future studies should proceed further up the tributaries (than just the mouth area for this study) to evaluate the full extent of fish and their reproductive strategies in these unique ecosystems.

Fish eggs in shallow water, such as salmon eggs in a streambed, can be wiped out by an oil spill. Other habitats of concern for fish kills are in contained areas, such as lakes, lagoons, and some shallow-water nearshore areas, where spilled oil naturally concentrates (NOAA, 2017). Many shellfish species are relatively immobile and often are indiscriminant filter-feeders, which means they may not be able to avoid exposures to oil. In addition, they don't possess the same suite of enzymes to breakdown contaminants as finfish and other vertebrates (NOAA, 2017).

The type of oil and the timing of the release influence the severity of oil's effects on fish. Light oils and petroleum products can cause acute toxicity in fish, but the toxic event is generally over fairly quickly. Heavier oils may not affect fish at all, or, in the cases of fish in larval or spawning stages, may be quite detrimental, as in the case of the 2007 Cosco Busan spill in San Francisco Bay (NOAA, 2017).

In our study, several buffalo were accounted for in the slower moving backwater areas where the tributaries came into the reservoir in the various reaches. In a study conducted by Welker & Scarnecchia in 1997 and 1998, the Missouri River, North Dakota, was sampled to determine if anthropogenic disturbances had influenced catostomid species composition and feeding ecology. Other studies within the MRS show highly altered segments and also exhibited greatly different sucker communities. Bigmouth buffalo (*Ictiobus cyprinellus)* smallmouth buffalo (*Ictiobus bubalus)* and river carpsucker (*Carpiodes carpio*) represented 94% of the sucker catch in the YSS, whereas in the GOS, white sucker (*Catostomus commersoni*) and longnose sucker (*Catostomus catostomus*) constituted 98% of the sucker catch. More sampling is required for our determination for this community.

Our walleye, northern pike, smallmouth bass, yellow perch and channel catfish length and weights were representative of other fishery investigations conducted in Lake Oahe and Missouri by SDGFP biologists, see Appendix for comparison data (Meyer, 2014).

Emerald, spottail shiners and other cyprinids were abundant along certain shorelines where ample sand, gravel and cobble were present. Emerald shiners were by far, most abundant.

As written by Whitley and Campbell (1974), excessive turbidity is the factor limiting photosynthesis and basic production in the Missouri River, states that the wash load in a river (clay and silt particles less than 0.062 mm) is normally carried downstream in suspension and usually does not become deposited on the bed.

There are indirect effects of turbidity on fishes. A decline in turbidity permits greater light penetration, photosynthesis at greater depths, and increased visibility for sight-feeding fishes. Marked changes in phytoplankton production associated with altered turbidity have been documented for Lake Erie, farm ponds and the Missouri River below Fort Randall Dam. Further, growth of largemouth bass and the angler catch of largemouth bass and bluegill sunfish are improved in clearer water. However, as will be developed subsequently, channelization has resulted in decreased production and harvest of fishes (Whitely and Campbell, 1974).

Streamflow data was gathered from the Cannonball River near Breien, ND. The Cannonball River is one of many major tributaries of which flows into the Missouri River. Habitat/flora assessments and fish surveys were conducted at the mouth of the Cannonball River where it flows into the Missouri River. This was a very unique and sensitive area which lies in Reach 2. This area harbors a great deal of

recruitment for fish species and unique aquatic floral species, many fauna observations were made at this location such as raccoon, deer, waterfowl and shorebird foot tracks.

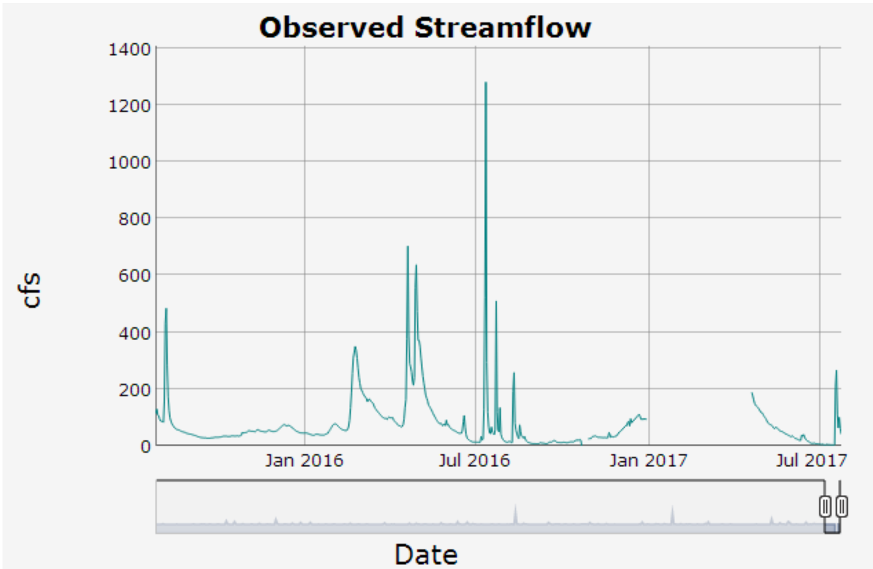

Figure 10. Streamflow on the Cannonball River near Breien, ND from July, 2015 through July 2017.

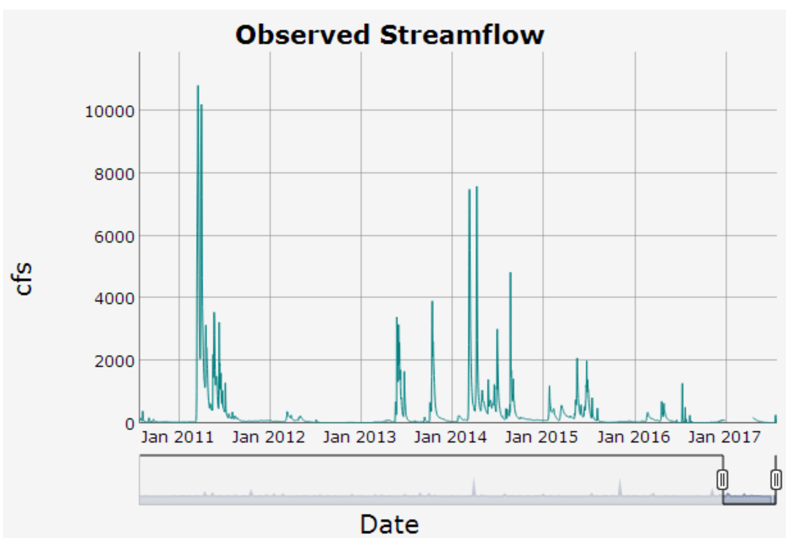

Figure 11. Historic streamflow of the Cannonball River near Breien, ND data from January, 2011 through July, 2017.

Representative Bird Communities

Colonial Waterbirds

Thirty-three species of colonial (nesting in large colonies) and semi-colonial species of waterbirds nest in the general reservation area. They include double-crested cormorants (*Phalacrocorax auritis*), great blue herons (*Ardea herodias*), black-crowned nightherons (*Nycticorax nycticorax*), ring-billed gulls (*Larus delawarensis*), California gulls (*Larus californicus*), and common terns (*Sturna hirundo*) along with other egrets, grebes, and shorebirds. In addition, interior least terns, black terns (*Chlidonias niger*), Franklin's gulls (*Larus pipixcan*), American white pelicans (*Pelecanus erythrorhynchos*), and white-faced ibis (*Plegadis chihi*) are colonial waterbird BLM species of concern found here. These birds are important because they nest in large colonies in limited areas and are highly vulnerable to habitat changes and disturbances to their breeding colonies. Current management actions focus on protecting these colonies from human disturbance (Kushlan et al. 2002). The wetland/water-associated habitats on which they depend on are maintained through wetland-specific management. Habitat management challenges for colonial waterbirds include protecting habitat from degradation and loss and minimizing human disturbance.

The Missouri River, and its surrounding areas, provides habitat for a number of different bird species. In North Dakota a total of 376 species of birds have been recorded in the state by the North Dakota Game and Fish Department, with 50 species noted to be accidental, meaning sightings are not likely to occur again in the state (Checklist of North Dakota Birds 2016). Within these species, 20 Conservation Priority Level I species and 21 Level II species are present (Wildlife and Conservation 2016).

The Missouri River System is critical habitat to two species of federally threatened status found in the state, Piping Plover (*Charadrius melodus*) and Least Tern (*Sternula antillarum*). Both of these species were listed in 1985 due to negative habitat impacts from the alteration of the natural stream flows of the Missouri River. Population estimates for Piping Plover in the state are around 300-400 breeding pairs on the Missouri River System. Least Tern population is estimated at 100 breeding pairs in the entire state. The Bald Eagle (*Haliaeetus leucocephalus*), which has recently been downgraded from endangered status and is now listed as threatened, is also known to utilize the Missouri River System as wintering and nesting habitat (Dyke et al. 2015) .

As expected our observations comprised mostly wading and shorebirds common in the area. Predatory raptors were also seen in the area that forage on reservoir fish species. A total of 41 bird species were observed in our assessment, with 3,366 total individuals recorded. Species listed as threatened in the state of North Dakota were observed in low quantities. A total of seven Least Terns and eight Bald Eagles were observed in our assessment. One individual of plover species was observed, but not identifiable down to species. A total of eight conservation priority species were also observed in our assessment, with four Level I and four Level II species. Amongst the Level II species observed were eight individual bald eagles. Our study reach appears to provide nesting, foraging and seasonal habitat for a variety of listed species within North Dakota. The observations of our assessment support that not only does the Missouri River offer habitat for a variety of bird species, but it specifically provides habitat for sensitive species of North Dakota. Sensitive species utilizing such habitat could make them exceptionally vulnerable in the case of an oil spill.

Assessments from oil spills of the past show that bird populations are affected in both physiological and ecological aspects. Direct exposure, whether it be through external contact with contaminants while swimming, using oiled nesting materials, or ingestion while foraging, results in increased mortality within populations (Parsons 1996). Direct exposure may also lead to lower reproductive success and inviable eggs in species nesting in affected areas, leading to lower future populations (Brzorad and Maccarone

2000). On the larger scale, ecological impacts may be long lasting, with research of previous spills indicating that some ecosystems may take as long as ten years to recover. Feeding, breeding, and nesting grounds that have been degraded by oiling have been shown to experience abandonment from bird species and decreased populations of returning species in the following years (Brzorad and Maccarone 2000, Parsons 1996).

Oil spills in general, have large scale effects on wildlife, both directly and indirectly. Furthermore, research of previous spills provides evidence that bird species are severely impacted by oiling (Parsons 1996). Recording baseline counts of bird populations in areas that could be affected by a spill is helpful in assessing impacts on populations in the event that oiling does occur (Speich et al. 1991). Our study assessment will help provide such baseline data to infer potential effects. Furthermore, future monitoring will help support the data base needed to assess any future impacts from a spill or other perturbations.

Raptors

Approximately 25 species of raptors use the planning area during migration and as breeding habitat. Raptors (predatory birds such as hawks, eagles, owls, and falcons) can be found throughout much of the area.

Common breeding species include the red-tailed hawk (*Buteo jamaicensis*), prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), great-horned owl (*Bubo virginianus*), and long-eared owl (*Asio otus*). Other sensitive and less common breeding species that may be found locally include the ferruginous hawk (*Buteo regalis*), bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*) and burrowing owl (*Athene cunicularia*). Nesting habitats are found in cottonwood, ash, and ponderosa pine trees, and buttes. Burrowing owls rely on other burrowing species, especially black-tailed prairie dogs, to excavate burrows in which the owls take up residence, and northern harriers nest on the ground in grasslands or marshes. Nesting substrate of burrowing owls includes prairie dog and badger burrows. Ferruginous hawks are also known to nest on rock outcrops or other prominent landscape features in lieu of trees.

Prey species are more likely to be available for a wide range of raptors when plant communities are structurally diverse and support mixtures of grasses, forbs, and shrubs. Some of the breeding species are year-long residents and winter within the planning area; however, the rough-legged hawk (*Buteo lagopus*) only uses the reservation rea for its wintering grounds. Nineteen eagles were observed during our surveys which are species of special significance to the tribe.

Missouri River Bird Survey Reach Totals									
Species			Reach #						
Common name	**Taxonomic name**	**ND Conservation Status**	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**	**Reach 5**	**Reach 6**	**TOTAL**
American avocet	*Recurvirostra americana*	Level II	0	0	0	0	1	0	1
American goldfinch	*Spinus tristis*	No concern	2	0	0	0	0	0	2
Bald eagle	*Haliaeetus leucocephalus*	Level II	1	1	1	1	0	4	8
Belted kingfisher	*Megaceryle alcyon*	No concern	1	0	1	1	0	0	3
Black tern	*Chlidonias niger*	Level I	0	0	12	0	5	0	17
Bonaparte's gull	*Chroicocephalus philadelphia*	No concern	0	0	0	0	2	0	2
Canada geese	*Branta canadensis*	No concern	7	0	0	0	2	0	9
Caspian tern	*Hydroprogne caspia*	No concern	0	2	3	0	0	1	6
Cliff swallow	*Petrochelidon pyrrhonota*	No concern	1550	350	50	180	500	0	2630
Common merganser	*Mergus merganser*	No concern	1	0	0	0	0	0	1
Common sanpiper	*Actitis hypoleucos*	No concern	0	0	1	5	0	0	6
Common tern	*Sterna hirundo*	No concern	0	0	59	6	75	0	140
Double crested cormorant	*Phalacrocorax auritus*	No concern	11	15	0	0	0	0	26
Forster's tern	*Sterna forsteri*	No concern	0	0	0	0	1	0	1
Franklin's gull	*Leucophaeus pipixcan*	Level I	6	0	3	0	0	1	10
Gadwall	*Anas strepera*	No concern	4	0	0	0	0	0	4
Golden eagle	*Aquila chrysaetos*	Level II	0	4	1	2	1	3	11
Great blue heron	*Ardea herodias*	No concern	2	0	4	1	0	0	7
Great white pelican	*Pelecanus onocrotalus*	Level I	7	2	0	2	6	0	17
Gull spp.	*Laridae spp.*	No concern	0	0	0	1	0	0	1
Herring gull	*Larus argentatus*	No concern	6	19	2	3	55	13	98
Hungarian partridge	*Perdix perdix*	No concern	0	7	0	0	0	0	7
Killdeer	*Charadrius vociferus*	No concern	0	10	17	8	20	0	55
Least sandpiper	*Calidris minutilla*	No concern	0	0	0	2	18	0	20
Least tern	*Sternula antillarum*	Federally threatened	4	0	3	0	0	0	7
Magpie	*Pica hudsonia*	No concern	0	0	4	3	13	0	20
Mourning dove	*Zenaida macroura*	No concern	0	10	0	0	11	0	21
Osprey	*Pandion haliaetus*	No concern	1	0	0	0	0	0	1
Pectoral sandpiper	*Calidris melanotos*	No concern	0	0	0	1	11	0	12
Plover spp.	*Charadrinae spp.*	No concern	0	0	0	0	1	0	1
Redtail	*Buteo jamaicensis*	No concern	3	0	3	0	0	1	7
Redwing blackbird	*Agelaius phoeniceus*	No concern	20	0	0	10	0	0	30
Ring billed gull	*Larus delawarensis*	No concern	0	0	13	17	44	25	99
Ringneck pheasant	*Phasianus colchicus*	No concern	2	2	4	2	2	0	12
Sandpiper spp.	*Scolopacidae spp.*	No concern	0	0	32	0	10	0	42
Semipalmated plover	*Charadrius semipalmatus*	No concern	0	0	0	0	1	0	1
Sharptail grouse	*Tympanuchus phasianellus*	Level II	0	2	0	2	1	0	5
Spotted sandpiper	*Actitis macularius*	No concern	14	0	0	1	1	0	16
Stilt sandpiper	*Calidris himantopus*	No concern	0	0	1	0	0	0	1
Turkey vulture	*Cathartes aura*	No concern	0	1	2	3	0	0	6
Willet	*Tringa semipalmata*	Level I	0	0	3	0	0	0	3

Figure 12. Total number of birds observed per reach within the study area.

Mammals

The Missouri River and adjacent grassland areas support a viable and thriving whitetail and mule deer population. During our investigation intensive use of deer was noted at all locations (where flora, birds and fish were observed). Tracks were observed for raccoon, coyote, muskrat and prairie dog. Observations of these species were also documented for these species within each reach.

Antelope were also documented in R-6 northeast of Kenel in the largest herd we have seen this summer (~15 animals, see Appendix). Whitetail and mule deer were seen throughout our Missouri River reach surveys.

Standing Rock Game & Fish Department has managed their wildlife populations successfully for 30 years. To further describe our big game composition, the results of our aerial survey population trends have been included. From our surveys in January 2017, our reservation wide whitetail deer average was 398.89deer/hour. Our mule deer average was 75.11 deer/hour. Antelope, when they have not migrated, are typically less than 50 antelope/hour. Data specific to our study reach recorded a dusk deer survey conducted in R-2 (Marina) in January 2017, with 134 deer recorded at a rate of 4.96 deer/ mile or 67 deer per hour. Pheasant numbers in R-2 were recorded at a total of 86 which is 3.19/mile or 43 per hour.

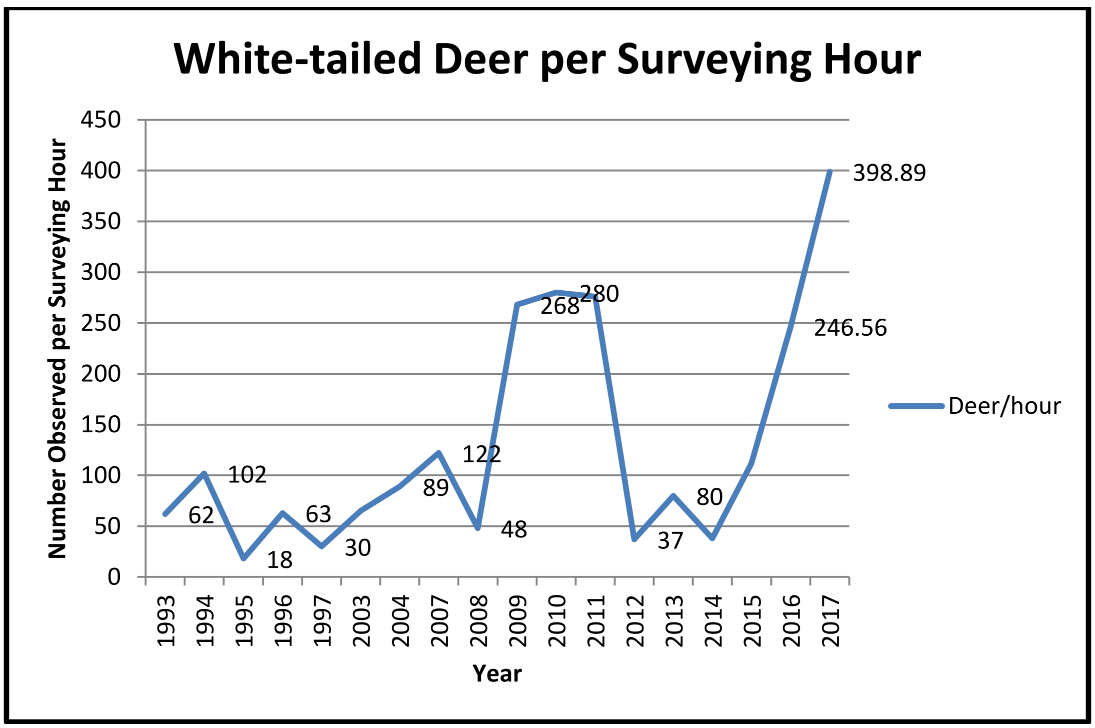

Figure 14. Historic aerial survey results of white tail deer on Standing Rock Reservation.

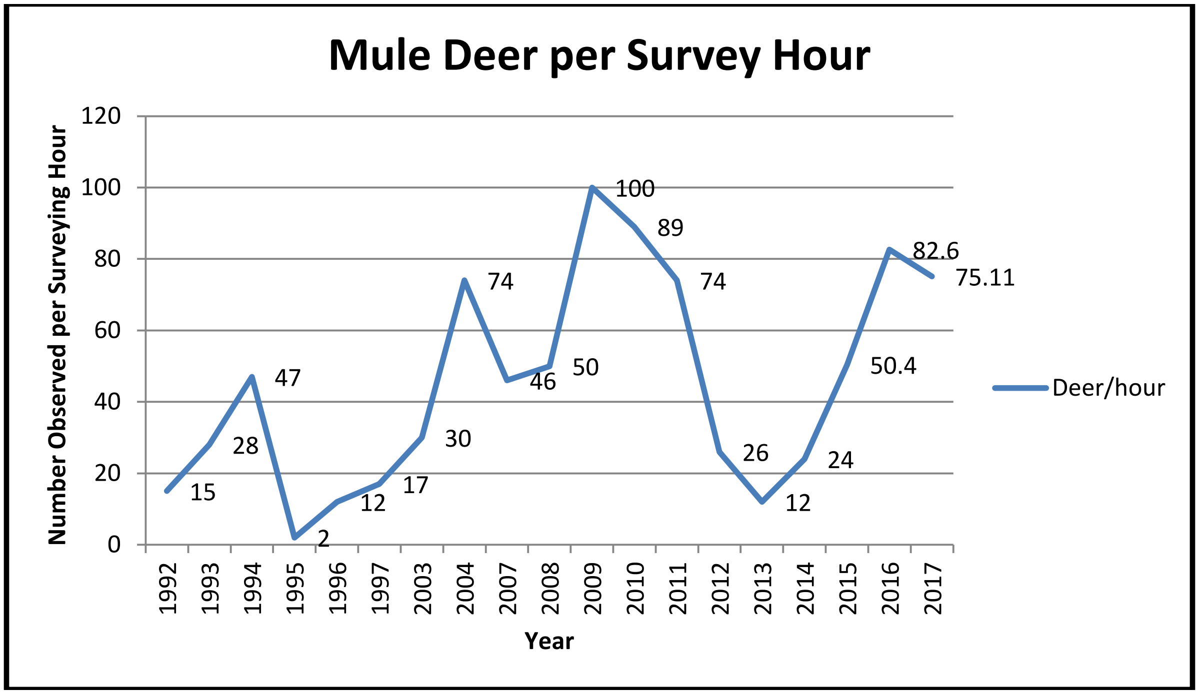

Figure 15. Historic aerial survey results of mule deer on Standing Rock Reservation.

Mammal Summary in General for the Reservation (North & South Dakota)

The study area in general provides habitat for approximately 70 species of mammals. Many species are small terrestrial mammals such as porcupines (*Erethizon dorsatum*), rabbits, squirrels, ground squirrels, pocket gophers, mice, voles, and shrews, along with several species of bats which are not as visible but play an important ecological role in their associated habitats. The reservation also provides habitat for many species of medium-sized mammals, including coyote (Canis latrans), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), beaver (*Castor canadensis*), and raccoon (*Procyon lotor*), which are the main furbearers with a role in contributing to the economics within the planning area. Other species of small furbearers, such as skunks (*Mephitis mephitis*), mink, muskrat (*Ondatra zibethicus*), and weasels, are not as visible or as economically valuable, but they do play an important ecological role in their associated habitats. The larger mammals, mainly big game including elk (*Cervus elaphus*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and mountain lions (*Puma concolor*), are much more visible and play a larger role in contributing to the economics of the reservation.

Big Game

Mule deer, white-tailed deer, and pronghorn are the most common big game animals occupying much of the reservation area. The sagebrush areas, to the west in Corson and Sioux counties, riparian habitats, upland woodlots, river breaks, and mixed grass rangelands found on the reservation provide important big game habitats and are very important winter range areas for pronghorn, mule deer and game birds. Other big game species in the planning area include elk, mountain lion, and an occasional moose (*Alces alces*).

Mule deer are widespread in North and South Dakota west of the Missouri River on the reservation, and are typically associated with the more open landforms that support a wide variety of sagebrush, juniper, and herbaceous vegetation. They also use the riparian stringers and woody draws, and are frequently associated with meadow and riparian habitat. Mule deer tend to be present yearlong where public land

adjoins cultivated farmland. Based on South Dakota Game, Fish and Parks (SDGFP) survey data, mule deer numbers are currently depressed relative to historic numbers. Severe winters, drought, and other biological factors have contributed to fluctuations in their numbers. Deer are generally classified as browsers, and forbs and shrubs make up the bulk of their annual diet. Woodland and rangeland management actions all have the potential to influence mule deer cover and forage. Healthy sagebrush communities are important habitats for mule deer, and open grasslands and riparian areas provide important forage and water, especially during the summer and fall.

White-tailed deer, found throughout all of South Dakota, are typically associated with river bottoms, riparian stringers, and woody draws. The white-tailed deer population is increasing across the planning area and fluctuates mainly because of disease and weather-related issues. Seasonal habitats typically include riparian features such as rivers or streams. These habitats contain diverse vegetation that includes herbaceous forage throughout the year. Forage crops and crop residue provide the bulk of feeding areas, with browse becoming increasingly important during the winter.

Pronghorn antelope are distributed throughout much of the western half of the planning area. During summer, pronghorn antelope are widely distributed throughout the grassland and sagebrush steppe habitats. Rangelands with a mixture of grasses, forbs, and shrubs provide the best habitat (Yoakum 1972). The sagebrush community is used for both thermal cover and forage. On tribal lands some existing woven wire, barbed wire fences with bottom wire less than 16 inches from the ground, and other non-wildlife friendly fences, are major movement barriers to pronghorn, especially in winter. Construction specifications for new BLM fences allow for freedom of movement for pronghorn by spacing the bottom wires at least 16 inches from the ground. The SDGFP has established population management objectives for pronghorn.

Elk populations exist within a couple of locations on the reservation and transient observations have been made by the Missouri River. They have expanded their range in recent years, with an established population in Unit 41 and the Black Hills and adjacent ponderosa pine/grassland areas. Elk in this area use much of the same habitat season-long and are primarily grazers, opportunistic consumers of forbs, and browsers of aspen and other tree vegetation.

Bighorn Sheep: Not commonly seen or documented on the reservation.

Mountain lions are most likely to be found in the Black Hills and on BLM lands therein. Some observations have occurred on Standing Rock. However, mountain lions are adaptable to a variety of cover types and landscapes, and individuals are known to disperse many miles from a population source. Mountain lions hunt by ambushing prey, and rely on an element of surprise when hunting. Sufficient cover provided by some combination of terrain and vegetation, and a sufficient prey-base are necessary components of mountain lion habitat. Prey species include numerous small mammals and birds, as well as deer and other large game.

Other big game species include mountain goat (*Oreamnos americanus*) and an occasional moose. Neither of these species is likely to occur on tribal land. Seasonal and spatial protective stipulations are currently applied around identified seasonal habitat use areas to afford big game a certain level of protection from human disturbance and industrial activities.

Buffalo

Mr. Sid Bailey is the buffalo manager for the Standing Rock Buffalo program. According to Manager Bailey the buffalo pasture south of Prairie Knights Casino is 1,680 acres in size. In the last roundup, the herd consisted of 69 cows, 32 bulls and 47 calves. The buffalo pasture is only 0.5 miles away from the Missouri River.

Our concern is that if contaminated water wells in the vicinity of the buffalo pasture have their cone of depression in the Missouri River strata it could be migration patterns for contaminants for our buffalo water wells in the event of a spill. Any perturbations to water quality in the Missouri River could have impacts on local water wells and indirectly impact this buffalo herd. Hydrocarbons can persist in water wells for years and have deleterious impacts on buffalo physiology and general health.

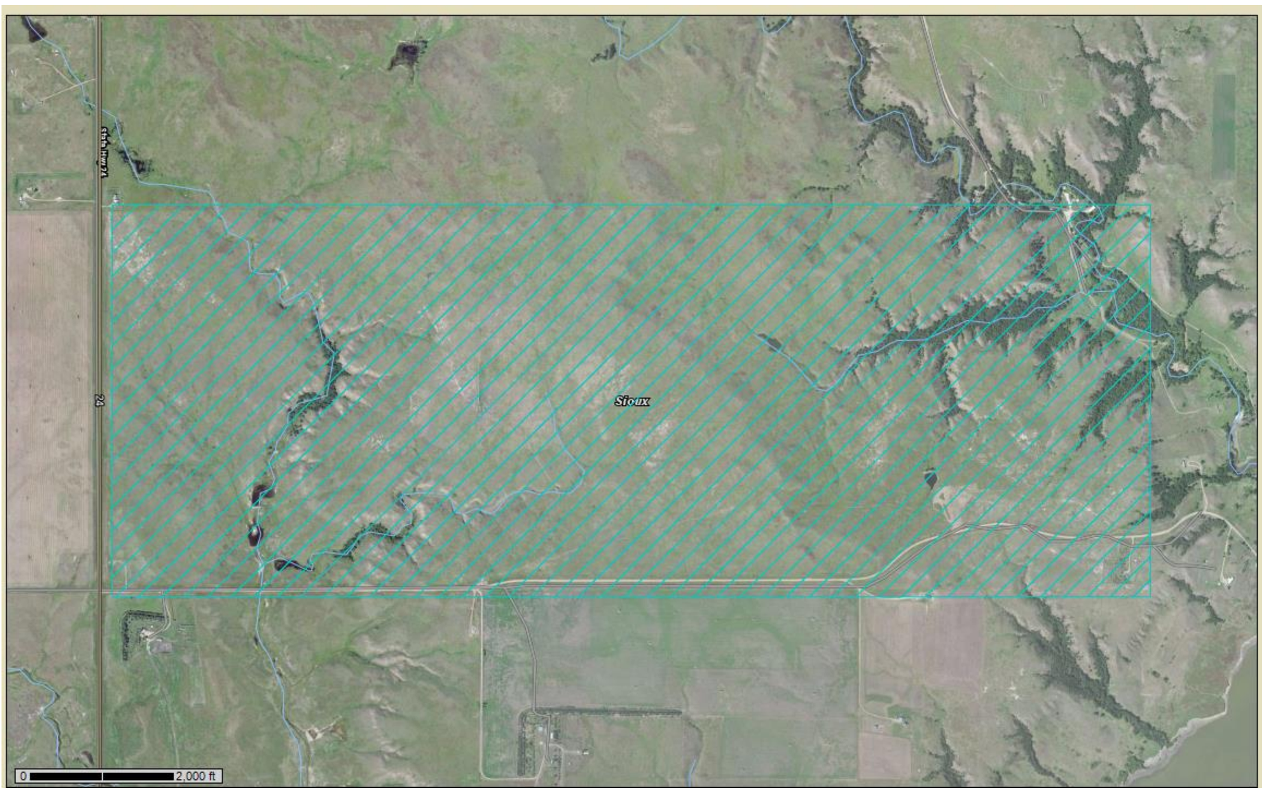

Figure 18. Buffalo pasture with Missouri River directly to the east.

Amphibians & Reptiles

Although our initial assessment did not expand to observe and record reptiles and amphibians (herpetofauna), these species also utilize habitat in and surrounding the Missouri River. North Dakota has a smaller population of reptile and amphibian species, totaling at 28, because of its cold climate. We realize more work is needed in this area.

Regardless of its lower total, compared to other regions, herpetofauna are important components of any ecosystem as they serve as prey, predators, insectivores, and herbivores (Blaustein et el. 2003). Eleven species of conservation concern are listed in North Dakota, with four Level I, two Level II, and five Level III (NDGFD). Of these species of concern, seven are known or likely to inhabit the Missouri river and its

surrounding habitat; Plains spadefoot (*Spea bombifrons*), smooth green snake (*Opheodrys vernalis*), Plains hog-nosed snake (*Heterodon nasicus*), snapping turtle (*Chelydra serpentine*), smooth softshell turtle (*Apalone mutica*), spiny softshell turtle (*Apalone spinifera*), and false map turtle (*Graptemys pseudogeographica*) (Johnson 2015). Considering the total species of concern present in North Dakota, the Missouri River system provides habitat to a good portion of these sensitive species. Alongside serving an important role in ecosystems, herpetofauna are also valuable indicators of environmental quality and changes. More specifically, they are sensitive indicators to environmental stress and contamination (Blaustein et al. 2003, Blaustein and Bancroft 2007).

Amongst the most sensitive to environmental contamination are amphibians. In fact, amphibian populations are on a global decline due to their sensitivity to environmental stressors. This group of herpetofauna utilizes both aquatic and terrestrial habitats, making them vulnerable to both direct and indirect impacts. Amphibians have both permeable skin and unshelled eggs that are exposed directly to soil and water and readily able to absorb substances from their environment, making them especially susceptible to absorbing toxic substances. Larvae are vulnerable even more so, due to spending their early life stages before adulthood in direct water (Blaustein et al. 2003, Blaustein and Bancroft 2007). The event of an oil spill would ensure direct contamination to amphibian species, and could very well lead to mortality.

Reptile species are also sensitive to aquatic environmental stressors, with some snakes and lizards utilizing habitat near water bodies, but more directly, turtles utilizing water body habitats. Habitat loss and fragmentation are a major threat to turtle populations worldwide, with oil production being a significant factor. Oil contamination not only leads to mortality in turtles from direct contact, but also contributes to habitat degradation and modification of river system characteristics, whether it be destruction of bank plants and aquatic vegetation or alteration of river courses to place pipelines. Pollutants can be carried long distances and deposited into nearby wetlands associated with the main source of water. Therefore, not only are turtles that inhabit the rivers impacted, but turtle populations utilizing nearby wetlands are likely to be impacted. Assessments of past spills show that this habitat degradation leads to habitat abandonment and reduction of returning populations (Luiselli et al. 2006).

Reptile and amphibian species in North America are the most threatened vertebrates, and therefore a high conservation concern. Although our assessment did not expand on herpetofauna, assessing threats to populations and their habitat is essential in conservation approaches (Olson 2009). Furthermore, considering the key role that reptiles and amphibians play in their ecosystems, loss of these populations would have impacts on the trophic dynamics of wildlife in the area (Blaustein et al. 2003). In the event of an oil spill, herpetofauna would need to be taken into consideration when assessing impacts and recovery.

Impacts on Subsistence Hunting and Fishing

Sustainable management of subsistence hunting and fishing requires accurate and timely information about the abundance, health, and distribution of fish stocks and wildlife populations. Information that supports our hunting program on Standing Rock is compiled each year in our annual hunting recommendations. Hunter harvest information is also compiled each year and available through Integrated Software Technologies to our tribal biologists who use the information to make recommendations for the coming year. This information is available through our SR Game & Fish Department biologist files which reports survey information of those fish and wildlife species utilized by tribal members.

This is typical information and effort that reports harvest monitoring, traditional ecological knowledge, and stock assessment field projects along with habitat development. In addition to providing essential biological data, SR Game & Fish department creates local jobs, builds capacity within communities, and involves subsistence users in meaningful stewardship roles as they partake in wildlife commission and other tribal roles. Our hunting system is designed to gather information related to tribal member hunting experiences and their effective success.

Subsistence fisheries are important not only for food but also for culture. For example, fishing is considered to be part of First Nations culture in northern Manitoba and elsewhere in the Canadian North. Some Indigenous peoples in Canada are referred to as First Nations. The significance of fish to First Nations communities is exhibited by lands (reserves) set aside for the exclusive use of indigenous peoples. Reserves are almost always adjacent to good fishing areas, both inland and coastal (Tough 1996). Standing Rock Indian Reservation is no exception.   Fishing plays an important role in bringing people together socially and culturally.   The SR Game & Fish Department conducts annual fishing seminars to teach their tribal youth on how to fish the river (Fun on the Water Event).

There is an immense need to understand how an oil spill can impact our subsistence hunting and fishing opportunities.   Oil spills can have a large impact on many components of natural ecosystems. Some of the most conspicuous effects of oil spills are apparent among larger species of wildlife, such as mammals and shorebirds. The consequences of oil exposure to wildlife include both immediate impacts on health as well as long-term changes in behavior. In small doses, the presence of oil can cause temporary physical harm to animals. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease. When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Ober, 2010).

Direct Effects of Oil Spills on Wildlife

Oil spills can impact wildlife directly through three primary pathways:

- Ingestion - when animals swallow oil particles directly or consume prey items that have been exposed to oil
- Absorption - when animals come into direct contact with oil
- Inhalation - when animals breathe volatile organics released from oil or from “dispersants” applied by response teams in an effort to increase the rate of degradation of the oil in water

Ingestion of oil or dispersants can cause gastrointestinal irritation, ulcers, bleeding, diarrhea, and digestive complications. These complications may impair the ability of animals to digest and absorb foods, which ultimately leads to reduced health and fitness. Ingestion can occur at multiple levels of the food chain.

Indirect Effects of Oil Spills on Wildlife

Oil spills can also have indirect effects on wildlife by causing changes in behavior:

- Relocation of home ranges as animals search for new sources of food
- Increases in the amount of time animals must spend foraging
- Disruptions to natural life cycles

Changes in foraging locations may result from oil spills. If a spill causes direct mortality to the food resources of a particular species, many individuals of this species will need to relocate their foraging activities to regions unaffected by the spill. This leads to increased competition for remaining food sources in more localized areas. This congregating can be especially problematic for rare species which

may become more susceptible to predation or to future catastrophic events while a large proportion of the population forages in a few concentrated patches.

Increases in foraging time may be required to meet energetic requirements. Animals may need to make longer trips to find food in unfamiliar areas, and they may need to forage on less preferred food that takes more time to acquire or that is digested less efficiently. Decreases in diet diversity due to lower food availability may lead to reduced overall health. At the same time, the energetic requirements of these animals may be heightened, due to the physiological challenges brought on by exposure to the oil (difficulty maintain temperature balance or compromised immune systems).

Disruptions to life cycles may become apparent if particular life forms are more susceptible to the effects of oil than others. Eggs, larvae, and juveniles of many species are more vulnerable to harmful effects from pollutants than adults. Changes in the relative numbers of individuals from different life stages within a species may lead to shifts in habitat use patterns which cause ripple effects up and down the food chain. Furthermore, if all individuals of a life stage of a species are decimated, the ability of the species to rebound after the spill is greatly reduced.

Factors Influencing the Degree of Impact of Oil Spills on Wildlife

The magnitude of harm caused to wildlife by oil spills varies according to a number of factors:

- Amount of exposure of each animal to oil
- Pathway through which each animal is exposed to oil
- Age, reproductive state, and health of each animal
- Type of synthetic chemicals used by response teams to clean the spill

The magnitude of exposure an animal has to oil influences the degree of harm caused (such as the amount of time the skin is in direct contact with oil, or the amount of toxic material ingested or inhaled). The more extensive the area an oil spill covers, the more difficult it becomes for animals to avoid the oil particles, and the greater the magnitude of exposure. Also, the longer the time period over which oil is present at the surface, the greater the likelihood of exposure to species that forage at or near the surface. Wave action and prevailing winds can accelerate the rate of mixing of oil from the surface into the water column, reducing exposure to species that spend time at or near the surface, while increasing exposure of benthic organisms to smaller particles.

The route by which an animal is exposed to oil (ingestion, absorption, or inhalation) can also influence the rate and toxicity of the effects. Animals with varied diets may have fairly limited contact with oil through the ingestion route, whereas low-mobility animals that need to breathe at the surface will have high rates of exposure through inhalation due to their limited ability to escape the extent of the spill.

The age, reproductive state, and overall health of an animal may influence the degree of harm caused by exposure to an oil spill. In general, eggs, larvae, and early juvenile life stages are more susceptible to oil and to chemical dispersants than adult animals of most species. Widespread mortality of larvae from the year a spill occurs will have long-term consequences for the species due to a reduction of the capacity of the species to rebound the following year when fewer reproducing individuals are present. Also, individuals of lower fitness are likely to be impacted to the greatest extent by the additional stresses imposed by an oil spill.

Finally, the types of synthetic materials used by response teams to clean up or disperse oil can influence the magnitude of harmful effects felt by wildlife. Materials called “dispersants” are surfactants that are often applied to an oil spill site to increase the rate of degradation of oil. The use of these dispersants can reduce exposure to harmful effects caused by the inhalation of toxic materials by animals visiting the

surface to breathe, and can reduce impacts to shoreline habitats. However, these materials may increase the harmful effects of oil on the insulation abilities of bird feathers. Dispersants also cause oil particles to disperse deeper into the water column where the oil may cause more harmful effects to benthic animals in deeper waters such as game fish species like walleye and northern pike (Ober, 2010).   Two of the most common species of game fish found in the Missouri River are at risk here.

Susceptibility of various types of wildlife to oil spills

The vulnerability of various species of wildlife to an oil spill changes as time since the spill increases. Species that spend time at the surface of the water will be impacted most during the early stages of the spill. Once the oil begins to wash ashore, species that utilize the shoreline are affected. Finally, influence on benthic species begins once the oil particles leave the surface and become mixed throughout the water column.

Impacts on Standing Rock Wildlife -Mammals

Standing Rock's Hunter Harvest for 2016 deer

A total of 1855 deer tags were sold during the 2016 deer season. Out of the 1855 licenses sold, 781 hunter harvest reports were turned back in (42.10%). From the 781 returned, a total of 563 hunters reported harvesting a deer; this comes to a 72.09% success rate. An average of 37.37 hours was spent per hunter that hunted deer on Standing Rock. An average of 22.05 bucks, 27.18 does and 27.18 fawns were observed by hunters during their hunt. A total of 246 (31.50%) whitetail bucks, 236 (30.22%) mule deer bucks, 53 (6.79%) white tail does and 57 (7.30%) mule deer does were taken on Standing Rock, 192 (24.58%) did not answer. Bucks averaged 4.01 antlers on the left side and 4.07 antlers on the right side.

In the event of an oil spill there is no doubt that Standing Rocks whitetail, mule deer and antelope could be impacted in the river corridor.

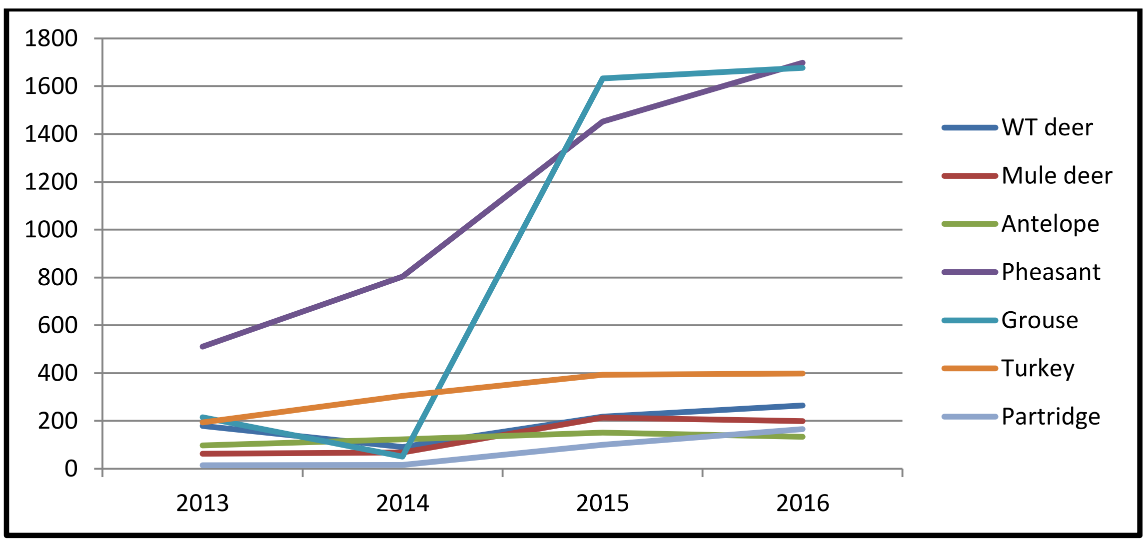

Figure 13. Number of animals all surveys combined (vertical axis= total Number of animals).

Mammals that may be affected directly by a spill include muskrats, raccoons and river otters. Their inherit behavior in wetland areas allows them to be vulnerable.

Mammals with fur become vulnerable when oil coats their fur and prevents it from providing insulation from cold temperatures. Direct ingestion, by deer for example, on vegetation that has been contaminated by oil could result in direct mortality due to disruption of the rumen fermentation process and aspiration of rumen fluids into the lungs (Collingsworth, 1989).

Herbivorous (plant-eating) wildlife, such as deer, may consume vegetation that has been coated with oil particles. Inhalation of volatile chemicals (vaporized materials released by oil floating on the surface) commonly occurs among those species of wildlife that need to breath at the surface of the water, such as otters, muskrats, beavers swimming in the water. Inhalation of these harmful materials can cause respiratory inflammation, irritation, emphysema, or pneumonia (Ober, 2010).

Birds

Those species most likely affected by an oil spill are wading shore birds, waterfowl, and potentially raptors feeding on fish. They can become oil soaked, and develop abnormal conditions in their lungs, kidneys, liver and other internal injuries. The Standing Rock Game & Fish Department biologists conduct ground counts of all game species in the environment. In our ground counts, in the last 5 years we have noted an increase in the numbers of waterfowl using the reservation. An oil spill could be devastating to either migrating or nesting waterfowl species found on the river. Large numbers of Canada geese were noted in the upper reaches of our study. This could have an effect on waterfowl hunting in the area.

Birds are primarily affected through thermoregulatory challenges caused by oiling of plumage and through ingestion. Oil reduces the ability of bird feathers to provide insulation, which increases their risk of hypothermia. Rate of heat loss is much higher in the water than in air, so oiled plumage is particularly problematic for birds that must find food in the water, such as shorebirds, waterfowl, and grebes. Oil is most commonly ingested by birds while preening their contaminated feathers or while feeding on contaminated prey (Ober, 2010).

Carnivorous (animal-eating) wildlife, such as shorebirds that feed on clams, mussels, or worms buried in the intertidal area, may consume prey organisms that have been exposed to oil sediments washed onto the shoreline. Absorption of oil or dispersants through the skin can damage the liver and kidneys, cause anemia, suppress the immune system, induce reproductive failure, and in extreme cases cause death. The skin of some species may experience irritation, burns, and infections.

Fish

The food fish populations [pike, walleye, catfish, yellow perch] in this reach of the Missouri river is very prominent and supplies ample opportunity for tribal and non-tribal members. An oil spill from DNPL could jeopardize this stable and robust population of game fish.

Persistence of oil material in the littoral zone (shallow) also provide for long term impacts to benthic organisms feeding in those shallow water wetland areas found within the study area, primarily fish. Exposure of oil to fish eggs in the water can lead to slower embryonic growth, lower hatching rates, and developmental impairments.

Ingestion of adult fish that have eaten contaminated prey, especially species like walleye, pike and catfish by tribal members that were exposed to oil could create symptoms conducive to higher mammals exhibiting oil toxicity and create human health issues.

Wetlands

The High Consequence Areas identified in this assessment include the mouth of the Cannonball River and Porcupine Creek. An oil spill from DNPL could impact these important habitat areas which would have a devastating impact on fishery spawning, rearing and foraging areas as well as impact many aquatic mammals including potential acute and chronic assaults to big game adjacent to the river complex.

In our assessment we predict that significant impairment could result in the sub-mergent and emergent wetland vegetation communities that results from surficial oiling of shoots and leaves. Additionally, oil may have a detrimental effect on the physiology of these wetland species, their roots, and their rhizomes. There is much literature evidence that light oils will considerably stress and kill wetland vegetation. Other factors impacting wetland plant species are reduced photosynthesis, and limited or no reproduction after exposure.

Below the DNPL crossing there are numerous wetlands that support a diverse community of *Potamogeton* species (submerged wetland plant species) that provide a unique habitat for a wide variety of organisms that support larval and juvenile fish growth such as walleye, white bass, northern pike, catfish and of forage fish species.

Emergent wetlands would certainly be vulnerable and depending on the severity of spill shoreline, and riparian flora species could be at-risk. Increased sediment, drilling mud, incidental sheens, and hydraulic fluids partially comprise the list of point and non-point inputs potentially during construction. Dispersal of these materials into these areas could have negative impact on these aquatic communities in general.

Conclusions

Our ecological surveys revealed unique and sensitive habitats below the DNPL pipeline crossing. Our inventory documented almost 80 flora species, 24 fish species (~1000 fish collected) and 41 bird species (3366 observations) and documentations of numerous mammals found within the study area.

There are approximately 40,000 acres of varying wetland types present in the 30 miles below the pipeline crossing adjacent to Standing Rock Indian Reservation (Wetland Mapper, 2017). The most sensitive depositional areas in the event of a spill are found within the first 15 miles of the approximately 30 river miles of survey. The Cannonball River and Porcupine Creek appear to be major tributaries that could realize the greatest impacts in the event of a spill. The tributary just below the pipeline crossing in the mouth of the Cannonball River is the most sensitive environment and appears to be highly vulnerable in the event of a spill as a high consequence area.

Sensitive wetlands begin just below the pipeline crossing in the mouth of the Cannonball River. The unique and highly diverse sub-mergent macrophyte community found in several reaches (primarily R-1) has created a productive benthic community composed of several indigenous flora that harbor insects and several aquatic organisms beneficial to critical life stages of sport and native fish species. The forested wetlands (PFOA) adjacent to the original flowing Missouri river have evolved into submerged macrophyte beds which are attractive to all age classes of representative fish species in the Missouri.

Subsistence hunting and fishing would be deleteriously affected in the event of an oil spill. Depending on the magnitude of the spill, numerous wildlife species and their habitats could be impacted in some

way. Provided are several examples of how an oil spill can impact the various animal groups and their habitats. As more ecological data is collected, the clarity and precision of the environmental impact can be assessed or determined. There is a strong connection between a major pollution event like an oil spill and the resident populations of fisheries and wildlife currently found on the reservation. Impacts on tribal special species of significance, the buffalo, bald and golden eagle, and elk are possible. The tribe is concerned about the well-being of these species.

Aquatic habitats appear generally intact with unique and sensitive locations noted and more information will be needed going forward to more fully characterize this unique ecosystem in southern North Dakota. The biodiversity in this portion of the river appears representative from the limited information we discovered from tribal sources and state and federal databases.

The tribe is very concerned with potential threats to their water quality and ensuring their fishery and wildlife resources in and adjacent to the river are not impaired.

Recommendations

1) Continue to conduct annual ecology monitoring of the study area (reaches 1-3) is highly recommended to develop a complete baseline of current and changing environmental condition. Even though this study has considerably enhanced our ecological understanding of the area, much information is yet to be gathered. Pilot studies that would enhance pre-spill conditions that would be strategic are;
    a- **Conduct a detailed mapping assessment** to understand extent of establishment and more thorough investigation of unique and diverse submergent macrophytes growing in particular in the mouth of the Cannonball River. This appears to be a highly diverse and sensitive ecological area presenting a wide range of biodiversity of flora and fauna. An oil spill in this area could be significantly damaging to the sport fishery, raptor use, and overall avian biodiversity in general.
    b- **Conduct a comprehensive survey of reptiles and amphibians** found in the area. Even though we documented a woodhouse toad, *Anaxyrus woodhousii*, limited or no data exists on this group of animals.
    c- **Continue documentation of the culturally important plants of the Lakota**. Uses of native vegetation by tribal members depending on subsistence hunting and fishing could be significant and very little is known about current status of native flora given the current conditions.
    d- **Conduct periodic riverine nocturnal surveys of deer** to more accurately assess river (riparian) populations of deer that are common in nearby uplands.

2) Continue to compile hunter harvest and in-field creel information for tribal members that depend on the Missouri River for their calorie supplementation. Subsistence hunting and fishing requires an in-depth understanding of tribal member uses of fish and wildlife resources and many of the uses of these natural resources may be understated in this document.
3) Investigate the impacts of an oil spill on the water intake structure and determine potential water quality impacts to the drinking water supply at Fort Yates.
4) Conduct cultural historical surveys in river corridor. In the event of an oil spill, what impacts would there be to yet to be discovered cultural historical sites along the west bank of the Missouri River.

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KEY BENEFITS realized related to the awareness of this study includes, but are not limited to:

Tribal members benefit from nature and healthy waters on the reservation and Missouri River

Aesthetic values related to fish, aquatic flora and fauna these national and tribal treasures bring forward- the Missouri River is one of our last remaining natural treasures. People are our most valuable asset and rely on this water for drinking and subsistence hunting and fishing in this part of the river.

The Missouri River is a premier fish and aquatic habitat conservation area requiring much attention.

Science is the foundation for collaborative fish and aquatic conservation on tribal lands.

The SR Game & Fish Department manages some of the best remaining fish and aquatic habitat in the country.

Fish and aquatic resources on the reservation streams and grasslands are an irreplaceable part of America's and SR cultural legacy.

Fish and aquatic resources on the reservation and adjacent grasslands have tremendous economic value.

Partnerships are key to our success.

Our efforts are key to natural resource sustainability.

Appendix

The following tables depict specific data collected during the study within each reach.

Species	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
WT deer	2 observed & tracks	8	2 observed & tracks	0	0	8
Mule deer	0	3	0	0	0	0
Antelope	0	0	0	0	0	13
Coyote	tracks	tracks	0	0	0	0
Raccoon	tracks	0	0	0	0	0
Muskrat	0	1	0	0	0	0
Prairie dogs	0	colony present	colony present	colony present	0	0

Figure 16. Mammal observations within each reach of the study.

Species	# observed	#/mile	#/hour
Antelope	13	0.22	13
buck	1		
doe	8		
fawn	4		
Mule deer	7	0.12	7
buck	2		
doe	4		
fawn	3		
WT deer	4	0.07	4
buck	0		
doe	2		
fawn	2		
Sharptail grouse	2	0.03	2
Pheasant	1	0.02	1
rooster	1		
Mourning dove	75	1.27	75
Mallards	12	0.2	12
BW teal	7	0.12	7

Figure 17. Ground count of all species observed within two miles of the Missouri River on the Reservation.

Appendix B

Declaration of Jon Eagle, Sr., Standing Rock Sioux Tribal Historic Preservation Officer

DECLARATION OF JON EAGLE, SR.

I, Jon Eagle, Sr., under penalty of perjury, hereby state and affirm as follows:

1. I am the Tribal Historic Preservation Officer for the Standing Rock Sioux Tribe. The Standing Rock Sioux Tribe is located in both the States of North Dakota and South Dakota and is home to the Hunkpapa and Sihasapa bands of Lakota Oyate and the Ihunktuwona and Pabaksa bands of the Dakota Oyate. We are a member tribe of the Oceti Sakonwin (Seven Council Fires), also known as the Great Sioux Nation. I was appointed by the SRST Council to serve in this capacity on February 8, 2016. I have twenty eight years of experience working with children, families and communities and eighteen years of experience consulting with tribal, state and federal agencies. After studying Sociology at Fort Lewis College, in Durango, Colorado, I returned home to Sitting Bull College where I finished a Bachelor of Science Degree in General Studies. I have three years of experience working with the SRST/Elders Preservation Council to identify and evaluate Stone Features, stone cairns, and stone effigies and two years of experience as a Tribal Historic Preservation Office. Since my appointment I have attended the Advisory Council on Historic Preservation, National Historic Preservation Act, Section 106 Essentials and Advanced training in Denver, Colorado and Native American Graves Protection Repatriation Act training.

2. My mother is Isanti Dakota from the Sisseton Wahpeton Oyate and my father is Hunkpapa Lakota from the Standing Rock Sioux Tribe. I am a fortunate man to have known my grandparents and many elders in my lifetime. There are certain people in our society who are trained since childhood and have earned the right to share, Otokaheya Wicoyake (Creation Stories) and Wicahpi Ta Wicoyake (Star Knowledge). These stories can only be told at night after the first day of winter and cannot be told again after the first day of spring. It is the telling

of these stories that gives our people a spiritual foundation to interact with a living universe and reverence for the sacred.

3. An elder by the name of Albert White Hat, a respected spiritual leader among the Sicangu Lakota once spoke to me about the sacredness of our language. Mr. White Hat challenged me to gain a deeper understanding of our language and used the phrase, "Tunkasila Cekiye," to help me to understand. He said that today because of Christian influences on our language many will translate this phrase to mean, "Pray to Grandfather." But he said the understanding goes much deeper than that. He said that, "TUN," refers to the creation of or the beginning. "KA," means, "to go back to." He said that, "SI is archaic. Today we say NI, for life," and "LA," is a term of endearment. Then he broke down the second word in the phrase by saying, "Our ancestors didn't pray. They acknowledged their relationship to everything in creation then stated their needs. Albert said, "That's CEKIYE." Now when you put them back together they become, "To acknowledge our relationships in this dear life going back to the beginning."

4. Today because of technology we can look far out into the universe. We know that the galaxies in the universe are in the form of spiral galaxies and everything in the universe is moving. We are connected to that sacred motion. It's on top of our heads in the form of a spiral; it's in our finger prints and all around us. We inhale oxygen and exhale carbon monoxide; trees inhale carbon monoxide and exhale oxygen. Water evaporates and goes into the air then comes back as rain. The sun rises in the east and sets in the west only to return again the next day. Day to night, winter to spring, to summer then fall and that cycle repeats itself again. This is an example of what we mean when we refer to Cangleska Wakan, the sacred hoop of life.

5. There are sacred places on the earth, connected to that sacred motion. Places where my ancestors stood in prayer. It wasn't the exposure to the elements or the lack of food that was their greatest test; it was the lack of water. There are sacred places that are beyond our memory, that when we approach we always have a loaded cannupa. In English we say pipe, but I will not translate that again in this declaration because to say it in English diminishes what it is to our people.

6. Water is considered to be sacred among my people. Our word for water is "Mni." We refer to water as "Mni Wiconi", the water of life, because without water there can be no life. At a gathering of elders Chief Arvol Looking Horse, the nineteenth generation keeper of our Sacred White Buffalo Calf Pipe said, "Iyapi Wakan, it has a spirit. It is our relative, our first medicine." For nine months our mothers carried us in water. We are primarily made up of water. Unci Maka, Grandmother Earth has the same percentage of water as our own bodies.

7. We still have people who go to the water to pray and make offerings so that all life that is sustained by our river may live. People, horses, buffalo, deer, fish, birds, all life is considered to be sacred and is dependent upon the Missouri River. It was the water ways of this nation that were the highways of their times as my ancestors traveled from lake to lake, river to river, steam to stream. Water defined our ancestral territory. Stone features, burial cairns and stone effigies can be found near water on hill tops, along ridges, hill sides and drainages.

8. My elders have taught me to have a deep reverence for the land. We do not look at Unci Maka, Grandmother Earth as a resource. We look at her as a living being who provides and nurtures. One of my aunts, Cecilia Fire Thunder said, "Le makoce ki teunkilapi sni ki hehan un Lakotapi kte sni," which translates to, "When we no longer cherish the land we will no longer be Lakota."

9. Years ago I asked my father what the river bottom looked like before the building of the dams and the flooding of the river. He was quiet for a while then said that only once in his childhood did his parents travel to Bismarck, ND. He said they traveled in a team and wagon and he and his brother followed on horseback. My father told me that the river bottom was like a great cathedral; the canopy of trees providing shade and shelter; the wagon trail winding its way along the river bottom. He said that as they traveled they encountered other families who were also traveling. My grandparents would be invited into camps and the people would share whatever they had, dried meat, berries, and tea. He said that the river bottom had provided for the people for generation upon generation.

10. My father said they used to back their wagons up to the river and fill rain barrels for drinking water. They'd take the water back to their log cabin and let the sediment drift to the bottom then drink the water off the top. My generation grew up drinking water out of creeks, steams and springs. We were told as long as the water was moving it was safe to drink. My children drink water out of plastic bottles. That's how fast our environment is deteriorating.

11. An educator from the Bear Soldier Community and former Chairman, Jesse Taken Alive said that in his classroom they pray every morning for the water. The children bring their own cups, fill them with water then pray for the water. He said they do this every morning because his students are worried about the pipeline breaking.

12. Our children are living under duress. It is widely known that if the pipeline breaks and the Standing Rock Sioux Tribe has to close our intakes, we only have 3-5 days of water in our MRI Water System. Keep in mind that the Standing Rock Reservation is in two counties, Sioux County and Corson County. Both counties made the list of the ten poorest counties in the nation according to the census.

13. As a Tribal Historic Preservation Officer who engages Federal Agencies in consultation, I am often asked to pin point an area of potential effect. The challenge is trying to help people to understand that the area of potential effect is global. That is what we are up against in addressing the impacts on our Tribe from the Dakota Access Pipeline.

Jon Eagle, Sr.

STATE OF NORTH DAKOTA)
:
COUNTY OF SIOUX)

SUBSCRIBED AND SWORN to before me
this 12 day of February, 2018

NOTARY PUBLIC

CLAUDETTE R STRICKER
Notary Public
State of North Dakota
My Commission Expires August 3. 2021

My Commission expires August 3, 2021

Appendix C

Standing Rock Sioux Tribe's Notice of Intent Comments on the Dakota Access Pipeline to the Army Corps of Engineers

February 7, 2017

STANDING ROCK SIOUX TRIBE'S

NOI COMMENTS, DAKOTA ACCESS PIPELINE

PRELIMINARY SUBMISSION

FEBRUARY 7, 2017

I. The EIS Process should be allowed to continue and to do so would not be inconsistent with the Presidential Memorandum.

On December 4, 2016, the Department of the Army ("Army") announced that it would not approve an easement that would allow the proposed Dakota Access Pipeline to cross under Lake Oahe, in North Dakota.[1] The proposed crossing is located approximately half a mile upstream from the Standing Rock Sioux Tribe's ("Tribe") northern reservation boundary, which extends into Lake Oahe.[2] The December 4 decision was based on the determination that a "more rigorous exploration and evaluation of reasonable siting alternatives" and a heightened analysis of "potential spill risk and impacts and treaty rights" was needed before the Army could make a decision on the easement in accordance with the Mineral Leasing Act ("MLA"), 30 U.S.C. § 185.[3] The decision noted that this additional analysis should be done with greater public and tribal participation and would be best accomplished through an environmental impact statement.

The December 4 decision was implemented on January 18, 2017, when the scoping process for the EIS was announced. In addition to general comments, the notice requested input on three particular areas:

> (1) Alternative locations for the pipeline crossing the Missouri River;
> (2) Potential risks and impacts of an oil spill, and potential impacts to Lake Oahe, the Standing Rock Sioux Tribe's water intakes, and the Tribe's water, treaty fishing, and hunting rights; and
> (3) Information on the extent and location of the Tribe's treaty rights in Lake Oahe.[4]

Shortly thereafter, on January 24, 2017, the White House issued a Presidential Memorandum directing the Secretary of the Army to "review and approve in an expedited manner, to the extent permitted by law and as warranted, and with such conditions as are necessary or appropriate, requests for approvals to construct and operate the [Dakota Access Pipeline], including easements or rights-of-way to cross Federal areas . . . ."[5] While no action to date has been taken on the pending easement crossing for Lake Oahe, the Acting Secretary of the Army issued a

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[1] Jo-Ellen Darcy, Assistant Secretary of the Army, Department of the Army, Office of the Assistant Secretary, Civil Works, Memorandum for Commander, U.S. Army Corps of Engineers, Subject: Proposed Dakota Access Pipeline Crossing at Lake Oahe, North Dakota (Dec. 4, 2016) (found at: https://www.army.mil/e2/c/downloads/459011.pdf) (last accessed Feb. 4, 2017).
[2] *See* M-37038, *Tribal Treaty and Environmental Statutory Implications of the Dakota Access Pipeline,* at 8 (Dec. 4, 2016) (Attachment A).
[3] *See supra* n.1.
[4] 82 Fed. Reg. 5543, 5544 (Jan. 18, 2017).
[5] Presidential Memorandum Regarding Construction of the Dakota Access Pipeline, Memorandum for the Secretary of the Army, *Construction of the Dakota Access Pipeline,* Sec. 2(i) (Jan. 24, 2017) (found at: https://www.whitehouse.gov/the-press-office/2017/01/24/presidential-memorandum-regarding-construction-dakota-access-pipeline) (last accessed Feb. 4, 2017).

Memorandum directing compliance with the Presidential Memorandum.[6] The United States recently reported that the "Army will make any decisions once a full review and analysis is completed in accordance with the Presidential Memorandum."[7]

The Tribe urges the Army to allow the EIS process to move forward. Recently, the former chairs and current Ranking Member of the Senate Committee on Indian Affairs also requested that the EIS process be allowed to continue.[8] The Final Environmental Assessment ("Final EA") issued in July 2016[9] is not sufficient to satisfy the standards of the MLA or ensure that the proposed easement will not adversely impact the Tribe's treaty rights, including water rights, cultural resources and the general health and welfare of tribal members. For example, the MLA requires an evaluation of damages to the environment (including damage to fish and wildlife habitat) and the development of any "requirements to protect the interests of individuals living in the general area . . . who rely on the fish, wildlife, and biotic resources of the area."[10] The Final EA does not provide sufficient information to fully analyze these issues to determine or fully evaluate the risks associated with the proposed Lake Oahe crossing or impacts on treaty rights and the environment. The Solicitor for the Department of the Interior also issued an M-Opinion finding that additional analysis of the Tribe's treaty rights and a more in-depth evaluation of the risks and impacts associated with the proposed pipeline is warranted and required before a decision can be made on the proposed easement crossing.[11]

The Final EA did not separately evaluate or provide any information related to the Tribe's treaty rights. As discussed below, the Tribe has treaty rights within Lake Oahe and depends on fish, wildlife and plants in and around the lake for subsistence. An analysis of the Tribe's treaty rights must be done in coordination with the Tribe. Moreover, given the high risks related to the proposed Lake Oahe crossing for this crude oil pipeline and potential adverse impacts to the Tribe's treaty and religious freedome rights, it is necessary to evaluate and analyze reasonable alternatives to the proposed crossing. And as noted below in Section VIII, the Final EA falls far short of providing any adequate or robust analysis of feasible alternatives. Thus, the EIS process can (and should) continue, consistent with the Presidential Memorandum, because additional environmental, human impacts and tribal treaty rights analyses are necessary to comply with federal law, including the MLA.

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[6] Robert M. Speer, Acting Assistant Secretary of the Army, Memorandum for the Assistant Secretary of the Army for Civil Works and the Chief of Engineers/Commanding General, U.S. Army Corps of Engineers, Subject: Presidential Memorandum – Construction of the Dakota Access Pipeline (Jan. 31, 2017).
[7] United States Army Corps of Engineers' Notice Regarding Public Document, *Standing Rock Sioux Tribe v. U.S. Army Corps of Engineers*, Case No. 1:16-cv-01534, DKT 91 at 1 (D.D.C. Filed Feb. 1, 2017).
[8]Letter to Donald Trump, President of the United States, from Maria Cantwell, Tom Udall and Jon Tester (Feb. 1, 2017) (Attachment B).
[9] Environmental Assessment, Dakota Access Pipeline Project, Crossings of Flowage Easements and Federal Lands (July 2016) (found at: http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p16021coll7/id/2801) (last accessed Feb. 7, 2017).
[10] 30 U.S.C. § 185(h)(2).
[11]*See generally* Attachment A.

II. The Tribe must be invited as a cooperating agency.

Guidance from the Council on Environmental Quality ("CEQ") "urge[s] agencies to more actively solicit . . . the participation of . . . tribal . . . governments as 'cooperative agencies.'"[12] On January 23, 2017, the Tribe officially requested participation in the EIS process as a cooperating agency. The Tribe must be allowed to be a cooperating agency during the EIS because the proposed pipeline would be located in the aboriginal and treaty territory of the Great Sioux Nation and is approximately half a mile from the Tribe's Reservation boundary.

CEQ guidance provides that "no later than the scoping process" federal agencies should identify tribal agencies "with jurisdiction by law and or special expertise with respect to reasonable alternatives or significant environmental, social or economic impacts associate[ed] with a proposed action . . . ."[13] The Tribe has significant legal rights that will be impacted by the proposed easement despite the fact that the crossing is not technically within the Tribe's Reservation. For example, the Tribe has existing treaty rights, including water rights, within and around Lake Oahe. Lake Oahe and the surrounding area is also central to the Tribe's exercise of its religious beliefs guaranteed by the American Indian Religious Freedom Act[14] and protected under the Religious Freedom Restoration Act of 1993 ("RFRA").[15]

The waters and shoreline of Lake Oahe are the primary source of fish, wildlife, and plants on which many tribal members rely to meet basic subsistence needs, as well as for important religious and cultural practices. Because of the proximity of the Reservation, it is the Standing Rock Sioux Tribe and the Reservation that will be most immediately and directly harmed by adverse impacts of construction as well as oil spills. The Tribe also has special expertise with respect to its rights, cultural beliefs and tribal member reliance on the waters and resources of the lake, and can provide information related to its Reservation that is not generally publicly available, but is needed to adequately assess impacts and issues like environmental justice. As such, the Tribe should be allowed to participate as a cooperating agency.

III. The EIS must discuss the presence of the Standing Rock Sioux Tribe and fully evaluate the risks associated the proposed project and impacts to the tribal population, including addressing environmental justice issues.

The Final EA does not discuss the impacts that spills will have on the Tribe's communities. Nor does it properly address environmental justice issues. The EIS must discuss

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[12] George F. Frampton, Jr., Acting Chair, Executive Office of the President, CEQ, Memorandum for Heads of Federal Agencies, *Designation of Non-Federal Agencies to be Cooperating Agencies in Implementing the Procedural Requirements of the National Environmental Policy Act* (July 28, 1999) (located at: https://energy.gov/sites/prod/files/G-CEQ-DesigNonfedCoopAgencies.pdf) (last accessed Feb. 5, 2017).
[13] *Id.*
[14] Pub. L. No. 95-341, 92 Stat. 469 (Aug. 11, 1978), 42 U.S.C. § 1996.
[15] Pub. L. No. 103-141, 107 Stat. 1488 (Nov. 16, 1993), 42 U.S.C. §§ 2000bb-2000bb-4.

the proximity of the Tribe's Reservation and the existence of the tribal population that relies on the resources of Lake Oahe.[16]

There are 567 Federally recognized Tribal Nations today, with an American Indian/ Alaska Native (AI/AN) population totaling 5.2 million (1.7% of the total U.S. population), with 2.9 million of those (.9% of the total U.S. population) identifying solely as AI/AN.[17] Further, AI/ANs rank among the lowest on the socio-economic scale. The overall poverty rate of AI/ANs is the second highest (16%) among all minorities.[18] The high school dropout rate for AI/ANs is the second highest of all minorities (11%); and AI/ANs rank the second lowest for having a bachelor's degree or higher (17% of the population).[19] But these statistics are much worse for the Standing Rock Sioux Tribe. At Standing Rock 19% of the population has less than a high school degree, and while 15% have a bachelor's degree or higher, the poverty rate at Standing Rock is 43% of the population.[20]

As discussed in more detail below, the Tribe relies on water from Lake Oahe for all domestic, municipal and rural water needs. The water from Lake Oahe provides drinking water to almost all homes on the Reservation, as well as the schools, community centers, hospital and tribal and federal government buildings. It is the source of water for the Tribe's business enterprises (casinos and hotel) and the source of water for irrigation. In the event of a catastrophic spill or even a long slow leak of oil from the pipeline, the Tribe would be without water. The Tribe's Municipal, Rural and Industrial ("MR&I") program estimates that if its intakes on Lake Oahe are shut down due to an oil spill, the Tribe would have 3-days maximum of drinking water. There are no alternative sources of water. Moreover, an oil spill in Lake Oahe would damage or destroy wildlife, plants and soil in derogation of the Tribe's treaty rights in and around Lake Oahe. This can have long-term adverse impacts on tribal health as it relates to not only exposure to oil chemicals and contaminants in the water, but also to the food chain because tribal members regularly exercise their treaty right to hunt, fish and gather plants in and around Lake Oahe.

The EIS must fully examine the short and long terms impacts that spills or releases of oil can have on tribal communities and there must be express recognition that these communities are greatly impacted by environmental justice issues. The environmental justice analysis must take into account the disproportionate adverse effects of a proposed pipeline crossing immediately upriver from the Reservation in terms of both quantitative as well as qualitative effects – as required by the CEQ guidance on environmental justice. The CEQ directs that: "Agencies should recognize the interrelated cultural, social, occupational, historical, or economic factors

[16] Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Feb. 11, 1994).
[17] U.S. Census, 2010 Census Redistricting File.
[18] http://www.pewresearch.org/fact-tank/2014/06/13/1-in-4-native-americans-and-alaska-natives-are-living-in-poverty/ (last accessed on Feb. 6, 2017).
[19] *Id.*
[20] *Id*.

that may amplify the natural and physical environmental effects of the proposed agency action. These factors should include the physical sensitivity of the community or population to particular impacts; the effect of any disruption on the community structure associated with the proposed action; and the nature and degree of impact on the physical and social structure of the community."[21] The CEQ guidance calls for special consideration to be given to Indian tribes, stating that in determining the affected environment, "[a]gencies should recognize that the impacts within . . . Indian tribes may be different from impacts on the general population due to a community's distinct cultural practices. For example, data on different patterns of living, such as subsistence fish, vegetation, or wildlife consumption and the use of well water in rural communities may be relevant to the analysis."[22] In addition, "[w]here environments of Indian tribes may be affected, agencies must consider pertinent treaty, statutory, or executive order rights . . . ."[23]

IV. The EIS must acknowledge the existence of the Tribe's treaty rights and discuss the risks associated with the proposed project and the impacts to those rights.

Federal law mandates that Federal agencies consider impacts to treaty rights in Federal decision making, and protect treaty rights when exercising decision-making.[24] Indian treaties, like all treaties, are the "supreme law of the land" and have the same legal force and effect as Federal statutes. *Antoine v. Washington*, 420 U.S. 194, 204 (1975); *Skokomish Indian Tribe v. U.S.*, 410 F.3d 506, 512 (9th Cir. 2005) (en banc). Through treaties with the United States, Indian tribes ceded vast amounts of land in exchange for certain benefits and the reservation of rights and privileges. *See, e.g.*, *United States v. Winans*, 198 U.S. 371, 380-81 (1901) (noting among other things that treaties are not a grant of rights *to* the Indians, but *from* them).

The Supreme Court has noted that "[i]n carrying out its treaty obligations with the [tribes] the Government is something more than a mere contracting party . . . it has charged itself with moral obligations of the highest responsibility and trust." *Seminole Nation v. United States*, 316 U.S. 286, 296 (1942). Further, treaties may not be disregarded for convenience or by implication; treaties can only be abrogated by Congress when it shows an express intent to do so. *See, e.g.*, *United States v. Dion*, 476 U.S. 734, 738 (1986) ("We have required that Congress'

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[21] CEQ, *Environmental Justice, Guidance under the National Environmental Policy Act*, at 9 (Dec. 10, 1997) (found at: https://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf) (last accessed Feb. 7, 2017).
[22] *Id.* at 14.
[23] *Id.*
[24] Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty Rights (Sept. 2016) (found at https://www.epa.gov/Tribal/memorandum-understanding-regarding-interagency-coordination-and-collaboration-protection) (last accessed Feb. 6, 2017); *See also* Department of Defense American Indian and Alaska Native Policy (found at: http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/techbio/DoDPolicy.pdf) (last accessed Feb. 6, 2017).

intention to abrogate Indian treaty rights be clear and plain.”).[25] Federal agencies, therefore, have no authority to take unilateral action that would abrogate treaty rights.[26] Accordingly, treaties have been construed by Federal courts to reserve and protect a number of rights, both on and off reservation, such as water rights[27] and hunting and fishing rights.[28]

The Standing Rock Sioux Tribe is a successor to the Great Sioux Nation, a signatory to the Fort Laramie Treaty of 1851.[29] The geographical boundaries of the Tribe’s Treaty-recognized territory was initially described in Article 5 of the 1851 Fort Laramie Treaty:

> The territory of the Sioux, or Dahcotah Nation, **commencing the mouth of the White Earth River, on the Missouri River**; thence in a southwesterly direction to the forks of the Platte River; thence up the north fork of the Platte River to a point known as the Red Bute, or where the road leaves the river; thence along the range of mountains known as the Black Hills, to the head-waters of the Heart River; thence down Heart River to its mouth; **thence down the Missouri River to the place of beginning**.[30]

The 1851 Treaty lands of the Sioux include the lands where the Dakota Access pipeline is proposed to cross Lake Oahe and extending west and north to the Heart River. Among other things, this Treaty reflects that the Tribe has strong historic and cultural connections, recognized by the United States, to the lands and water that will be impacted by the proposed Lake Oahe crossing.

The Fort Laramie Treaty of 1868 was an effort to restore peace.[31] In that Treaty, the Sioux reserved the Great Sioux Reservation for the “absolute and undisturbed use and occupation” of the Sioux Nation.[32] The Treaty also secured to the Sioux an additional area of land, defined as “unceded Indian territory,” and the United States promised that “no white person

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[25] *See also Menominee Tribe of Indians v. United States*, 391 U.S. 404, 413 (1968) (refusing to imply that a Federal statute terminated a Tribe’s hunting and fishing rights); *United States v. Santa Fe Pac., R.R.*, 314 U.S. 339, 346 (1941) (congressional intent to abrogate Tribal property rights must be “plain and unambiguous”).
[26] *See, e.g.*, *Confederated Tribes of Umatilla Indian Reservation v. Alexande*r, 440 F. Supp. 553, 556 (D. Or. 1977) (declaring that the Army Corps of Engineers had no authority to construct a dam when it “would take treaty rights without proper authorization”). To the contrary, Federal agencies have a duty to consider and protect treaty rights when making discretionary decisions. *E.g.*, *Northwest Sea Farms, Inc. v. U.S. Army Corps of Eng’rs*, 931 F. Supp. 1515, 1519–20 (W.D. Wash. 1996).
[27] *See e.g.*, *U.S. v. Adair*, 723 F.2d 1394, 1410 (9th Cir. 1983)
[28] *See e.g.*, *Menominee Tribe of Indians v. United States*, 391 U.S. 404, 406 (1968); *Minnesota v. Mille Lacs Band of Chippewa Indians*, 526 U.S. 172 (1999); *see also Fond du Lac Band of Chippewa Indians v. Carlson*, 68 F.3d 253 (8th Cir. 1995). It should be emphasized that treaty rights frequently extend off-reservation and it is unnecessary that “the Tribes have title to the land.” *Lac Courte Oreilles Band of Lake Superior Chippewa Indians v. Voight*, 700 F.2d 341, 352 (7th Cir. 1983).
[29] 11 Stat. 749 (Sept. 17, 1851).
[30] *See* 11 Stat. 749 (emphasis added).
[31] 15 Stat. 635 (Apr. 29, 1868).
[32] *Id.* art. 2.

or persons shall be permitted to settle upon or occupy any portion of the same; or without the consent of the Indians first had and obtained, to pass through the same."[33] The proposed pipeline route would cross through this "unceded Indian territory" – again from the Heart River to Lake Oahe. The 1868 Treaty also recognized the central importance of hunting to the Sioux, and, in addition to the lands reserved, provided that the Sioux retained rights to hunt over an extensive additional territory.[34] The United States further promised that no cession of lands by the Tribe would be valid "unless executed and signed by at least three-fourths of all the adult male Indians."[35]

However, the United States has broken this promise numerous times and the Tribe has suffered repeated and major losses of its lands through unconsented actions by the federal government. Large areas of lands promised to the Sioux Nation in the 1868 Fort Laramie Treaty were unilaterally taken away along with the buffalo and other resources that sustained the Tribe's traditional way of life. In 1889, Congress took more lands, enacting a statute that stripped large portions of the Great Sioux Reservation that had been promised to the Tribe forever and leaving a much smaller Sioux Reservation, including Standing Rock.[36]

The land losses continued during the Allotment Era without the consent of the Tribe. In 1908 and 1913, Congress passed two specific "Surplus Land Act" to break up tribal landholdings in an attempt to assimilate the Tribe and destroy traditional ways of life.[37] During the same generation for many tribal members, the United States, through the Army Corps, took an additional 56,000 acres of bottomlands on the Reservation for the Oahe project.[38] In taking these lands for the Oahe Dam (part of the overall Pick-Sloan Plan), the Army Corps proceeded without considering the impacts on the Tribe. A Congressional Committee, which looked at the Pick-Sloan plan in 1992, noted

> The Pick-Sloan Plan was presented to the Tribes as a fait accompli. The Corps of Engineers was so confident that it could acquire the Indian land it needed through Federal power of eminent domain that it began to construct the dams on the reservations even before opening formal negotiations with tribal leaders.[39]

The tribal lands taken for the Oahe Project were flooded to create Lake Oahe, and were the best remaining lands of the tribes. The Senate Committee on Indian Affairs has stated that "[t]he Missouri River's wooded bottomlands provided the tribes' reservation economics with fertile agricultural lands, timber for lumber and fuel, coal deposits, seasonal fruits, habitat for wild game, medicines, shelter for domestic animals, and plentiful supplies of clean water. These

[33] *Id*. art. 16.
[34] *Id.* art. 11.
[35] *Id*. art. 12.
[36] Act of Mar. 2, 1889, ch. 405, 25 Stat. 888.
[37] *See* Act of May 29, 1908, ch. 218, 35 Stat. 460; Act of Feb. 14, 1913, ch. 211, 27 Stat. 675.
[38] Act of Sept. 2, 1958, Pub. L. No. 85-915, 72 Stat. 1762.
[39] S. Rep. No. 102-267 at 188 (1992).

lands were also an important part of the tribes' social, cultural, and spiritual lives."[40] Vine Deloria, Jr., a citizen of the Standing Rock Sioux Tribe, described the Pick-Sloan Plan as "the single most destructive act ever perpetuated on any tribe by the United States." Approximately 190 families lost their homes as a result of the flooding and tribal communities were forced to move from the sheltered and natural resource resource rich lands along the Missouri River to the windswept and desolate uplands.[41]

Despite the significant taking of tribal lands by the United States, the Tribe's treaty rights have not been abrogated.[42] Under its Treaties with the United States, the Tribe and its members also retain the right to hunt, fish and gather on the reservation. *Menominee Tribe v. United States*, 391 U.S. 404 (1968); *United States v. Dion*, 476 U.S. 734, 738 (1986) ("Indians enjoy exclusive treaty rights to hunt and fish on lands reserved to them . . . [and] [t]hese rights need not be expressly mentioned in the treaty"). These rights were explicitly preserved when Congress authorized the Oahe project.[43] These treaty rights continue on the Reservation and extend into Lake Oahe. The EIS must acknowledge the Tribe's treaty rights and provide a robust discussion of the proposed Lake Oahe crossing's risks and potential impacts to ensure that none of the Tribe's treaty rights are impacted. This requires a showing that there will not be more than a *de minimus* impact on the Tribe's treaty rights as a result of the proposed project.[44] If the proposed Lake Oahe crossing will have anything more than a *de minimus* impact on the Tribe's treaty rights, federal law requires that the route must be rejected.

By virtue of the Fort Laramie Treaties and the Tribe's aboriginal use and occupancy the Tribe also possesses extensive off-Reservation consultation and repatriation rights throughout its broader Treaty area, including the lands that would be crossed by the proposed easement under Lake Oahe. The EIS must also analyze and evaluate any impacts to the Tribe's cultural sites and religious beliefs in coordination and collaboration with the Tribe.

V. The EIS must acknowledge that the Tribe has water rights to the Missouri River, including Lake Oahe, and discuss the proposed project's impacts to tribal water resources.

The United States has a unique trust relationship with Indian tribes. In carrying out its trust responsibility, the federal government "has charged itself with moral obligations of the highest responsibility and trust." *Seminole Nation v. United States*, 316 U.S. 286, 296 (1942). This basic principle extends to Indian water rights, which are vested property rights held in trust

[40] S. Rep. No. 111–357 (Dec. 8, 2010).
[41] S. Rep. No. 102-267 at 188-89.
[42] Attachment A at 10-14.
[43] Pub. L. No. 85-915, 72 Stat. 1762, 1764 (Sept. 2, 1958).
[44] *See e.g.*, Memorandum for Record, Application: NWS-2008-260 Pacific International Holdings LLC (PIH) (previously Pacific International Terminals, LLC), Subject: Gateway Pacific Terminal Project and Lummi Nation's Usual and Accustomed Treaty Fishing Rights at Cherry Point, Whatcom County) (May 9, 2016) (found at: http://media.bellinghamherald.com/static/downloads/GPTDecision.pdf) (last accessed Feb. 6, 2017).

by the United States for the benefit of Indian tribes.[45] And as part of its trust responsibility for Indian water rights, the United States has an obligation to preserve, protect and enforce those rights.[46]

The Tribe possesses extensive water rights to the Missouri River, its tributaries and groundwater under the *Winters* Doctrine. *Winters v. United States,* 207 U.S. 564 (1908). These rights have been recognized by the federal government.[47] The Tribe's *Winters* right carry a time immemorial priority date, which means that the Tribe's rights to water are senior as compared to its non-Indian neighbors. The Tribe's reserved water rights extend to all beneficial uses needed to make the Reservation a permanent homeland, including cultural uses, agriculture, municipal, domestic, industrial, fish and wildlife, and energy, among other uses.

Lake Oahe plays a vital role in the tribal life on the Reservation. Approximately 4,300 people on the Reservation, the majority of Reservation residents, are served by the Tribe's MR&I water system that is serviced from intakes on Lake Oahe. In addition to these homes, the waters from Lake Oahe and the MR&I system are the source of water for all the schools, community centers, hospital and public buildings, as well as the Tribe's two casinos and hotel on the Reservation. The Final EA incorrectly states that "the majority of reservation residents depend on wells water supply." Final EA at 38. This is incorrect, and the consequences of the error are significant. Based on this fundamental factual error, the Final EA then incorrectly dismisses the risk of oil spill to the Tribe and the people who live on the Reservation. The Tribe relies on waters of Lake Oahe for irrigating over 3,000 acres of land, and the nearest intake for this purpose is just seven miles downriver from the proposed Lake Oahe crossing. The waters of Lake Oahe also provide habitat for fish, wildlife, and plants important to the diet and cultural and religious practices of the Tribe. The EIS must recognize that Lake Oahe is fundamental to the health and welfare of the Tribe, fully analyze the Tribe's *Winters* rights and discuss the potential for the proposed Lake Oahe crossing to negatively impact those rights.

VI. The EIS must acknowledge the importance of the Lake Oahe and discuss the proposed project's impacts to the Tribe's cultural and religious beliefs.

In the American Indian Religious Freedom Act, Congress prescribed that it is national policy to protect the freedom of Native American people to exercise their traditional religions,

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[45] Cohen's Handbook of Federal Indian Law § 1905 at 1257 (Nell Jessup Newton ed., 2012).
[46] For example, in *Pyramid Lake Paiute Tribe of Indians v. Morton*, involving a water infrastructure project in Nevada, the Court found that the Federal trust responsibility created an obligation to protect the waters of Pyramid Lake for the Paiute Tribe. 354 F. Supp. 252, 256 (D.D.C. 1973). In finding that the Interior Department had not fulfilled its trust obligation the court stated: "The Secretary was obliged to formulate a closely developed regulation that would preserve water for the Tribe. . . . Possible difficulties ahead could not simply be blunted by a 'judgment call' calculated to placate temporarily conflicting claims to precious water. The Secretary's action is therefore doubly defective and irrational because it fails to demonstrate an adequate recognition of his fiduciary duty to the Tribe. This also is an abuse of discretion and not in accordance with law." *Id*.
[47] Attachment A at 14-16. *See also e.g.* Charles Carvell, *Indian Reserved Water Rights: Impending Conflict or Coming Rapprochement Between the State of North Dakota and the North Dakota Tribes*, 85 N.D. L. Rev. 1 (2009).

including providing access to site.[48] And Executive Order 13007 ("Indian Sacred Sites") directs each land managing Federal agency to "(1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners; and (2) avoid adversely affecting the physical integrity of such sacred sites."[49] The religious practices of the Tribe and its members, especially as they relate to the water of Lake Oahe, are further subject to protection under RFRA.[50]

The Standing Rock Sioux Tribe is home to the Hunkpapa and Sihasapa bands of Lakota Oyate and the Ihunktuwona and Pabaksa bands of the Dakota Oyate. The Tribe is a member tribe of the Oceti Sakonwin (Seven Council Fires), also known as the Great Sioux Nation. The confluence of the Cannon Ball River and the Missouri River is a site of religious and cultural significance to the Oceti Sakonwin. The Cannon Ball River was known to the Tribe's ancestors as Inyan Wakan Kagapi Wakpa (River Where the Sacred Stones Are Made). The Missouri River was known as Mni Sose (Turbulent Water). The force of those two rivers coming together formed a great whirlpool where perfectly round stones were created that are considered to be sacred to the Mandan, Arikara, Cheyenne and the Oceti Sakonwin.

The Lake Oahe area was once a place of commerce where traditional enemies camped within sight of each other. The tribes who visited this area had such a reverence for the land that no blood was spilt in this sacred place. Within this area are sacred stones where the people to this day go to pray and ask for good direction, strength and protection for the coming year. Over the years several Sundance's have taken place in this area because of the sacred nature of the rivers and the land. The Lakota/Dakota Oyate have seven sacred rites given to the Oceti Sakonwin by the creator and the Sundance is held to be one of the most sacred.

When the Army Corps constructed the dams to create hydroelectric power, that federal undertaking had an adverse effect on a traditional cultural landscape. Construction had begun north of Standing Rock and the Army Corps did not bother to tell the people. It wasn't until the water came that they realized they were flooding the river. There are many sad stories from families and communities that lived on the river bottom about the deep spiritual wound this caused. When the river bottom was lost traditional foods and medicine were also lost and that caused the people to become dependent on the Indian Health Service. Prior to that there was no diabetes, heart disease and obesity among the Oceti Sakonwin. In addition, those two rivers no longer produce the sacred stones.

The confluence of the Cannon Ball River and the Missouri River is a Traditional Cultural Landscape that contains ancient village sites, burial cairns, stone features, stone effigies and sacred sites that have a religious and cultural significance to the Tribe. Construction and the

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[48] 42 U.S.C. § 1996.
[49] 61 Fed. Reg. 26771 (May 24, 1996).
[50] Pub. L. No. 103-141, 42 U.S.C. § 2000bb. *See Burwell v. Hobby Lobby Stores, Inc.*, 134 S. Ct. 2751, 2760-62 (2014); *Holt v. Hobbs*, 135 S. Ct. 853, 859 (2015); *Haight v. Thompson*, 763 F.3d 554, 561 (6th Cir. 2014); *Yellowbear v. Lampert*, 741 F.3d 48, 55–56 (10th Cir. 2014); *Comanche Nation v. United States*, No. CIV-08-849-D, 2008 WL 4426621 (W.D. Okla. Sept. 23, 2008).

subsequent operation of the Dakota Access Pipeline will have an adverse effect on this Traditional Cultural Landscape. The Tribe's people still travel to these sacred areas, including Lake Oahe, for prayers and ceremonies and will be permanently impacted by the desecration of the area, which is central to the exercise of the Tribe's and its members' religious beliefs. The waters of the Missouri River itself are also sacred to the Tribe, a cultural and spiritual resource that is central to the Tribe's practice of religion. The EIS must acknowledge and discuss the impacts the proposed project will have on the Tribe's culture and exercise of religion.

VII. The EIS must establish a new "Purpose and Need" that takes into account the current controversy related to the Dakota Access easement and the Tribe's legal rights.

A. Purpose and Need in General.

The Purpose and Need Statement in an EIS is key because it sets the stage for consideration of the alternatives. The Purpose and Need statement should be designed to help evaluate the alternatives to be considered and to take into account the requirements of other federal statutes.

The EIS scoping process should allow for examination and consideration of the Purpose and Need that will help frame the rest of the EIS process. The Purpose and Need statement should clearly identify both the underlying need and purpose for the proposed action – what the Army is planning to accomplish, and why is it necessary – but it cannot predetermine a particular alternative as was done in the Final EA/FONSI. The Purpose and Need statement, therefore, must define what can be considered reasonable, prudent and practicable alternatives.

Table 1 below identifies the significant misconceptions and truths about Purpose and Need statements in NEPA.

Table 1. Misconceptions and Truths about NEPA Purpose and Need

Misconception about Purpose and Need	Truth about Purpose and Need
Purpose and need is expressed as one concept	Both the need and the purpose of the action should be articulated individually
Purpose and need is related to the purpose of the EIS	The need and purpose are related to the action
Purpose and need requires a long explanation of the history of the project area and associated issues	Purpose and need should be concise, based on relevant socioeconomic and scientific information, and focused on the decisions to be made

The scoping meetings early in the EIS process are an excellent means to refine or reach agreement with cooperating agencies and other participants on the basic Purpose and Need for the project. As the project's Purpose and Need is refined, a number of additional alternatives may be necessary, or others may be eliminated, thereby permitting a more focused analysis of those alternatives that more fully address the problem to be solved.

B. The EIS "Purpose and Need" must acknowledge the Tribe's rights and the current controversy over the proposed easement.

Since the Final EA was issued, the Army has determined that more rigorous analysis and evaluation of alternative routes and the Tribe's treaty rights is needed, as well as impacts related to spill impacts on those rights.[51] The Final EA treated the Purpose and Need as a unitary concept; however, it is not one thing. Defining the Purpose and the Need are two different issues each with different meanings, and the EIS process mandates they be clearly defined and disclosed.

The purpose in the EIS must include statements that recognize the Tribe's treaty rights, which can only be framed in collaboration with the Tribe. The purpose should not include planning decisions or be written so that the selection of a specific alternative is predetermined. While the Tribe understands that one of the purposes of the EIS is to evaluate the Lake Oahe crossing being proposed by Dakota Access, there must also be recognition that the United States has a legal obligation to protect tribal treaty rights and an agency cannot unilaterally abrogate or negatively impact those rights.

The need section in the EIS should be separately stated and provide a more detailed explanation, with supporting information, of the specific problems associated with both the need for the pipeline and the significance of tribal treaty and religious freedom rights. The need section should explain deficiencies or opportunities that exist currently or in the future that justify the proposed action, and explain the need to analyze and review alternative routes given the tribal treaty rights at issue. Needs should be demonstrated through specific quantitative and qualitative investigation and should enable decision-makers to evaluate alternatives by providing measurable objectives or specifications. Among other things, as part of drafting the need for federal action there should be some explanation of crude oil demand projections (that analyze and revise the projections used to establish the purpose and need in the Final EA). The need for the proposed project should also examine the potential for future development of renewable sources that may offset demand for crude oil; address the current controversy and asserted risks associated with the proposed Lake Oahe crossing. A robust discussion of the Tribe's treaty and religious freedom rights must be included and impacts to those rights must be fully evaluated against each proposed alternative.

At bottom, the EIS must recognize that the current controversy over the proposed easement has brought to light the need for further legal analysis and examination of the impacts

[51] *See supra* n.1.

that the proposed route would have on the Tribe, including the need to analyze reasonable alternatives.

VIII. The EIS must fully evaluate and analyze reasonable alternatives.

The EIS must spend adequate time identifying, developing and analyzing additional routes that would be feasible alternatives to the proposed Lake Oahe crossing. A robust discussion of how each alternative was developed must be included, and if any route is rejected, the EIS must provide sufficient information to allow the public to understand why the route was deemed infeasible. The EIS should also consider one No Action Alternative and reconsider the North of Bismarck route.

The Final EA initially considered a "trucking transportation alternative" and a "rail transportation" alternative separately but then combined these two and carried them forward throughout the document as a "No Action" alternative. Final EA at 5-6. Both of these alternatives are similar to and should again be included in a No Action alternative in the EIS because currently Bakken Crude is being transported by rail and truck, as well by other means that should also be discussed in this alternative.[52] The Final EA's discussion of both the rail and trucking alternatives provides insufficient baseline information to adequately understand the current use of trucks and rail to transport Bakken Oil. Rather in discussing the impacts of these alternatives the Final EA makes numerous conclusory statements that transporting oil through a pipeline is "a safer and more economical alternative than trucking for the volumes transported and distances covered by the [Dakota Access] Project." Final EA at 5. In other places, the Final EA implies that [Dakota Access] Project oil will be in addition to current production without any explanation. *See, e.g.*, Final EA at 6 (noting that "the [Dakota Access] Project would represent a 50 to 60% increase in the number of trains transporting crude oil out of state"). But no discussion is provided explaining how oil that will be transported through the pipeline relates to current or historical production. For example, there is little to no discussion relating to the quantity of production at the height of Bakken operations versus current production. Facts and figures are sporadically provided, but the Final EA fails to provide a comprehensive summary of baseline facts or adequately explain how not building the pipeline will increase current and historical impacts to rail and truck traffic.

Similarly, the Final EA provided insufficient information relating to the north of Bismarck route. The Final EA dismisses this route at the outset based on its proximity to "several wellhead source water protection areas" and to "protect areas that contribute water to municipal water supply wells." Final EA at 8. The Final EA also states that this route would require additional waterbody and wetland crossings and crossed "other populated PHMSA high consequence areas ("HCAs"), that are not present on the preferred route." Final EA at 8. But no information is provided to support these assertions. Moreover, although the reasons for rejecting

[52] U.S. Department of Energy, Memorandum to Members of the Public from Quadrennial Energy Review Task Force Secretarial and Energy Policy Systems Analysis Staff, "*QER Public Stakeholder Meeting: Infrastructure Constraints in the Bakken*" at 4 (Aug. 8, 2014).

the north of Bismarck route have equal application to a pipeline crossing just upstream from the Reservation, there is no discussion or comparison of the risks associated with the Bismarck route versus the risks associated with the significant horizontal directional drilling ("HDD") drilling that will occur at Lake Oahe. In short, the north of Bismarck route is summarily rejected with little justification, especially given the presence of similar facts and potential for higher risks associated with the Lake Oahe route. The EIS should re-examine and fully evaluate the feasibility of the north of Bismarck route.

Any examination of alternatives should consider whether the proposed pipeline needs to cross the Missouri River at all. The current plan has this oil pipeline cross the Missouri twice – once in the north, from east to west, and then in the south, from west to east. An EIS should address and evaluate this as part of its alternatives analysis.

Lastly, any balancing of alternatives must be fair and accurately account for the factual circumstances and impacts associated with each alternative. The EIS must consistently analyze and evaluate the characteristics and impacts of each feasible alternative.

IX. The EIS must contain sections that fully evaluate existing human and natural environmental conditions and impacts to these conditions based on each alternative route.

The Final EA/FONSI did not meet the requirements of NEPA, and was flawed because it contained inadequate information, as recognized by the Army in their memorandum of December 4, 2016.[53] The Final EA should not be used as a baseline for the EIS due to its deficiencies and the need for an analysis of viable route alternatives for the proposed project.

NEPA requires a "full and fair" and a "hard look" analysis which can only be achieved through a full disclosure of all alternatives, mitigation measures, and potential impacts related to the proposed project. Such an analysis should be conducted by identifying the qualitative and quantitative criteria necessary to more rigorously and objectively assess the significance of the effects of the project. Qualitative and quantitative criteria should be identified for each element considered important to the human and natural environment. Additionally, due to the proposed project's complexity and magnitude, the EIS must allow adequate time and opportunity for the Tribe's involvement and review by the public.

Below is a summary of relevant topics that must be included in the EIS.

A. Project Description

In describing the project, the EIS must provide consideration and analysis of a range of viable alternatives. Commenters on the Draft EA raised this question and in the response to comments prepared by the applicant stated "the company carefully considered possible route alternatives in the EA and considered other transportation options. The route with the least

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[53] *See supra* n.1.

impact has been chosen by the company." Final EA at Appendix J 1 of 19 (Table). However, the Final EA fails to disclose anything about the methodology as to how this analysis was done much less the basis on which the conclusions were reached. It is also not up to the applicant to choose the route "with the least impact"; rather, it is the federal agency's responsibility. What the project proponent considers as having the "least impact" is subjective. For example, Tables 2-1 and 2-2 are heavily relied upon using what appears to be a subjective ranking of key elements. But there is virtually no explanation of these elements in the Final EA and their relationship to the purpose and need.

Given the recent spate of pipeline leaks in the U.S. and those in relatively close proximity to the project, the EIS should also identify and analyze the risk of pipeline oil spills, the causes of such spills, the elements necessary to reduce the risk of spills (including pipeline design and operation), the measures that are needed to properly maintain, monitor and inspect the pipeline, as well as measures to ensure proper and effective response systems in the event of a spill. Specific project requirements (especially crossing techniques) should be analyzed and the best available technical engineering implemented for the protection of related surface and ground water, tributaries/upstream segments, flood plains, and other sensitive water resources.

Additionally, the EIS should provide a more robust/rigorous analysis for the natural resources of the proposed and alternative routes. Such analysis should be subject to objective independent review – by the federal government, the Tribe and the public. The EIS must also analyze impacts related to ground and surface water resources, seismic risks, soils, vegetation, taxes, employment, cultural resources, and natural resources including, but not limited to, endangered species, recreational waterways, fisheries, wildlife, and conservation lands.

B. Cumulative Effects

The conclusion that "this project will have insignificant incremental impact to other past, ongoing, or reasonably future actions of a similar nature" is flawed. Final EA at 6. The Final EA lacked the necessary diligence and "hard look" at the cumulative impacts from the project to conclude that the contribution of the project to cumulative impacts is insignificant. Therefore, the EIS must more clearly define the "area of influence" for each resource element and should evaluate the impacts of the proposed project in the context of other past, existing energy and reasonably foreseeable projects, including renewable resources and planned pipelines and their ancillary facilities. Furthermore, the EIS should study the cumulative economic impact of crude oil and wholesale fuel prices.

While a cumulative effects analysis involves assumptions and uncertainties, a comprehensive EIS scoping process, and a subsequent scoping report, will better ensure useful information is included in the project analysis and that decisions will be made based on the best and most up-to-date information and data that can be collected. Speculating on the limited potential for future projects with similar impacts as the proposed project is contrary to NEPA and impermissibly narrows the scope of the EIS analysis by excluding consideration of cumulative impacts. For example, given the magnitude of the project (570,000 barrels of crude oil per day;

three percent of U.S. total daily consumption; or about 24 million gallons), the EIS needs to examine how the project would contribute to the global/geographic context, including climate change.

C. Substantive Environmental Issues[54]

1. Water Resources

The EIS should disclose practices that will ensure pipeline integrity, including methods and monitoring that will protect water resources and should also include alternatives that not only avoid crossing the Lake Oahe, but also ensure that alternatives avoid potential impacts to water supply systems of all tribes and local municipalities dependent on the Upper Missouri River system. Additionally, the alternatives analysis must also address the way that the extended drought and record heat in the U.S. will affect the proposed project's potential impacts on water resources.

The EIS should clearly evaluate (through appropriate text, tables, and maps) the linkages between the proposed pipeline, distance to groundwater, and proximity to drinking water in the Missouri River. The EIS should include provisions for protecting groundwater, stream, and wetland resources at crossing points and along the entire route of the proposed pipeline.

2. Vegetation, Fish and Wildlife, Threatened and Endangered Species

The EIS must provide information on federally threatened, endangered and sensitive species ("TES"), species of state and tribal importance, migratory birds, and birds of prey, including bald and golden eagles, and the important habitats supporting these species. Impact analysis should specifically address the direct, indirect, and cumulative effects of pipeline construction and operation within the project action area.

Regarding federally listed species, the Army must initiate a new Section 7 Consultation with the U.S. Fish and Wildlife Service ("USFWS") and prepare a supplementary Biological Assessment ("BA") to account for any new information regarding TES and their habitats. In its letter of May 2, 2016 to the USACE Omaha District, the USFWS defines the action area to be analyzed for federally listed species as the entire pipeline.[55] Consultation must include consideration of new information the Tribe has obtained regarding the spill and safety risks from HDD and pipeline operation for route alternatives crossing the Missouri River. The EIS should provide the supplemental BA within an appropriate timeframe to allow public comment.

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[54]Other issues environmental issues not discussed here may need to be evaluated in the EIS depending on the alternative routes that are examined.

[55] Letter to Martha Chieply, Regulatory Branch Chief, USACE Omaha District from Kraig McPeek, Project Leader, USFWS Illinois and Iowa Field Office and Scott Larson, Project Leader, USFWS North and South Dakota Field Office (May 2, 2016).

The EIS should address the impact of temporarily disrupted habitat connectivity during construction activities and provide mitigation measures including native plant restoration and invasive species treatment.

The Army should consult with the USFWS, Standing Rock Sioux Tribe Game and Fish Department ("SRST-GFD"), and the North Dakota Game and Fish Department ("NDGFD"), respectively, to ensure compliance with the Migratory Bird Treaty Act ("MBTA") and the Bald and Golden Eagle Protection Act ("BGEPA"). Mitigation and protection measures in the EIS should be analyzed to ensure against the take of migratory birds; address the potential impacts of noise from construction, blasting, and operation of pump stations; loss of habitat resulting from blasting and ripping of rock outcrops used for nesting and foraging; developing conservation plans to help avoid or minimize potential project impacts to birds; and incorporate these conservation measures into a Migratory Bird Conservation Plan to help avoid and minimize expected impacts to birds and their habitats.

The Army should consult with the SRST-GFD regarding potential impacts to the Tribe's treaty hunting and fishing rights, and to ensure the Tribe's rights under the BGEPA are protected as eagles and other raptors have special significance to the Tribe. The USACE should also conduct consultation with the Tribe's Tribal Historic Preservation Officer ("THPO") regarding historic and medicinal plants and their location.

3. Soils and Geology

The EIS must fully consider how the following soil-related conditions impact or are impacted by pipeline construction and operation: drought, increased soil temperatures over the pipeline, increased risk of soil subsidence and instability, and difficulty of revegetating the pipeline right-of-way in drought conditions.

4. Climate Change

The Final EA makes only one mention of climate change and states that the "contribution of the Proposed Action to greenhouse gas emissions during construction would be considered a minor indirect impact to climate change." Final EA at 95. CEQ's draft guidance in 1997 called on federal agencies to consider climate change impacts in NEPA reviews.[56] It then provided more detail on when and how to do so in its 2010 and 2014 guidance, as well as in its Final

[56] *See supra* n.21.

Guidance adopted on August 1, 2016.[57] Courts have found that agencies must consider climate-related impacts in their NEPA reviews.[58]

While the Guidance states that it "is not a rule or regulation, . . . does not change or substitute for any law, regulation, or other legally binding requirement, and is not legally enforceable," some courts have referenced agency guidance documents as persuasive authorities.[59] Notably, even prior to the issuance of CEQ's Guidance or its earlier drafts, courts faulted federal agencies for insufficiently taking into account climate change in NEPA reviews.[60] For example, in *Center for Biological Diversity v. National Highway Traffic Safety Administration*, the U.S. Court of Appeals for the Ninth Circuit held that "the impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct," and remanded an agency action for further NEPA analysis.[61]

Given the substantial volume of crude proposed to be transported in the pipeline, the EIS should, therefore, evaluate the proposed project's cumulative impact on climate change. Specifically, the analysis should include the way in which the proposed project enables the processing and consumption of Bakken light crude and increases impacts from flaring. The EIS should also include a lifecycle analysis of greenhouse gas ("GHG") emissions throughout the proposed project's entire life, including development, processing, and consumption of crude resources, which should be treated as contingent on (and resultant from) the proposed project.

Other considerations for the EIS should be the impacts of future climate change, particularly increased rainfall and potential flooding, and higher temperatures, on the proposed project's design (e.g., deeper river crossings, appropriate spill response capabilities, physical and chemical impacts of higher temperatures). Lastly, the EIS should include a discussion of existing conditions in the areas that will be affected by the proposed Project, including how those conditions will change during its projected lifespan from the intensifying impacts of climate change as required by 40 C.F.R. § 1502.15.

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[57] *See* CEQ, *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions,* (Feb. 18, 2010) (found at: http://media.washingtonpost.com/wp-srv/nation/documents/post-carbon/NEPA-Guidance-FINAL-02182010.pdf) (last accessed Feb. 7, 2017); CEQ *Revised Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews,* 79 Fed. Reg. 77802 (Dec. 24, 2014); CEQ, *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* (Aug. 1, 2016) (found at: https://www.energy.gov/sites/prod/files/2016/08/f33/nepa_final_ghg_guidance.pdf) (last accessed Feb, 7, 2017).
[58] Linda Luther, *Overview of CEQ Guidance on Greenhouse Gases and Climate Change*. Congressional Research Service Insight (Aug. 18, 2016) (IN10554).
[59] 79 Fed. Reg. 77802; Congressional Research Service. *Legal Status of CEQ's Final Guidance on Climate Change in Environmental Reviews under NEPA* CRS Reports & Analysis Legal Sidebar (Aug. 17, 2016).
[60] *Id.*
[61] 538 F.3d 1172, 1217 (9th Cir. 2008).

5. Health, including Social and Psychological Impacts

The EIS should discuss and evaluate impacts to the health, safety, and well-being of the Tribe and tribal communities that would be impacted by the project – not simply the area where the pipeline would be constructed, but also those living downstream of the pipeline's crossing of the Missouri River. Overall, the EIS should address the more severe adverse impacts from an oil spill on communities (like those at Standing Rock), many of which live below the poverty level and have limited access to alternatives in the event of an oil spill.

Consideration must also be given to the impacts on the Tribe of historic losses of tribal lands and the resources on which the tribal members depend. The consequence of these activities has led to persistent psychological trauma that has been documented to last for generations within families. The Final EA failed to recognize and address these historical trauma concerns.

Recently, the American Psychological Association ("APA"), the nation's leading scientific and professional organization representing the field of psychology, published their professional opinion regarding historical trauma and its relationship to the psychological impacts of the Dakota Access Pipeline.[62] APA has also reiterated their position in a statement to President Trump in response to the recent Presidential Memorandum on the Dakota Access Pipeline, and previously co-authored a letter to former President Obama.[63] The significance of this issue has also garnered attention from the national and international media, as this is an issue of international and global importance.[64] These opinions and statements document the considerable psychological research on historical trauma and how it impacts tribal communities. The EIS must acknowledge historical trauma and analyze the impacts of the proposed project on the Tribe's communities.

Additionally, the Final EA failed to acknowledge the lack of emergency responders and infrastructure in the Lake Oahe area to adequately address safety hazards from any pipeline spills and leaks given the remoteness of the communities, and lack of emergency response and safety

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[62] Susan H. McDaniel, President, American Psychological Association, *Historical Trauma in the Present: Why APA Cannot Remain Silent on the Dakota Access Pipeline* (Nov. 16, 2016). (found at: https://psychologybenefits.org/2016/11/16/why-apa-cannot-remain-silent-on-the-dakota-access-pipeline/) (last accessed Feb. 6, 2017).

[63]American Psychological Association, *APA Urges Trump Administration to Safeguard Standing Rock Sioux in Response to Memorandum on Dakota Access Pipeline* (Jan. 26, 2017) (found at http://www.apa.org/news/press/releases/2017/01/trump-dakota-pipeline.aspx) (last accessed Feb. 6, 2017); Letter to President Barack Obama by Susan H. McDaniel, PhD, President, APA and Jacqueline Gray, PhD, President of Society for the Psychological Study of Culture, Ethnicity and Race (Nov. 14, 2016) (found at: http://www.apa.org/pi/oema/resources/pipeline-letter.pdf) (last accessed Feb. 7, 2017).

[64] Colby Itkowitz. *Here's Why the American Psychological Association Weighed in on Trump's Standing Rock Decision.* Washington Post (Jan. 26, 2017). (found at: https://www.washingtonpost.com/news/inspired-life/wp/2017/01/26/heres-why-the-american-psychological-association-weighed-in-on-trumps-standing-rock-decision/?utm_term=.8b0a25a1fc72) (last accessed Feb. 6, 2017).

personnel in the area. The Final EA said nothing about any of these issues and they must be evaluated and addressed in the EIS.

X. The EIS must provide a robust analysis of issues associated with pipeline construction, operation, and risks associated with each alternative route.

A. Bakken Crude Oil

The EIS must specifically discuss the physical attributes of Bakken oil and the human health and environmental impacts and risks associated with Bakken oil. The proposed pipeline will transport oil produced from the Bakken and Three Forks plays in North Dakota and portions of South Dakota. EA at 3. Oil produced from these areas is Bakken oil, which is "a light sweet crude, as compared to heavier crudes produced from conventional domestic reservoirs."[65] Bakken oil general contains chemical compounds of: ethyl benzene, benzene, naphthalene, N-Hexane, Xylenes and hydrogen sulfide.[66] The presence of benzene in Bakken oil poses significant negative human health and environmental impacts if spilled or released into the environment.[67]

Bakken crude is known as having a "high-value . . . with a high gasoline yield" but because it has low density it is "relatively volatile, with typically 30°-42° American Petroleum Institute ("API") gravity and 0.13% sulfur."[68] Because Bakken oil is light crude it is considered to be highly volatile and highly soluble in water.[69] This is because "lighter-end petroleum constituents often include flammable gases such as methane, ethane, propane and butanes and may also include hydrogen sulfide."[70] In addition,

> Bakken crude oil has a low viscosity, and will quickly spread and evaporate. It will quickly adhere to suspended solids in the water column, forming unstable emulsions. Recoverable product may persist for only 4 to 8 hours, depending on size of spill. Its lighter components volatilize, posing human health hazard near spill location, and the low molecular weight PAHs (i.e., naphthalene to

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[65] U.S. Department of Energy, Memorandum to Members of the Public from Quadrennial Energy Review Task Force Secretarial and Energy Policy Systems Analysis Staff, "*QER Public Stakeholder Meeting: Infrastructure Constraints in the Bakken*" at 3 (Aug. 8, 2014) (found at: https://energy.gov/sites/prod/files/2014/08/f18/FINAL-%20BAKKEN%20BRIEFING%20MEMO_8%208.14.pdf) (last accessed Feb. 4, 2017).
[66] Bakken Crude Oil, Distributed by the NW Area Committee (Feb. 2015) (found at: http://www.rrt10nwac.com/Files/FactSheets/150213064220.pdf) (last accessed Feb. 4, 2017).
[67] *See e.g.*, World Health Organization, *Exposure to Benzene: A Major Public Health Concern* (2010) (found at: http://www.who.int/ipcs/features/benzene.pdf) (last accessed Feb. 4, 2017).
[68] *Id*.
[69] *See e.g.*, CB&I Environmental and Infrastructure, Inc., *Bakken Crude Oil Spills – Response Options and Environmental Impacts*, Prepared for Commonwealth of Massachusetts Dept. of Environmental Protection, at E-1; 6-4 (June 2015) (found at: http://www.mass.gov/eea/docs/dep/cleanup/laws/bakken-crude-oil-spills-response-options-and-environmental-impacts.pdf) (last accessed Feb. 4, 2017).
[70] Id. at 3-2.

phenanthrene range) dissolve in the water column causing toxic aquatic effects (NOAA, 2014).[71]

Thus, given what is known about Bakken oil, the EIS must contain a robust discussion of the physical attributes of Bakken oil and analyze the risks associated with Bakken oil spills, including for example, evaluating, based on varying weather and conditions associated with various pipeline routes, the evaporation rate, boiling point, flammability, solubility and specific gravity of Bakken oil.[72] All of these issues should be discussed as they relate to each alternative pipeline route and the applicable conditions associated with pipeline operation and maintenance. The EIS should also discuss how a release of Bakken Oil will impact the surrounding environment. Evaluation of these factors is directly related to any risk analysis and potential environmental, human health and economic impacts as a result of a spill that would be associated with the proposed and alternative pipeline routes.[73]

B. Landslide Risks

When selecting and evaluating possible pipeline routes, special care must be taken in the EIS to assess the risk of landslide if terrain introduces such potential risks. For example, if a pipeline route (grade, soil, weather) can expose a pipeline to massive landslide risk (aka breakaway landslide), the pipeline needs to be rerouted out of the landslide threat area. Attempts may be made to downplay or dismiss such bona fide risk from poor route choices by attempting to create the impression that engineering approaches (e.g. thicker pipe, shielding, etc.) may mitigate such quick acting massive force abnormal loading threats. A simple evaluation of the possible impact of thousands, if not millions of tons, of force on a steel tube should readily demonstrate such mitigation claims are without merit. Massive landslide can place quick acting forces on pipelines that most likely result in pipeline rupture, large, high rate oil releases.

In evaluating proposed pipeline route options for the Dakota Access Pipeline, prudence requires that the Army Corps also evaluate the potential for massive landslide not only on the federal easement crossing Lake Oahe, but also whether such landslide risks can occur on nearby, off federal easement lands, where a pipeline release from possible landslide could result in oil reaching Lake Oahe. If massive landslide risks also exist for such nearby proposed right-of-way, the pipeline route needs to be changed to a route where such a landslide threat is not present.

Lastly, massive landside is usually associated with threats where the terrain most likely exhibits sudden breakaway or very quick acting land movement, placing considerable forces on any infrastructure that might have been unwisely sited in the possible impact area (such as a pipeline). There is a subset of landside threat, land creep, associated with less steep grade and

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[71] *Id*. at E-3.
[72] *See id.* at E-2 to E-3; 6-4.
[73] *See e.g.*, Great Lakes Commission des Grands Lacs, *Crude Oil Transport: Risks and Impacts*, Issue Brief 3 (Feb. 20, 2015) (found at: http://glc.org/files/projects/oil/GLC-Oil-Report-IssueBrief3-20150220.pdf) (last accessed Feb. 4, 2017).

soil type where the terrain moves much slower than a breakaway landslide. Such slower moving land creep risks can still result in pipeline failure, but the threat may not place such quick acting forces on a pipeline. Land creep does not always result in pipeline failure, but if not adequately addressed, land creep can still result in oil release, either a lower rate leak or a high rate release rupture.

C. Engineering Processes

The EIS must fully discuss and evaluate engineering processes for construction risk mitigation. The Final EA is deficient in its discussion and analysis of engineering processes. This must be remedied in the EIS. Below are some examples of things that the EIS must evaluate as they relate to the engineering process associated with the proposed pipeline.

The Final EA cites to various standards for the design, construction, testing, operation, and maintenance of the pipeline. *See* Final EA at 17-18. The EIS must adequately address the gaps between broad industry standards referenced in the Final EA and discuss actual known limitations to existing technology.

The Final EA also discusses construction risk mitigation but only as it relates to the trenched section of the pipeline (before and after the HDD section) at the Lake Oahe Crossing. There is no discussion of potential construction risk, mitigation and technology limitation on the actual HDD section. The EIS must include a discussion and evaluation of construction risk, mitigation and technology limitations associated with the HDD section of the pipeline.

The Final EA also appears to limit the proposed project implementation plans to only address things like storm water runoff and inadvertent release of drilling mud. The EIS should contain a more thorough examination of the proposed project's implementation plans.

A more rigorous discussion must also be included in the EIS to explore, capture and address known limitations to engineering processes. While not exhaustive, some examples of potential engineering process and technology limitations that the EIS should evaluate are discussed below.

- Current federal pipeline safety regulations only require that 10 % of welds (i.e., girth welds) be fully nondestructively tested.[74] While this may be adequate for a typical trenched application above land, it may not be sufficient for a HDD application that will have extreme limited operational mitigation for any weld defects detected during operational phases. Although the operator has apparently agreed to 100 nondestructively test girth welds, additional clarification in quality assurance/quality control, or QA/QC, should be defined to assure the welds are of the highest quality. The EIS should address needs for additional requirements in this area due to the critical nature of the proposed HDD section.

[74] 49 C.F.R. § 195.234(d).

- QA/QC is not a federal requirement of standards for pipeline construction for monitoring or reporting. The EIS must address this limitation as it relates to risks associated with the pipeline construction, operation and maintenance.

- Pigs that monitor the condition of the pipe are often categorized as in-line inspection tools or sometimes "smart pigs." While no discussion on smart pigs and application limits are discussed in detail in the Final EA, it's important to note that smart pigs are very limited for inspection of girth weld areas along the pipe. There are approximately 178 girth welds in the proposed pipe length that will go under Lake Oahe (~7500 ft from entry to exit and 40 ft sections). Those girth welds are potentially the most likely root cause of future leaks due to corrosion, micro crack propagation over time or pin hole propagation that eventually lead to long slow leaks in the HDD section, so proper field assessment of all such girth welds is critical for this route alternative. The Final EA, however, does not address how to detect potential leak volumes from girth welds. This is most likely because there is no instrumentation that can adequately detect long slow leaks along the HDD section of the proposed pipeline. Long slow leaks are considered acceptable by industry standards because even the best practices cannot limit their existence. However, the EIS must acknowledge and address the risk of long slow leaks and related short and long term impacts to the surrounding environment and the Tribe.

- Long slow leaks are perhaps one of the two biggest risks associated with HDD applications under a fresh water body like Lake Oahe. The long slow leak leads to soil contamination and saturation around the HDD that is eventually carried into the fresh water aquifers located just above the HDD and eventually directly into the lake itself. In all likelihood, the first real detection of this will come visual observation after the oil has contaminated the critical waters.

- The method of leak detection selected for a pipeline depends on a variety of factors including pipeline characteristics, product characteristics, instrumentation and communications capabilities, and economics. Pipeline systems vary widely in their physical characteristics and operational functions, and no one external or internal method is universally applicable or possesses all of the features and functionality required for perfect leak detection performance. Small leaks on large pipelines are very difficult to detect through these automated and measurement methods.[75] Therefore, the EIS must acknowledge this and discuss risks and impacts associated with these limitations.

The Final EA also incorrectly assumes no risks to plant, flora and fauna because the project utilizes an HDD pipe under Lake Oahe. *See* Final EA at 117-125; Table 8-2. As a result, the Final EA does not address the potential impacts to aquatic and land wildlife, plants, flora and

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[75] Argonne National Laboratory, *Overview of the Design, Construction, and Operation of Interstate Liquid Petroleum Pipelines* (November, 2007).

fauna. But once contamination of soil occurs from oil spills, the Tribe's reliance on the production of its traditional needs will forever be altered and this will negatively impact the Tribe. This was one of the most significant oversights perceived during the original damming of the Missouri River to create Lake Oahe. Prior to 1950 the Tribe didn't deal with many of the health issues it deals with today as a direct result of the changes along the shores of the river. Long slow oil leaks will further alter this balance from contamination of soils, even if the water levels remain within safe levels. The EIS must fully identify all risks and impacts to the surrounding environment as a result of spills or leaks, not just water contamination.

D. HDD Construction

An HDD construction method is proposed for the crossing at Lake Oahe. Installation of 30" steel pipe, for DAPL Project will require that the pipeline be placed in a 48" drilled opening provided by the HDD method. The 30" pipeline is then pulled into the opening while being supported and lubricated with bentonite clay and water mixtures. The length of the crossing is 7,500' (2,290 m), of which approximately 5,420 ft (1650 m) beneath the bed of Lake Oahe, the crossing depth is 92 ft. The method of HDD construction is described in the Final EA. *See* Final EA at 19. The EIS needs to more fully evaluate the risks associated with HDD construction under the proposed Lake Oahe crossing.

The "Guidelines for Installation of Utilities Beneath Corps of Engineers Levees Using Horizontal Directional Drilling"[76] by the Army Corps of Engineers mentions that "[a]lthough horizontal directional drilling could offer cost-effective, safe alternatives to installing pipelines with open trenching, the Corps Engineer has no standard guidelines allowing the installation of pipelines with this construction method. As a result, permitting policies are extremely varied and some districts strictly prohibit the use of this technique."[77] The EIS must address this lack of clear standard guidelines, especially considering that HDD under Lake Oahe has even higher sensitivities than most projects.

The Final EA relegates critical technical descriptions and engineering processes during construction to an appendix. *See* Final EA Appendix B at 291-297. While the information contained is a reasonable high level discussion of basic HDD construction method, it is more of a typical description that could be considered 'catalogue' type information. While it's a good basic reference, the Final EA totally lacks a critical discussion of post construction inspection and mitigation of problems resulting from the construction. There are a number of critical post construction potential risks that have been identified and summarized by the Tribe's EIS expert team of consultants. For example, there is a possibility of HDD pipe damage as a result of getting stuck during installation due to geological formation risks/difficulties (i.e., collapse, clay

[76] Latorre, Carlos A, Wakeley, Lillian D.Conroy, Patrick J., *Guidelines for installation of utilities beneath Corps of Engineers levees using horizontal directional drilling*, (Jun. 2002) (found at: http://acwc.sdp.sirsi.net/client/en_US/search/asset/1003339;jsessionid=8D772D7BF93DE75553F01A2AAF3CFFC4.enterprise-15000) (last accessed Feb. 6, 2017).
[77] *Id.*

swelling, hard rock encountered in the HDD tunnel). The EIS must include an exhaustive study of these post construction risks, identification of damage to the pipeline external wall, girth welds and internal pipe wall from over-pulling, scraping and other various factors. A detailed mitigation or remediation plan that avoids any acceptable leak volumes from the HDD pipeline section should specifically be addressed in the EIS.

The Final EA completely lacks citations or examples of similar HDD applications with similar applications involving crude oil as a product fluid in a large diameter pipe (30” pipe in a 48” open borehole assembly) over a long well bore (7500’) under a fresh water lake. A preliminary investigation did not result in any such examples anywhere in the world in operation as of early 2016 and certainly no long term operational examples. The EIS must investigate and analyze known industry examples and risks that have resulted in significant constructional challenges experienced in the past during HDD construction, including discussing past challenges or incidents involving pipelines constructed using HDD technology.

The proposed HDD profile under Lake Oahe is designed to provide 92 feet of cover below the bottom of the lake. The length of the crossing is 7,500' (2,290 m), of which approximately 5,420 ft (1650 m) occurs beneath the bed of Lake Oahe, the crossing depth is 92 ft. Both the Final EA and known past industry experiences show that HDD crossing activity will face many challenges and risks, and there are always risk of things like pipeline collapse, hydraulic fracture, loss of drilling fluids, and hole collapse. When considering the depth and length of the proposed Lake Oahe crossing, the construction is a very ambitious target even for HDD construction. Moreover, Lake Oahe is a freshwater lake and classified as Class I water under Section 33-16-02.1 of the North Dakota Administrative Code. The HDD crossing process has many potential risks during both construction and operation phase that can significantly impact this resource. The Final EA does not adequately identify or discuss risks and mitigation measures. While risks can be managed by good applications, low risk never means no risk. The Final EA does not adequately identify or discuss risks. The EIS must comprehensively discuss and analyze associated risks related to HDD at the proposed Lake Oahe crossing and identify alternative routes.

E. Safety Standards

As discussed below, the EIS Must Assess Risks using Key Modern Industry Safety Standards to Prevent Pipeline Failures.

1. The Army Corps Must Use Consensus Technical Standards in the EIS;

Federal law has long recognized the importance of the use of voluntary consensus technical standards to carry out agency decision-making. The National Technology Transfer and Advancement Act of 1995[78] states that

> Except as provided in paragraph (3) of this subsection, all Federal agencies and departments shall use technical standards that are developed or adopted by voluntary consensus standards bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments.[79]

The language in the Act broadly addresses the use consensus technical standards[80] and is not limited to the use of standards by agencies that have been incorporated by reference in federal regulations. Federal agencies such as the Army Corps are required to use relevant consensus standards in their activities, including in the EIS process.

2. Pipeline and Hazardous Materials Safety Administration standards are flawed.

The EIS should recognize that the Pipeline and Hazardous Materials Safety Administration ("PHMSA") standards are dated and significant oil spill incidents are increasing. PHMSA, the U.S. pipeline safety regulator, has recognized the importance of voluntary consensus standards in its oversight activities into its regulatory scheme.[81] However, as a regulator PHMSA has focused on incorporating consensus technical standards by reference.[82] The PHMSA standards that are applicable to the Dakota Access Pipeline, as a hazardous liquid pipeline,[83] are predominately out of date with key modern standards not incorporated by reference. For example, the oil industry trade association, the American Petroleum Institute ("API") is a key developer of pipeline safety and technical consensus standards. API has issued several new and revised standards recently in response to lessons learned from recent pipeline incidents or recommendations from agencies such as the National Transportation Safety Board ("NTSB"). API typically develops standards on a five-year cycle with all the pipeline operations

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[78] The National Technology Transfer and Advancement Act of 1995, Pub. L. No. 104-113, 110 Stat. 775 (Mar. 7, 1996).
[79] *Id.* § 12(d)(1). Exceptions are provided in Section 12(d)(3) for standards that are "inconsistent with applicable with federal law or otherwise impractical." It will be argued herein that these exceptions do not apply.
[80] The Act defines "technical standards" as "performance based or design-specific technical specifications and related management systems practices." *Id.*
[81] Pipeline and Hazardous Materials Safety Administration, Standards Incorporated by Reference (found at: http://phmsa.dot.gov/portal/site/PHMSA/menuitem.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=d5af714769382310VgnVCM1000001ecb7898RCRD&vgnextchannel=f0b8a535eac17110VgnVCM1000009ed07898RCRD&vgnextfmt=print) (Last accessed Feb. 4,2017).
[82] *Id.*
[83] 49 C.F.R. § 195.3.

standards on its website issued or reaffirmed since 2010 - with most dating from 2013.[84] However, for PHMSA standards, over three-quarters date from 2009 or earlier and lack incorporation of important modern standards containing more rigorous requirements relevant to this proposed pipeline.

As the PHMSA Inspector General recently noted: "PHMSA has long faced criticism from Congress for its lack of timeliness in implementing statutory requirements—mandates—and recommendations from NTSB, GAO, and OIG reports."[85] The 2016 report noted that while PHMSA has made some progress, 60 of NTSB's 118 recommendations remain open, 25% of regulatory mandates were unimplemented, and 75% of its mandated deadlines were missed.[86] The numerous mandates and recommendations were largely initiated as a result of serious pipeline incidents and a record of numerous pipeline loss of containment incidents. These incidents have risen even in areas designated as High Consequence Areas by PHMSA with additional integrity management requirements. The well-respected Pipeline Safety Trust has noted that "[r]ecent incident data that suggest there is something fundamentally wrong with the integrity management program as implemented today: significant incidents on hazardous liquid lines *within HCAs* are on a rising trend over the past several years"[87] *See* Figure 1.

[84] API Publications Catalog, Transportation (found at: http://www.api.org/~/media/Files/Publications/Catalog/2016_catalog/05%20Transportation.pdf?la=en) (last accessed Feb.4, 2017).

[85] Insufficient Guidance, Oversight, and Coordination Hinder PHMSA's Full Implementation of Mandates and Recommendations, U.S. Department of Transportation, Office of Inspector General, Report Number: ST-2017-002, at 1 (Oct. 2017) (found at https://www.oig.dot.gov/sites/default/files/PHMSA%20Progress%20Implementing%20Mandates%20and%20Recommendations%20Final%20Report%5E10-14-16.pdf) (last accessed Feb. 4, 2017).

[86] *Id.* at 2.

[87] PST Comments regarding Hazardous Liquid Pipeline Safety, docket number PHMSA-2010-0229, at 1 (Jan. 7, 20160 (found at: http://pstrust.org/wp-content/uploads/2015/10/US-Docket-PHMSA-2010-0229-PST-comments-20160107.pdf) (last accessed Feb. 4, 2017).

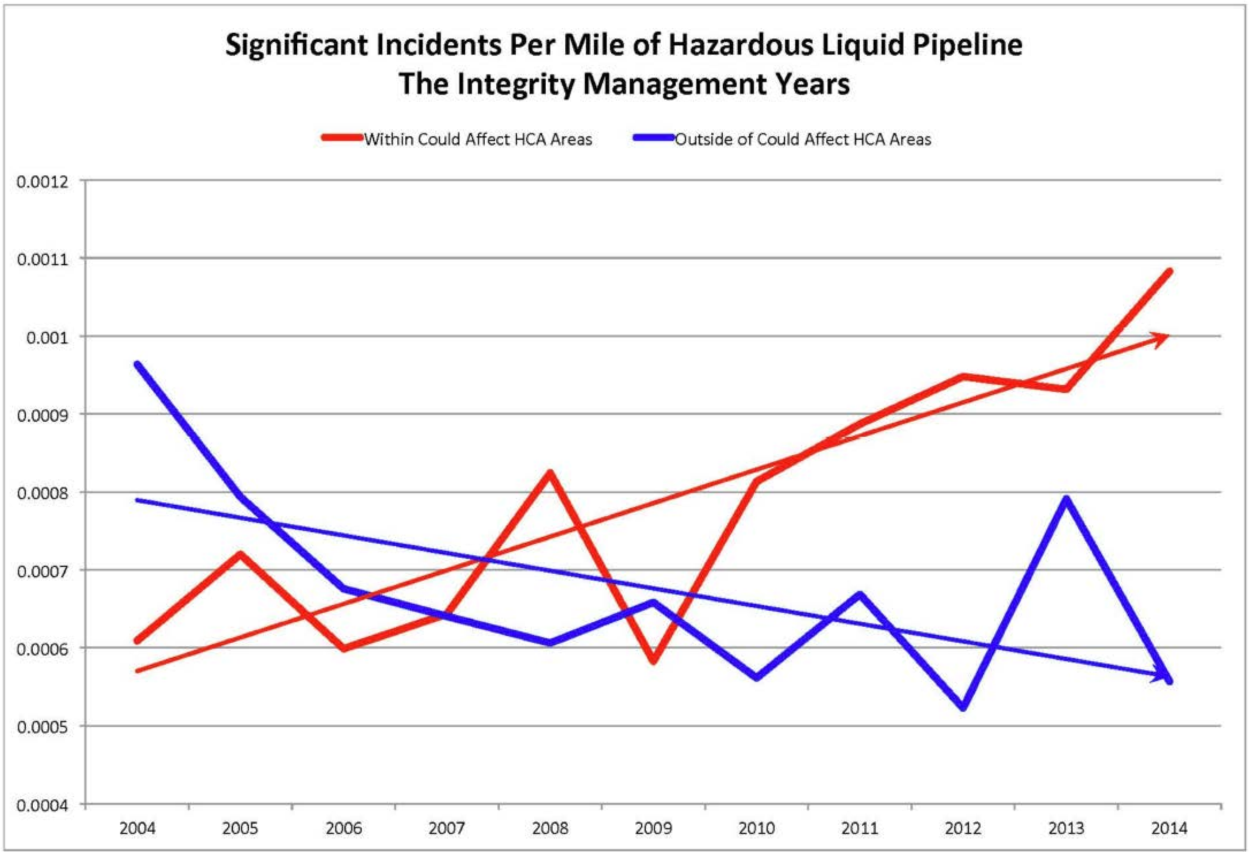

Figure 1. Significant Incidents Per Mile of Hazardous Liquid Pipeline (Pipeline Safety Trust, 2015)[88]

3. **The EIS must apply rigorous and updated safety standards to the pipeline to adequately assess risks.**

The Final EA failed to apply standards that are key to the Lake Oahe crossing. This must be corrected as part of the EIS process. It is especially important that up-to-date consensus technical standards and rigorous review of the risks of oil spill be conducted for the proposed Lake Oahe crossing. The Final EA simply asserts that:

> To prevent pipeline failures resulting in inadvertent releases, Dakota Access would construct and maintain the pipeline *to meet or exceed industry and governmental requirements and standards.*

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[88] *Id.* at 2.

Final EA at 48 (emphasis added). The pipeline has to comply with federal and industry standards whether or not an environmental review is done. The purpose of NEPA, and the need for an EIS, is to provide specific detailed information about which standard will be met and how those will be met by this specific proposed project. The Final EA did not do this. The Final EA fails to cite or apply more rigorous modern safety and environmental standards applicable to pipelines that need to be addressed in the EIS. Instead the Final EA utilized dated industry standards and accepted vague assurances of protection rather than a more rigorous examination of the serious risks of the Lake Oahe pipeline crossing. More recent safety and environmental standards applicable to pipelines require a more robust risk assessment and use of the most effective hazard controls where possible such as the avoidance of the hazard – here the risky lake Oahe crossing. A rigorous assessment of oil spill risks and alternatives in an EIS is even more critical given the safety record of the pipeline operator and industry in general. A full EIS using up-to-date consensus technical standards is required for the proposed project to ensure protection the public health and environment – anything less should be rejected.

Some examples of standards that must be applied to the proposed pipeline during the EIS process are listed below:

- API RP 1173, Pipeline Safety Management System Requirements (2014) establishes pipeline safety requirements for managements systems such as risk management, incident investigation, and safety assurance that are critical for preventing incidents such as loss of containment. The Final EA's treatment of these issues lacks any reference to specific standard requirements or effective application of these safety management systems.

- API RP 1133, Guidelines for Onshore Hydrocarbon Pipelines Affecting High Consequence Floodplains (reaffirmed 2010) establishes criteria for the safe design, construction, operation, maintenance, etc. in high consequence floodplains.[89] API RP 1133 includes, for example, criteria for block and check valves to minimize loss of containment in floodplains. Issues raised by the RP include the location of the valves based upon a risk analysis, the pipelines elevation profile, and access and availability of utilities during flood conditions. None of these issues are effectively discussed in the Final EA.

- API RP 1175, Pipeline Leak Detection Program Management states explicitly that the standard has been developed in response to mandates and recommendations from Congress and the NTSB to improve identified weaknesses in pipeline leak detection.[90] For example a 2012 PHMSA third party study found one type of leak detection systems—supervisory control and data acquisition, or SCADA — detected hazardous liquid leaks 28 percent of the time. Another type of system, called computational pipeline

[89] A high consequence floodplain is defined in API RP 1133 as a "floodplain adjacent to a waterway used in commercial navigation." The floodplain adjacent to Lake Oahe meets this definition as it is used for commercial activities.
[90] API RP 1175, Pipeline Leak Detection Program Management, at 4 (2015)

> monitoring or CPM, had a detection rate of 20 percent.[91] Additionally for hazardous liquid pipelines, "SCADA or CPM systems by themselves did not appear to respond more often than personnel on the ROW or members of the public passing by the release incident."[92] It should be noted that the Final EA states that Dakota Access is implementing SCADA and CPM to address leak detection making it critical that the EIS address system performance. The recently adopted API RP 1175 includes guidance on the selection of leak detection systems and establishing performance criteria for system effectiveness. The Final EA lacks any meaningful discussion on the actual implementation of SCADA and CPM and fails to reference the use of any performance metrics to assess effectiveness. This is particularly important where - as with the Lake Oahe crossing - some other means of leak detection such as visual observations and over-flights will be ineffective given the HDD construction 92 feet under the lake.

In addition, the Final EA lacks any discussion of critical management systems for preventing loss of containment incidents. This must be included in the EIS. It is well-established that chemical accidents are the result of management system failures.[93] As a result and in response to recommendations from the NTSB and GAO, API developed API RP 1173 Pipeline Safety Management System Requirements. The issuance of 1173 has been hailed as a critical step forward for incident prevention in the pipeline sector. The standard was developed over 20 years after similar management system standards were issued by API in upstream exploration and production and downstream in crude oil and petrochemical processing. API 1173 is applicable to pipeline operations including designing, constructing, operating, maintaining and managing the pipeline to prevent major accidents and continually improve pipeline safety. Three critical management system requirements provided for in API RP 1173, risk management, incident investigation and safety assurance are seriously deficient in the Final EA. API RP 1173 is a critical technical standard to apply in the EIS.

The Final EA also lacks an adequate formal risk assessment of the risks of an oil spill or rupture and fails to cite any consensus technical standard that is applied as the basis for the risk assessment methodology. For example, applying the risk management requirements of API RP 1173, the Final EA fails to effectively identify risks based upon data or prior operating experience.[94] The Final EA also does not examine where the threats may be potentially interactive with increased risk.[95] The Final EA's prevention and mitigation descriptions are also vague and lack adequate information on issues considered. For example, the Final EA fails to adequately examine control systems, equipment operability, adequacy of procedures, training, drills and accountabilities, adequacy of leak detection and incident response time and capability

[91] Pipeline and Hazardous Materials Safety Administration, Final Report 12-173, Leak Detection Study, at 2-11 (2012)
[92] *Id.*
[93] The Center for Chemical Process Safety (CCPS), Guidelines for Investigating Chemical Process Incidents, 2nd Ed., at 9 (2003).
[94] API RP 1173, Pipeline Safety Management System Requirements at 10 (2014).
[95] *Id.*

to organize an incident command system - as required by API RP 1173.[96] These deficiencies are particularly troubling for a High Consequence Area such as the Lake Oahe crossing, and must be corrected in the EIS process.

The Final EA lacks any analysis of the adequacy of the prevention and mitigation measures to control the risk of an oil spill. API RP 1173 states:

> In selecting measures to reduce risk, preference shall be given to prevention measures that eliminate or reduce the likelihood and consequences of incidents. Operators shall implement the selected measures and evaluate their impact on risk.[97]

This requirement in the RP is consistent with the concept of the hierarchy of hazard controls that is a required element of the ANSI/AIHA Standard Z10-2012 Occupational Health and Safety Management Systems (ANSI Z10). This standard is developed by a diverse group of organizations that include major oil and chemical companies and government agencies such as OSHA, NIOSH and the U.S. Army.[98] ANSI Z-10 requires the use of the hierarchy of controls that like API RP 1173 prioritize prevention and the elimination or avoidance of hazard in the risk assessment and control process.[99] ANSI Z10 states:

> The hierarchy provides a systematic way to determine the most effective feasible method to reduce risk associated with a hazard. When controlling a hazard, the organization should first consider methods to eliminate the hazard or substitute a less hazardous method or process. This is best accomplished in the concept and design phases of any project.[100]

Many severe oil spill risks for the Lake Oahe crossing have been identified including the high susceptibility of landslides, the risks to mechanical integrity from the HDD activities, and the lack of effective leak detection systems. In applying the hierarchy of controls as required by consensus technical standards, the priority preventative measure would be the avoidance of the Lake Oahe crossing. Avoidance of the crossing in an HCA would eliminate the risk to the Tribe and the sensitive lake environment. The Final EA fails to apply API RP 1173 and ANSI Z10 and does not effectively evaluate or prioritize the avoidance of the risky Lake Oahe crossing in comparison to other alternatives. This is a major failing of the Final EA and the critical safety analysis required by API RP 1173 and ANSI Z10 need to be a key component of the EIS analysis.

[96] *Id.* at 11.
[97] *Id.*
[98] ANSI/AIHA Standard Z10-2012 Occupational Health and Safety Management Systems, at Introduction (2012). Z10 is broadly applicable to industry and organizations.
[99] *Id.* at 15.
[100] *Id.*

An EIS should also describe the incident investigation system and implementation of lessons learned by the companies involved in the construction and operation of the proposed project. API RP 1173 requires an incident investigation management system that applies any investigation recommendations "to the risk assessment and control processes, including a review of the consequence and likelihood of failure, current procedures, training and resource allocation."[101] The Final EA fails to address these vital issues. This is particularly important given the safety record documented by the PHMSA database and citation history for the Dakota Access operator Sunoco Logistics. PHMSA data for hazardous liquid pipelines shows that Sunoco has experienced 276 incidents resulting in over $53 million in property damage from 2006-2016.[102] Moreover, the amount of property damage has significantly increased over the last three years.[103] To adequately address oil spill risks, the EIS needs to examine the safety record of Sunoco to determine from this serious history of incidents if the recommendations and lessons learned have been effectively implemented and transferred to the proposed project's risk assessment with the needed controls in place.

Given the serious risks of the Lake Oahe crossing and the incident history of Sunoco it is crucial that the EIS examine performance data related to the risk of oil spill from the key parties involved in the project. API RP 1173 requires effective safety assurance including audit, performance evaluation and the use of leading and lagging key performance indicators that provide data on progress toward effective risk management and incident prevention.[104] The Final EA lacks any data related to safety assurance. While the Final EA vaguely asserts prevention activities and states certain risks will be "mitigated" it fails to provide performance data to buttress its claims. Useful performance metrics could include the number of undetected mechanical integrity failures per distance unit of pipeline, percentage of spills detected by leak detection systems, and response times for leak detection and staging of Incident Command Systems compared to worst case discharge projections. The EIS needs to move beyond an examination of company claims and activities by examining actual performance data to properly assess the effectiveness of pipeline risk of oil spill as required by API RP 1173.

XI. Conclusion

The Final EA is fundamentally inadequate and cannot be relied upon to grant the proposed easement to cross Lake Oahe. As such, the EIS process should move forward and can be done expeditiously within the spirit of the Presidential Memorandum. During this process, it is imperative that the issues discussed above be included and that the Tribe be a cooperating agency.

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[101] API RP 1173, Pipeline Safety Management System Requirements at (2014).
[102] PHMSA Sunoco Incident and Mileage Operator Information, All Incidents – Hazardous Liquid Pipeline Systems 2006-2016 (found at: https://primis.phmsa.dot.gov/comm/reports/operator/OperatorIM_opid_18718.html?nocache=7702#_OuterPanel_tab_2) (last accessed Feb. 5, 2016)
[103] *Id.*
[104] API RP 1173, Pipeline Safety Management System Requirements at 15-17 (2014).

Appendix D

ToxServices, LLC

GreenScreen® for Safer Chemicals Assessment Report:
DAPL Bakken Pipeline Crude Oil
A Report Prepared for the Natural Resources Defense Council

December 2017

**GREENSCREEN® FOR SAFER CHEMICALS ASSESSMENT REPORT:
DAPL BAKKEN PIPELINE CRUDE OIL**

Prepared For:

NRDC

Prepared by:

ToxServices LLC

December 7, 2017

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INTRODUCTION

This report assesses human health, environmental, and physical hazards posed by DAPL Bakken pipeline crude oil, based on an assessment of chemical ingredients commonly disclosed on safety data sheets (SDS) for this type of crude oil. Chemical hazard assessment is a systematic process of assessing and classifying hazards across a spectrum of endpoints and severity (Whittaker and Heine 2013). Endpoints pertain to a specific adverse effect that is linked to mortality (death), morbidity (illness), or physical properties. Hazard endpoints are measured by changes in *in vivo*, *in vitro*, or *in silico* test systems, and/or changes in physiochemical parameters. The Globally Harmonized System of Classification and Labelling of Chemicals ("GHS") defines an endpoint as a physical, health, and/or environmental hazard (UN 2017). Relevant to other life cycle impacts, the inherent hazard of a chemical cannot be changed, and although it may be possible to reduce or minimize exposure (and subsequently reduce risk), it is challenging to accurately, precisely, or realistically assess exposure across all phases of a chemical's lifecycle.

Bakken crude oil, also known as "North Dakota Sweet" or "North Dakota Light" crude oil, is a crude oil with low sulfur content that is refined into gasoline, diesel fuel, and/or jet fuel (NW Area Committee 2015). Bakken crude oil is produced from oil fields in northwest North Dakota and northeast Montana in the United States, as well as southwest Manitoba and southern Saskatchewan in Canada, an area named the Bakken Formation. The Bakken Formation is one of the largest contiguous deposits of oil and natural gas in the United States. A map of this area of production is shown in Figure 1, below. The oil is drawn from the formation through a process known as fracturing, or "fracking".

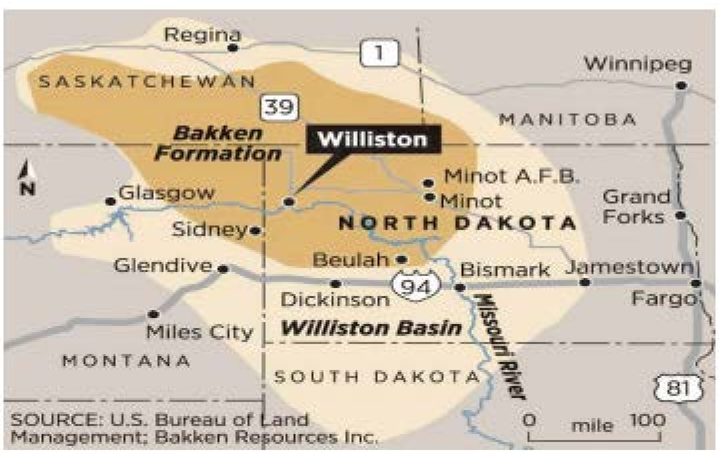

Figure 1: Map of Production of Bakken Crude Oil (NW Area Committee 2015)

Bakken crude oil contains light flammable gasses such as butane (C4) and propane (C3), which can readily ignite, and may also contain flammable hydrogen sulfide gas in the vapor space of a tank car. The high quantity of light end petroleum hydrocarbons increases vapor pressure, lowers the flashpoint, and lowers the initial boiling point of Bakken crude oil. Bakken crude oil is not necessarily uniform in its physical and chemical properties, which may vary from one oilfield to another, or even within wells in the same oilfield. Bakken crude oil is moderately volatile and has a specific gravity of less than 1 (i.e., will float on water) (NW Area Committee

2015). Approximately three-fourths of Bakken crude oil is transported by rail (NW Area Committee 2015). A typical composition of Bakken crude oil is shown in Figure 2, below.

Chemical Name	CAS#	Percent	Chemical Name	CAS#	Percent
Crude Oil (Petroleum)	8002-05-9	100 by weight	N-Hexane	110-54-3	<5 by volume
Ethyl Benzene	100-41-4	<3 by weight	Xylenes	1330-20-7	<1 by weight
Benzene	71-43-2	<1 by weight	Hydrogen Sulfide	7783-06-4	<0.2 by volume
Naphthalene	91-20-3	0 - 0.9 by weight	Total Sulfur:		< 0.5 wt%
Crude oil, natural gas and natural gas condensate can contain minor amounts of sulfur, nitrogen and oxygen containing organic compounds as well as trace amounts of heavy metals like mercury, arsenic, nickel, and vanadium. Composition can vary depending on the source of crude.					

Figure 2: Typical Composition of Bakken Crude Oil (NW Area Committee 2015)

HAZARD ASSESSMENT OF DAPL BAKKEN PIPELINE CRUDE OIL

ToxServices screened seven chemicals present in DAPL Bakken pipeline crude oil in the following sequential order:

1. ToxServices's internal library of GreenScreen® assessments was searched for current and available GreenScreen® assessments.
2. If a GreenScreen® assessment was not available in ToxServices's internal library, or if it was expired[1], ToxServices searched the Pharos Chemical and Material Library to obtain a publicly available GreenScreen® assessment.
3. If a GreenScreen® assessment was not identified using steps 1-2 above, a Pharos GreenScreen® List Translator (LT) score was assigned (please see below for a description of LT scores).
    - If the chemical was identified as an LT-1 or LT-P1, the basis for the LT-1 or LT-P1 classification was included, and the ECHA C&L Inventory (ECHA 2017) was searched to assign GHS Hazard Statements (H statements)[2] for relevant endpoints.
    - If the chemical was identified as an LT-UNK chemical or was not present in Pharos GreenScreen® List Translator screening, the ECHA C&L Inventory (ECHA 2017) was searched to assign H Statements[3] for relevant endpoints.

GreenScreen® for Safer Chemicals Chemical Hazard Assessment

The GreenScreen® for Safer Chemicals is a chemical screening method designed to identify less hazardous chemicals using a standardized approach that considers both human health endpoints and environmental fate and toxicity endpoints (CPA 2017b). A GreenScreen® chemical hazard assessment can identify substances that are inherently less hazardous for humans and the environment, and effectively manages chemical risk by reducing hazard rather than controlling exposure to potentially toxic chemicals.

[1] GreenScreen® assessments expire 3 years after the date of evaluation.
[2] Reported H statements reflect harmonized H statements or those reported by self-notifiers to the ECHA C&L Inventory (ECHA 2017).
[3] Reported H statements reflect harmonized H statements or those reported by self-notifiers to the ECHA C&L Inventory (ECHA 2017).

Among the chemicals present in DAPL Bakken crude oil, ToxServices evaluated chemicals against endpoints relating to human health effects, aquatic toxicity, and flammability/ reactivity, and each hazard endpoint was given a score of Very Low hazard (vL), Low hazard (L), Moderate hazard (M), High hazard (H), or Very High hazard (H). As shown in Figure A-1 in Appendix A, the combination of hazards for different endpoints translates into an overall GreenScreen® benchmark score for a chemical, which ranges from Benchmark 1 to 4, along with different sub-benchmark scores depending on the specific hazard combination leading to the overall benchmark score (for example, there are a total of seven different hazard combinations, ranging from Benchmark 2a to 2g, that can result in a Benchmark 2 score). These sub-benchmark scores provide insight into the specific types of health, environmental, and/or flammability/reactivity hazards posed by a chemical. Hazard scores for the screened endpoints were collectively evaluated in GreenScreen® Version 1.3 to assign one of the four different benchmark scores (from CPA 2017c):

- Benchmark One: Avoid (Chemical of High Concern)
- Benchmark Two: Use (But Search for Safer Substitutes)
- Benchmark Three: Use (But Still Opportunity for Improvement)
- Benchmark Four: Prefer (Safer Chemical)
- In addition, chemicals that have insufficient data or data gaps for specific hazard endpoints were assigned a Benchmark score of Unspecified ("U").

GreenScreen® List Translator

Clean Production Action's GreenScreen® List Translator comprises over 850 lists from 36 primary authoritative and screening sources that include national and international regulatory and hazard lists, influential NGO lists of chemicals of concern (screening lists), authoritative scientific bodies, European Risk and Hazard Phrases, and chemical hazard classifications by countries using the Globally Harmonized System of Classification and Labeling System (CPA 2017a). Pharos developed GS List Translator software to automate the GS List Translator (Pharos 2017). The purpose of the List Translator is to screen chemicals to identify those that would achieve a GreenScreen® Benchmark 1 score if a full GS assessment were performed; therefore, the scope of the LT tool is limited to capturing Benchmark 1 chemicals only. GreenScreen® assessments are required to determine if the final GreenScreen® Benchmark score is greater than 1. Pharos checks all of the lists in the List Translator with the exception of the U.S. Department of Transportation (U.S. DOT) lists (U.S. DOT 2008a,b) and these should be checked separately in conjunction with running the Pharos query.

Pharos List Translator (LT) scores fall under one of three classifications, as defined below:

- ***LT-1:*** *Likely Benchmark 1* – A LT-1 chemical score is based on clear agreement among authoritative lists that it is a Chemical of High Concern and is likely to be a Benchmark 1 chemical using the full GreenScreen® method.
- ***LT-P1:*** *Possible Benchmark 1* – A LT-P1 chemical score translates to Possible BM1 and reflects the presence of the chemical on Screening A or B lists and some uncertainty about the classification for key endpoints. Further research is needed to determine if the chemical is indeed a GreenScreen® Benchmark 1.
- ***LT-U:*** *Unspecified Benchmark* – A LT-U chemical score indicates that there is insufficient information to provide a Benchmark score for the chemical. Typically, only

known hazardous chemicals are found on authoritative and screening lists. However, lack of presence on hazard lists can also mean that the hazard of the chemical has not been fully characterized. Therefore, the resulting conclusion using the List Translator is that the Benchmark score is Unspecified pending full GreenScreen® review.

- Note that a full GreenScreen® assessment is needed to determine if a chemical is a Benchmark 2, 3, or 4.

GREENSCREEN® HAZARD ASSESSMENT RESULTS

ToxServices assessed human health and environmental hazards of the following chemicals present in DAPL Bakken pipeline crude oil:

- Crude Oil (Petroleum) (CAS #8002-05-9)
- Ethyl Benzene (CAS #100-41-4)
- Benzene (CAS #71-43-2)
- Naphthalene (CAS #91-20-3)
- n-Hexane (CAS #110-54-3)
- Xylenes (CAS #1330-20-7)
- Hydrogen Sulfide (CAS #7783-06-4)

Individual chemical hazard assessment scores (GreenScreen® Benchmark or List Translator Scores) are presented in Table 1, below, along with a discussion of these scores. In addition, Table 1 identifies GHS hazard statements derived from EU harmonized hazard classifications for these chemicals. Table 2 presents the hazard summary table for all chemicals assessed in this report. Appendix A, Figure A-1 provides the GreenScreen® benchmark scoring algorithm. Appendix B provides an executive summary of the GreenScreen® chemical assessments.

A number of chemicals present in Bakken Crude oil are LT-1 or GreenScreen® Benchmark 1 chemicals, indicating a high hazard to human health and/or the environment.

Human Health Hazard Assessment

Group I Human Health Hazards

The GreenScreen® methodology groups human health endpoints into two subcategories. Group I Human Health endpoints include carcinogenicity, mutagenicity, reproductive toxicity, developmental toxicity, and endocrine activity. GreenScreen® Group I Human Health endpoints carry more weight than other human health endpoints (i.e., the Group II and II* Human Health endpoints, discussed below) in the Benchmarking process, as these hazards lead to serious human health outcomes, can occur at low doses, and may transfer across generations. This weighting is consistent with national and international regulations (CPA 2017b).

- Crude oil (petroleum), the major component of Bakken crude oil, is an LT-1 chemical due to its carcinogenicity hazard. Crude oil is a presumed carcinogen based on limited evidence of skin tumors in animals following dermal exposure, and insufficient evidence of an increase in the incidence of cancer in human studies and case reports. In addition, crude oil is listed on the TEDX list of Potential Endocrine Disruptors.
- Ethyl benzene, present at <3% in Bakken crude oil, is a GreenScreen® Benchmark 2 chemical, and has Moderate hazards for carcinogenicity (due to evidence of increased incidence of lung and liver adenomas following inhalation exposures and renal tubule adenomas following oral exposures in animals, and listings by authoritative bodies),

developmental toxicity (due to reductions in fetal body weight and increased incidence of fetal skeletal variations in the presence of maternal toxicity, minor neurodevelopmental effects observed in animals, as well as a listing by an authoritative body), and endocrine activity (due to effects to hormone levels accompanied by uterine changes, and endocrine organ effects in animals studies) (Pharos 2017).

- Benzene, present at <3% in the mixture, is a Benchmark 1 chemical due to high hazards for all but one of the Group I Human Health endpoints. High scores were assigned for cancer (due to case reports and cohort studies of leukemia's in humans as well as being listed by multiple authoritative bodies as a known human carcinogen), mutagenicity (due to evidence of mutagenicity and clastogenicity in both *in vitro* and *in vivo* studies as well as being listed by multiple authoritative bodies), reproductive toxicity (due to ovarian menstrual disturbances observed in women, evidence of toxicity to reproductive organs and sperm effects in animals, and listings by authoritative bodies), and developmental toxicity (due to reduced pup weight and ossification delay observed in animals, and a listing by an authoritative body). Benzene is a Moderate hazard for endocrine activity due to its presence on the TEDX list of Potential Endocrine Disruptors (ToxServices 2014a).
- Naphthalene, present at up to 0.9% in Bakken crude oil, is a Benchmark 1 chemical due to its carcinogenic potential. Evidence of respiratory tumors was observed in animals following inhalation exposure to naphthalene, and it is listed by multiple authoritative bodies as a known carcinogen. Naphthalene received Moderate scores for mutagenicity (due to evidence of a clastogenic mode of action in *in vitro* and *in vivo* studies), and endocrine activity (due to its presence on the ChemSec SIN List of endocrine disruptors and the TEDX list of Potential Endocrine Disruptors). Insufficient data were available to assess its reproductive toxicity (Pharos 2017).
- n-Hexane is a Benchmark 2 chemical based on its Moderate hazards for carcinogenicity (due to evidence of liver and adrenal tumors in animals), reproductive toxicity (due to listings by multiple authoritative bodies), developmental toxicity (due to effects on fetal weights and listings by authoritative bodies), and endocrine activity (due to its presence on the ChemSec SIN List of endocrine disruptors and the TEDX list of Potential Endocrine Disruptors) (ToxServices 2014b).
- Xylenes (commercial mixed xylene), present at <1%, is a Benchmark 1 chemical due to its developmental toxicity. Xylenes received a High score for developmental toxicity due to equivocal experimental evidence of reduced fetal weight, skeletal malformations and behavioral impairments in animals, and a listing by an authoritative body. Additionally, xylenes received a Moderate score for endocrine activity due to its presence on the TEDX list of Potential Endocrine Disruptors and evidence in animal studies (ToxServices 2014c).
- Hydrogen sulfide is an LT-P1 chemical due to its potential endocrine activity (listed on TEDX list of Potential Endocrine Disruptors). However, a full GreenScreen® is required to fully assess its Benchmark Score.

Group II and II Human Health Hazards*

Group II and II* Human Health hazard endpoints in a GreenScreen® include acute mammalian toxicity, single and repeated dose systemic toxicity, single and repeated dose neurotoxicity, skin and respiratory sensitization, and skin and eye irritation. The Group II Human Health endpoints represent those that are based on single exposures and have scores ranging from Low to Very High, while the Group II* Human Health endpoints represent those that are based on repeated exposures and have scores ranging from Low to High (CPA 2017b).

- Crude oil (petroleum) was not classified with any harmonized H statements for the Group II and II* Human Health endpoints; however, the lack of data is not equal to a lack of hazards. A full GreenScreen® is required to fully assess its Group II and II* Human Health hazards.
- Ethyl benzene, a Benchmark 2 chemical, has a moderately hazardous toxicity profile in terms of Group II and II* Human Health endpoints, based on Moderate scores for acute toxicity, systemic toxicity (due to respiratory irritation and effects to the liver and hematology), and eye irritation. However, it has a Very High hazard for neurotoxicity due to its ototoxicity potential, and a High hazard for skin irritation.
- Benzene, a Benchmark 1 chemical, has a Very High hazard for systemic toxicity (single dose) due to pulmonary effects observed in humans, and a High hazard for systemic toxicity (repeated dose) due to evidence of adverse effects to hematopoietic organs observed in humans. Benzene also received a High score for neurotoxicity (repeated dose) based on clear evidence of neurotoxicity in animals and humans, and a Moderate score for neurotoxicity (single dose) based on transient narcotic effects observed in humans. In addition, benzene has a High hazard for both skin and eye irritation (ToxServices 2014a).
- Naphthalene, a Benchmark 1 chemical is moderately toxic following acute exposures, and has a Very High hazard for systemic toxicity (single dose) due to evidence of hemolytic anemia in humans, and a High hazard for systemic toxicity (repeated dose) due to adverse effects to the olfactory epithelium following inhalation exposures. Naphthalene additionally possess a Moderate hazard for producing transient narcotic effects following acute exposures, skin sensitization and skin irritation (Pharos 2017).
- n-Hexane, a Benchmark 2 chemical, has a moderately hazardous toxicity profile in terms of Group II and II* Human Health endpoints, based on Moderate scores for systemic toxicity (due to respiratory irritation and effects to the kidney, changes in body weight and evidence of nasal lesions in animal studies), neurotoxicity (due to transient narcotic effects and clear evidence of neurotoxicity in animals following repeated exposures) and eye irritation. n-Hexane has a High hazard for skin irritation (ToxServices 2014b).
- Xylenes, a Benchmark 1 chemical, is moderately toxic following acute exposures, and has a Very High hazard for systemic toxicity (single dose) due to evidence of severe respiratory irritation in animals. Xylenes also poses a Moderate hazard for neurotoxicity (due to transient narcotic effects and clear evidence of neurotoxicity in animals following repeated exposures) and is a High hazard for both dermal and ocular irritation (ToxServices 2014c).
- Hydrogen sulfide, an LT-P1 chemical, is highly acutely toxic via the inhalation route of exposure and is classified with H330: Fatal if inhaled. It was not classified with any additional harmonized H statements for the Group II and II* Human Health endpoints. A

full GreenScreen® is required to fully assess its Group II and II* Human Health hazards and assign a Benchmark Score.

Environmental Toxicity and Fate Hazard Assessment

Based on the available GreenScreen® assessments, the constituents of Bakken crude oil have some environmental concerns, with aquatic toxicity presenting the greatest hazard. Crude oil, however, the major component of Bakken crude oil is a PBT chemical, indicating a high environmental hazard. Nevertheless, low persistence and bioaccumulation potential for many of the other constituents of Bakken crude oil helps mitigate concern over their individual potential environmental hazards.

- Crude oil (petroleum) is an LT-1 chemical as it is a possible PBT chemical. Indicating it is a high hazard for persistence, bioaccumulation and toxicity.
- Ethyl benzene is highly toxic to aquatic organisms both the short and long term, and has a Moderate hazard for persistence based on its half-lives in air and soil. However, it is a Low hazard for bioaccumulation as demonstrated by experimental data. Therefore, ethyl benzene is not considered a PBT, vPT, vBT, or vPvB chemical.
- Benzene is highly toxic to aquatic organisms both short and long term, however, it has Very Low Hazards for both persistence and bioaccumulation based on experimental data. Therefore, benzene is not considered a PBT, vPT, vBT, or vPvB chemical.
- Naphthalene, is highly toxic to aquatic organisms both the short and long term, and has a Moderate hazard for persistence based on modeling results. However, it is a Low hazard for bioaccumulation as demonstrated by experimental data in aquatic vertebrates. Therefore, naphthalene is not considered a PBT, vPT, vBT, or vPvB chemical.
- n-Hexane is highly toxic to aquatic organisms both short and long term, however, it has a Very Low Hazard for persistence and a Low hazard for bioaccumulation based on modeling results. Therefore, n-hexane is not considered a PBT, vPT, vBT, or vPvB chemical.
- Xylenes (commercial mixed xylene) is highly toxic to aquatic organisms. Xylenes has a Low Hazard for persistence and a Very Low hazard for bioaccumulation based on experimental data with support from modeling results. Therefore, xylenes is not considered a PBT, vPT, vBT, or vPvB chemical.
- Hydrogen sulfide poses a hazard to the environment as it is classified with H400: Very toxic to aquatic life. It is important to note H statements are not assigned for the persistence and bioaccumulation endpoints, and therefore, a full GreenScreen® is required to fully assess its environmental hazards and assign a Benchmark Score.

Physical Hazards Assessment

Physical hazard endpoints in a GreenScreen® include reactivity and flammability. In general, the constituents of Bakken crude oil do not present a high hazard for reactivity, but many are highly hazardous flammable chemicals.

- Crude oil (petroleum) was not classified with any harmonized H statements for the physical hazards. However, the high quantity of light end petroleum hydrocarbons in Bakken crude oil increases its vapor pressure, lowers its flashpoint, and lowers its initial boiling point (NW Area Committee 2015).

- Ethyl benzene is a Low hazard for both reactivity and flammability.
- Benzene poses a High hazard for flammability as it is a GHS Category 2 flammable liquid (flash point less than 23ºC, boiling point greater than 35ºC), and is associated with H225: Highly flammable liquid and vapor. Benzene poses a Low hazard for reactivity.
- Naphthalene poses a Low hazard for reactivity and a Moderate hazard for flammability.
- n-Hexane poses a High hazard for flammability as it is associated with H225: Highly flammable liquid and vapor. n-Hexane poses a Low hazard for reactivity.
- Xylenes (commercial mixed xylene) poses a Low hazard for reactivity and a Moderate hazard for flammability.
- Hydrogen sulfide poses a High hazard for flammability as it is associated with H220: Extremely flammable gas. No harmonized H statements were identified for the reactivity endpoint for hydrogen sulfide. A full GreenScreen® is required to fully assess its Benchmark Score.

Table 1: GreenScreen® Assessment Scores for Chemicals in DAPL Bakken Crude Oil

Chemical Name (CAS Number)	Percentage	GreenScreen® Benchmark Score[a,b,c]/List Translator Score	GHS Hazard Statement(s)[c]	GreenScreen® Rating
Crude Oil (CAS #8002-05-9)	100 by wt	LT 1	H350: May cause cancer	Avoid – Chemical of High Concern
Ethyl Benzene (CAS #100-41-4)	< 3% by wt	Benchmark 2[4]	H225: Highly flammable liquid and vapor H332: Harmful if inhaled H304: Maybe harmful if swallowed and enters airways H373 (hearing organs): May cause damage to organs through prolonged or repeated exposure	Use but Search for Safer Substitutes
Benzene (CAS #71-43-2)	<1% by wt	Benchmark 1	H225: Highly flammable liquid and vapor H315: Causes skin irritation H319: Causes serious eye irritation H304: Maybe harmful if swallowed and enters airways H340: May cause genetic defects H350: May cause cancer H373: May cause damage to organs through prolonged or repeated exposure	Avoid – Chemical of High Concern

[4] Ethyl benzene, version 1.2 GreenScreen® was identified in the Pharos database and was performed by Rosenblum Environmental in 2015.

Table 1: GreenScreen® Assessment Scores for Chemicals in DAPL Bakken Crude Oil				
Chemical Name (CAS Number)	**Percentage**	**GreenScreen® Benchmark Score[a,b,c]/List Translator Score**	**GHS Hazard Statement(s)[c]**	**GreenScreen® Rating**
Naphthalene (CAS #91-20-3)	0 – 0.9% by wt	Benchmark 1[5]	H302: Harmful if swallowed H351: Suspected of causing cancer H400: Very toxic to aquatic life H410: Very toxic to aquatic life with long lasting effects	Avoid – Chemical of High Concern
n-Hexane (CAS #110-54-3)	<5% by volume	Benchmark 2	H225: Highly flammable liquid and vapor H315: Causes skin irritation H304: Maybe harmful if swallowed and enters airways H336: May cause drowsiness or dizziness H373: May cause damage to organs through prolonged or repeated exposure H411: Toxic to aquatic life with long lasting effects H361f: Suspected of damaging fertility	Use but Search for Safer Substitutes
Xylenes (CAS #1330-20-7)	<1% by weight	Benchmark 1	H226: Flammable liquid and vapor H312: Harmful in contact with skin H315: Causes skin irritation H332: Harmful if inhaled	Avoid – Chemical of High Concern
Hydrogen Sulfide (CAS #7783-06-4)	<0.5% by volume	LT-P1	H220: Extremely flammable gas H330: Fatal if inhaled H400: Very toxic to aquatic life	N/A
[a]Please see Appendix A, Figure A-1 for a GreenScreen® benchmark scoring algorithm.				
[b]Please see Appendix B for an executive summary of each GreenScreen® hazard assessment.				
[c]Please see Table 2 for the hazard table of each assessed chemical.				

[5] Naphthalene, version 1.2 GreenScreen® was identified in the Pharos database and was performed by NSF International in 2014. Although the assessment has expired because it was performed over 3 years ago, the Benchmark score is unlikely to change.

Table 2: Hazard Summary for Chemicals in DAPL Bakken Crude Oil																							
		Group 1 Human Health					Group II and II* Human Health									Ecotox.		Fate		Physical			
Chemical	CAS #	Carcinogenicity	Mutagenicity	Reproductive	Developmental	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic	Chronic Aquatic	Persistence	Bioaccumulation	Reactivity	Flammability	**GreenScreen® Benchmark Score/Pharos List Translator Results**	Source
								s	r*	s	r*												
Crude oil	8002-05-9	**H - H350**	#	#	#	Possible H	#	#	#	#	#	#	#	#	#	Possible PBT				#	#	**LT-1**	Pharos 2017
Ethyl benzene	100-41-4	**M**	*L*	*L*	*M*	**M**	**M**	*M*	**M**	**vH**	*M*	*L*	DG	*H*	*M*	**H**	*H*	*M*	**L**	*L*	**L**	**Benchmark 2**	Pharos 2017
Benzene	71-43-2	**H**	**H**	**H**	**H**	*M*	**L**	**vH**	**H**	**M**	**H**	**L**	*L*	**H**	**H**	**H**	**H**	**vL**	**vL**	*L*	**H**	**Benchmark 1**	ToxServices 2014a
Naphthalene	91-20-3	**H**	**M**	DG	**L**	*M*	**M**	**vH**	**H**	*M*	DG	*M*	DG	*M*	**L**	**vH**	**H**	**M**	**L**	**L**	*M*	**Benchmark 2**	Pharos 2017
n-Hexane	110-54-3	*M*	**L**	**M**	**M**	*M*	**L**	*M*	**M**	**M**	**M**	*L*	DG	**H**	*M*	**H**	*H*	*vL*	*L*	*L*	**H**	**Benchmark 2**	ToxServices 2014b
Xylenes	1330-20-7	**L**	**L**	**L**	*H*	*M*	**M**	*H*	**L**	**M**	**M**	*L*	DG	**H**	**H**	**H**	**M**	**L**	**vL**	*L*	**M**	**Benchmark 2**	ToxServices 2014c

Table 2: Hazard Summary for Chemicals in DAPL Bakken Crude Oil

		Group 1 Human Health					Group II and II* Human Health									Ecotox.		Fate		Physical			
Chemical	CAS #	Carcinogenicity	Mutagenicity	Reproductive	Developmental	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic	Chronic Aquatic	Persistence	Bioaccumulation	Reactivity	Flammability	**GreenScreen® Benchmark Score/Pharos List Translator Results**	Source
								s	r*	s	r*												
Hydrogen Sulfide	7783-06-4	#	#	#	#	Possible H	**vH - H330**	#	#	#	#	#	#	#	#	**vH - H400**	#	#	#	#	**H - H220**	**LT-P1 (Human and/or Aquatic Toxicity and/or Persistence and/or Bio-accumulation)**	Pharos 2017; ECHA 2017

Note: Bold H statements (e.g., **H350**) represent harmonized H statements identified in the ECHA C&L Inventory. Italicized H statements (e.g., *H350*) reflect those reported by self-notifiers to the ECHA C&L Inventory.

Note: Please see Appendix D for a list of H statements and their meanings.

CONCLUSION

ToxServices assessed human health, environmental, and physical hazards posed by DAPL Bakken pipeline crude oil, based on an assessment of chemical ingredients commonly disclosed on safety data sheets (SDS) for this type of crude oil. In terms of human health hazards posed by constituents of Bakken crude oil, high hazards were identified for various human health endpoints for all of the identified constituents of Bakken crude oil. This mixture's primary health hazard is Bakken crude oil's potential carcinogenicity. Crude oil, the major component of Bakken crude oil, is a presumed carcinogen and is classified as such by authoritative bodies. Other constituents of Bakken crude oil are also carcinogenic, including benzene and naphthalene. Besides carcinogenicity, all constituents of Bakken crude oil are potentially endocrine active, and are listed on the TEDX list of Potential Endocrine Disruptors. High hazards assigned for these and other priority health effect endpoints indicate that exposure to Bakken crude oil can lead to serious human health effects that can occur at low doses and may transfer across generations. Additional human health hazards posed by constituents of Bakken crude oil include neurotoxicity, systemic toxicity, and skin and eye irritation.

In terms of environmental hazards posed by constituents of Bakken crude oil, all of the identified constituents of Bakken crude oil pose a hazard to the ecosystem. Toxicity to aquatic organisms is of particular concern, as each constituent of Bakken crude oil is aquatically toxic. Crude oil, which is the major component of Bakken crude oil, is a PBT chemical, indicating a high hazard for persistence, bioaccumulation, and toxicity.

In terms of physical hazards, Bakken crude oil possess a high hazard for flammability. As Bakken crude oil is a "light, sweet" oil, it contains a high quantity of light end petroleum hydrocarbons that increases the mixture's vapor pressure, lowers the flashpoint, and lowers the initial boiling point of Bakken crude oil. Additionally, the presence of hexane and benzene in Bakken crude oil increases this mixture's flammability, as both constituents are highly flammable.

In order to move away from the use of hazardous mixtures such as Bakken crude oil, it is critical to classify the potential toxicity of its constituent chemicals. Various definitions of toxicity exist in the published literature, and although they identify slightly different definitions, they all relate to the ability of a substance to cause an adverse change in an organism from normality, which may or may not be reversible (Woolley and Woolley 2017). A key factor influencing the toxicity of any type of substance (whether chemical, biological, radiological, or physical substance) is the level or degree of exposure. Additionally, toxic effects in an organism will not be manifested by a substance or its transformation product(s) unless that substance or its transformation product(s) reaches appropriate sites in an organism at a concentration and length of time sufficient to produce a toxic effect. Whether a toxic response occurs is a function of the chemical and physical properties of that chemical, the exposure scenario, how the chemical is metabolized in an organism, the concentration of the active form of the chemical at a target site within the organism, and the overall susceptibility of the organism (Eaton and Gilbert 2013).

This report evidences the toxic potential of Bakken crude oil, and indicates that this mixture has the potential to harm humans and wildlife, both during transportation and processing.

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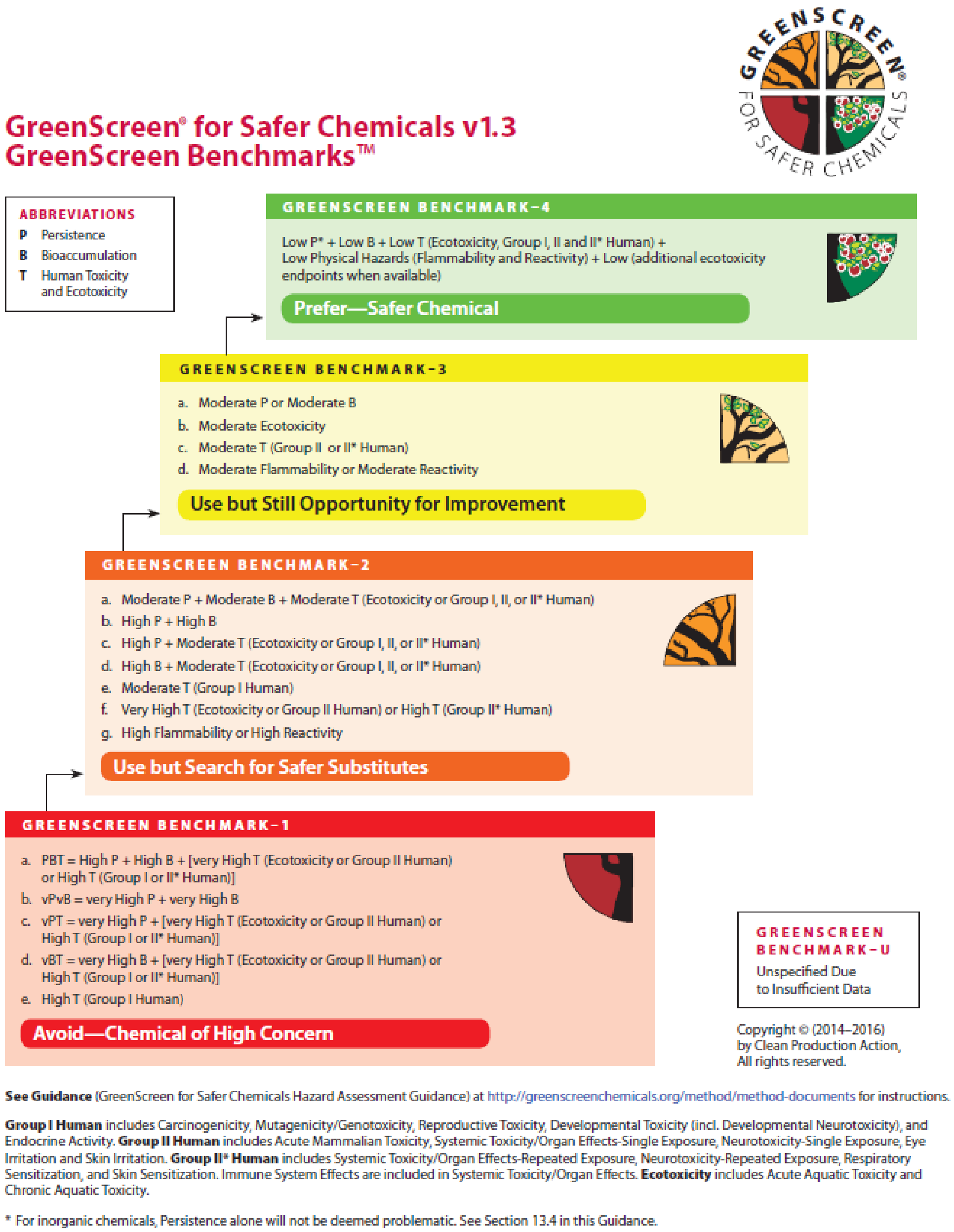
APPENDIX A: GREENSCREEN® BENCHMARK FRAMEWORK

Figure A-1: CPA Benchmarks (From CPA 2017c)



APPENDIX B: GREENSCREEN® EXECUTIVE SUMMARIES AND PHAROS OUTPUTS

Pharos Output for Crude Oil (CAS #8002-05-9)

Pharos — Building Products | Chemicals and Materials | Certifications | CompAIR | Dashboard | Logout

Dashboard / Chemicals and Materials / [8002-05-9] Crude oil

[8002-05-9] Crude oil

General Information | Hazards | Compound Groups | Process Chemistry Research | GreenScreen | C2C | Sources

Direct Hazards:

PBT	EC - CEPA DSL - Persistent, Bioaccumulative and inherently Toxic (PBiTE) to the Environment (based on aquatic organisms)	+1
	EC - CEPA DSL - Persistent, Bioaccumulative and inherently Toxic (PBiTH) to humans	
CANCER	EU - Annex VI CMRs - Carcinogen Category 1B - Presumed Carcinogen based on animal evidence	+6
	EU - GHS (H-Statements) - H350 - May cause cancer	
	EU - R-phrases - R45 - May cause cancer	
	EU - REACH Annex XVII CMRs - Carcinogen Category 2 - Substances which should be regarded as if they are Carcinogenic to man	
	Australia - GHS - H350 - May cause cancer	
	Japan - GHS - Carcinogenicity - Category 1A	
	IARC - Group 3 - Agent is not classifiable as to its carcinogenicity to humans	
BIOACCUMULATIVE	EC - CEPA DSL - Bioaccumulative	
PERSISTENT	EC - CEPA DSL - Persistent	
ENDOCRINE	TEDX - Potential Endocrine Disruptors - Potential Endocrine Disruptor	
GENE MUTATION	Japan - GHS - Germ cell mutagenicity - Category 2	

ORGAN TOXICANT	Japan - GHS - Specific target organs/systemic toxicity following repeated exposure - Category 1	+ 1
	Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 2-3	
MAMMALIAN	Japan - GHS - Acute toxicity (inhalation: dust, mist) - Category 4	+ 2
	US EPA - OPP - Registered Pesticides - FIFRA Registered Pesticide Japan - GHS - Aspiration hazard - Category 1	
EYE IRRITATION	Japan - GHS - Serious eye damage / eye irritation - Category 2B	
SKIN IRRITATION	Japan - GHS - Skin corrosion / irritation - Category 3	
RESTRICTED LIST	CA SCP - Candidate Chemicals - Candidate Chemical List ✱	+ 3
	CPA - Chemical Footprint CoHC 2016/17 - CoHC List (non SVHC) EU - Cosmetics Regulation Annex II - Prohibited in Cosmetic Products MDH - Chemicals of High Concern and Priority Chemicals - Chemicals of High Concern	
FLAMMABLE	Québec CSST - WHMIS 1988 - Class B2 - Flammable liquids	
MULTIPLE	EC - CEPA DSL - Inherently Toxic in the Environment	+ 2
	EC - CEPA DSL - Inherently Toxic to Humans (iT human) German FEA - Substances Hazardous to Waters - Class 3 - Severe Hazard to Waters	

GreenScreen® Executive Summary for Ethyl Benzene (CAS #100-41-4)

Pharos

Building Products | Chemicals and Materials | Certifications | CompAIR | Dashboard | Logout

General Information | Hazards | Compound Groups | Process Chemistry Research | GreenScreen | C2C

GreenScreen for Safer Chemicals Full Assessment Chemical Benchmark: Benchmark 2

Download GreenScreen Assessment

Group I Human					**Group II and II* Human**									**Ecotox**		**Fate**		**Physical**	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeat*	single	repeat*										
M	*L*	*L*	*M*	**M**	**M**	*M*	**M**	**vH**	*M*	*L*	DG	*H*	*M*	**H**	*H*	*M*	**L**	*L*	**H**

Title: Ethylbenzene

Organic: Organic

Profiler: Rosenblum Environmental (Clean Production Action Toxicologist)

Date of Assessment: 2015-12-25

Version: 1.2

Type of GreenScreen: Certified

Summary Explanation:

Ethylbenzene was assigned a Benchmark Score of 2 based on Moderate Group I human health endpoints (carcinogenicity (C), developmental toxicity (D), and endocrine activity (E)); High Flammability (F); and a score of very high single dose neurotoxicity (N). A data gap (DG) exist for respiratory sensitization (SnR). Ethylbenzene meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if ethylbenzene were assigned a High score for respiratory sensitization it would still be categorized as a Benchmark 2 Chemical._x000D__x000D_

GreenScreen® Executive Summary for Benzene (CAS #71-43-2)

Benzene is a chemical that functions as a raw material and intermediate for chemical synthesis, a solvent, a gasoline additive, and a natural component of diesel fuel that is used as a solvent in hydraulic fracturing fluids. Benzene was assigned a GreenScreen® Benchmark Score of 1 ("Avoid-Chemical of High Concern") as it has High Group I Human Toxicity (High carcinogenicity (C), mutagenicity (M), reproductive toxicity (R), and developmental toxicity (D)). This corresponds to GreenScreen® benchmark classification 1e in CPA 2011. There are no data gaps. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), benzene meets requirements for a GreenScreen® Benchmark Score of 1.

GreenScreen® Benchmark Score for Relevant Route of Exposure:

Data for all routes were combined as a standard GreenScreen® assessment approach. Therefore, the benchmark score applies to all routes of exposure to this compound.

GreenScreen® Hazard Ratings for Benzene

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
H	**H**	**H**	**H**	*M*	**L**	**vH**	**H**	**M**	**H**	**L**	*L*	**H**	**H**	**H**	**H**	**vL**	**vL**	*L*	**H**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated (modeled) values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

GreenScreen® Executive Summary for Naphthalene (CAS #91-20-3)

Pharos | Building Products | Chemicals and Materials | Certifications | CompAIR | Dashboard | Logout

Dashboard / Chemicals and Materials / [91-20-3] NAPHTHALENE

[91-20-3] NAPHTHALENE

General Information | Hazards | Compound Groups | Process Chemistry Research | GreenScreen | C2C

GreenScreen for Safer Chemicals Full Assessment Chemical Benchmark: Benchmark 1

Download GreenScreen Assessment

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeat*	single	repeat*										
H	**M**	DG	**L**	*M*	**M**	**vH**	**H**	*M*	DG	*M*	DG	*M*	**L**	**vH**	**H**	**M**	**L**	**L**	*M*

Title: Naphthalene

Organic: Organic

Profiler: NSF International (Licensed GreenScreen Profiler)

Date of Assessment: 2014-04-14

Version: 1.2

Type of GreenScreen: Certified

Summary Explanation:

Naphthalene was assigned a Benchmark Score of 1 based on criteria 1e. (high concern for Group I Human health endpoint: cancer and possibly endocrine activity). This Benchmark score meets the Data Gap analysis. Note this chemical is also flagged on a number of PBT lists, however no data was found to support a concern for bioaccumulation.

GreenScreen® Executive Summary for n-Hexane (CAS #110-54-3)

n-Hexane is a chemical that is used as a reagent in chromatography, in the extraction of edible fats in the food industry, as a cleaning agent in textile and furniture manufacturing, and as a solvent base for consumer products. n-Hexane was assigned a GreenScreen® Benchmark Score of 2 "Use but Search for Safer Substitutes") as it has Moderate Group I Human Toxicity (carcinogenicity-C, Reproductive Toxicity-R, developmental toxicity-D, and endocrine activity-E) and High Flammability-F. This corresponds to GreenScreen® benchmark classifications 2e and 2g in CPA 2011. Data gaps (DG) exist for respiratory sensitization-SnR*. As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), n-hexane meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if n-hexane were assigned a High score for the data gap SnR*, it would still be categorized as a Benchmark 2 Chemical.

GreenScreen® Benchmark Score for Relevant Route of Exposure:
As a standard approach for GreenScreen® evaluations, all exposure routes (oral, dermal, and inhalation) were evaluated together, so the GreenScreen® Benchmark Score of 2 "Use but Search for Safer Substitutes") is applicable for all routes of exposure.

GreenScreen® Hazard Ratings for n-Hexane

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
M	**L**	**M**	**M**	*M*	**L**	*M*	**M**	**M**	**M**	*L*	DG	**H**	*M*	**H**	*H*	*vL*	*L*	*L*	**H**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

GreenScreen® Executive Summary for Xylenes (CAS #1330-20-7)

Xylenes are commonly used as an industrial solvent for paints, coatings, adhesives, and rubber. Xylenes were assigned a GreenScreen® Benchmark Score of 1 ("Avoid- Chemical of High Concern") as it has high Group I Human Toxicity (developmental toxicity (D)). This corresponds to GreenScreen® benchmark classification 1e (High T (Group I Human)) in CPA 2011. Data gaps (DG) exist for respiratory sensitization (SnR). As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), xylenes meet requirements for a GreenScreen® Benchmark Score of 1 despite the hazard data gaps. In a worst-case scenario, if xylenes were assigned a High score for the data gap respiratory sensitization (SnR), it would still be categorized as a Benchmark 1 Chemical.

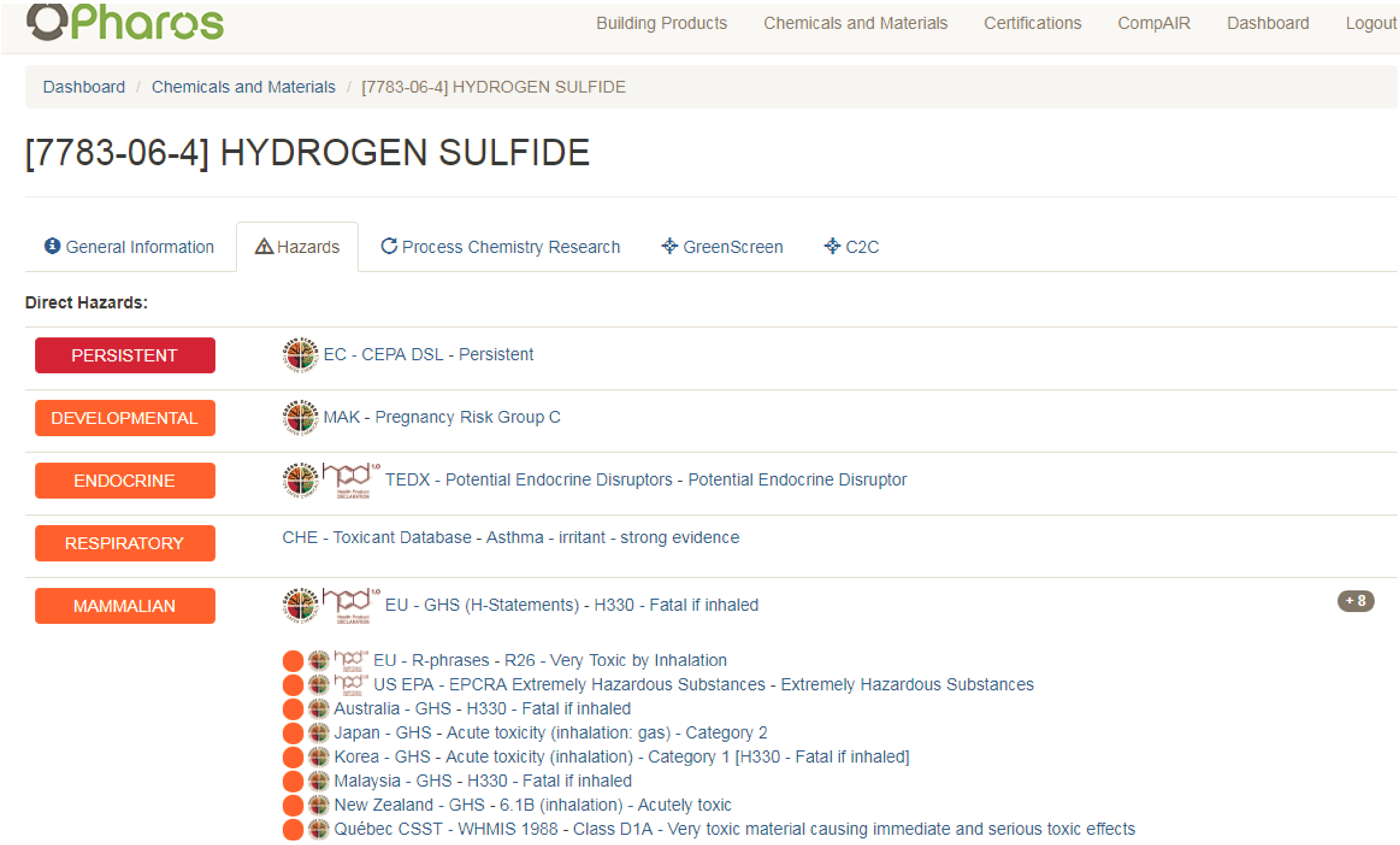
GreenScreen® Benchmark Score for Relevant Route of Exposure: All exposure routes (oral, dermal and inhalation) were evaluated together, as a standard approach for GreenScreen® evaluations, so the GreenScreen® Benchmark Score of 1 ("Avoid – Chemical of High Concern") is applicable for all routes of exposure.

GreenScreen® Hazard Ratings for Xylenes

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
L	**L**	**L**	*H*	*M*	**M**	*H*	**L**	**M**	**M**	*L*	DG	**H**	**H**	**H**	**M**	**L**	**vL**	*L*	**M**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated (modeled) values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

Pharos Output for Hydrogen Sulfide (CAS #7783-06-4)



Pharos — Building Products | Chemicals and Materials | Certifications | CompAIR | Dashboard | Logout

Dashboard / Chemicals and Materials / [7783-06-4] HYDROGEN SULFIDE

[7783-06-4] HYDROGEN SULFIDE

General Information | Hazards | Process Chemistry Research | GreenScreen | C2C

Direct Hazards:

PERSISTENT	EC - CEPA DSL - Persistent
DEVELOPMENTAL	MAK - Pregnancy Risk Group C
ENDOCRINE	TEDX - Potential Endocrine Disruptors - Potential Endocrine Disruptor
RESPIRATORY	CHE - Toxicant Database - Asthma - irritant - strong evidence
MAMMALIAN	EU - GHS (H-Statements) - H330 - Fatal if inhaled (+8) EU - R-phrases - R26 - Very Toxic by Inhalation US EPA - EPCRA Extremely Hazardous Substances - Extremely Hazardous Substances Australia - GHS - H330 - Fatal if inhaled Japan - GHS - Acute toxicity (inhalation: gas) - Category 2 Korea - GHS - Acute toxicity (inhalation) - Category 1 [H330 - Fatal if inhaled] Malaysia - GHS - H330 - Fatal if inhaled New Zealand - GHS - 6.1B (inhalation) - Acutely toxic Québec CSST - WHMIS 1988 - Class D1A - Very toxic material causing immediate and serious toxic effects

EYE IRRITATION	Japan - GHS - Serious eye damage / eye irritation - Category 2A Korea - GHS - Serious eye damage/irritation - Category 2 [H319 - Causes serious eye irritation] New Zealand - GHS - 6.4A - Irritating to the eye (Cat. 2A)	+ 2
ORGAN TOXICANT	New Zealand - GHS - 6.9A (inhalation) - Toxic to human target organs or systems (Cat. 1) Japan - GHS - Specific target organs/systemic toxicity following single exposure - Category 1-2	+ 1
ACUTE AQUATIC	EU - GHS (H-Statements) - H400 - Very toxic to aquatic life EU - R-phrases - R50 - Very Toxic to Aquatic Organisms Australia - GHS - H400 - Very toxic to aquatic life Japan - GHS - Hazardous to the aquatic environment (acute) - Category 1 Korea - GHS - Hazardous to the aquatic environment (acute) - Category 1 [H400 - Very toxic to aquatic life] Malaysia - GHS - H400 - Very toxic to aquatic life New Zealand - GHS - 9.1A (crustacean) - Very ecotoxic in the aquatic environment New Zealand - GHS - 9.1A (fish) - Very ecotoxic in the aquatic environment	+ 7
CHRON AQUATIC	Japan - GHS - Hazardous to the aquatic environment (chronic) - Category 1	
FLAMMABLE	EU - GHS (H-Statements) - H220 - Extremely flammable gas Australia - GHS - H220 - Extremely flammable gas Japan - GHS - Flammable gases - Category 1 Korea - GHS - Flammable gases - Category 1 [H220 - Extremely flammable gas] Malaysia - GHS - H220 - Extremely flammable gas New Zealand - GHS - 2.1.1A - Flammable Gases: high hazard Québec CSST - WHMIS 1988 - Class B1 - Flammable gases	+ 6
SKIN IRRITATION	New Zealand - GHS - 6.3B - Mildly irritating to the skin	

MULTIPLE	Québec CSST - WHMIS 1988 - Class D2B - Toxic material causing other toxic effects EC - CEPA DSL - Inherently Toxic in the Environment German FEA - Substances Hazardous to Waters - Class 2 - Hazard to Waters	+ 2
RESTRICTED LIST	CA SCP - Candidate Chemicals - Candidate Chemical List MDH - Chemicals of High Concern and Priority Chemicals - Chemicals of High Concern	+ 1
CANCER	US EPA - IRIS Carcinogens - (1999) Data are inadequate for an assessment of human carcinogenic potential	
NEUROTOXICITY	G&L - Neurotoxic Chemicals - Neurotoxic	
REACTIVE	EU - R-phrases - R12 - Extremely Flammable Liquid	

Potential Residual Hazards:

See Process Chemistry Research tab for details on residuals and other substances used in manufacture.

None identified

APPENDIX C: GREENSCREEN® HAZARD BENCHMARK ACRONYMS
(in alphabetical order)

(AA) **Acute Aquatic Toxicity**

(AT) **Acute Mammalian Toxicity**

(B) **Bioaccumulation**

(C) **Carcinogenicity**

(CA) **Chronic Aquatic Toxicity**

(D) **Developmental Toxicity**

(E) **Endocrine Activity**

(F) **Flammability**

(IrE) **Eye Irritation/Corrosivity**

(IrS) **Skin Irritation/Corrosivity**

(M) **Mutagenicity and Genotoxicity**

(N) **Neurotoxicity**

(P) **Persistence**

(R) **Reproductive Toxicity**

(Rx) **Reactivity**

(SnS) **Sensitization- Skin**

(SnR) **Sensitization- Respiratory**

(ST) **Systemic/Organ Toxicity**

APPENDIX D: GHS HAZARD STATEMENT GLOSSARY

H220: Extremely flammable gas

H330: Fatal if inhaled

H335: May cause respiratory irritation

H350: May cause cancer

H400: Very toxic to aquatic life

Appendix E

Standing Rock Sioux Tribe Technical Team Fatal Flaw Analysis Lake Oahe HCA Pipeline Crossing: Safety Instrumented Systems Report

Standing Rock Sioux Tribe Technical Team
Fatal Flaw Analysis

Lake Oahe HCA Pipeline Crossing
Safety Instrumented Systems

The objective of this analysis was to identify flaws in the design of the installed DAPL Safety Instrumented Systems that would prevent them from responding to a pipeline break if required to reduce the worst case discharge of crude oil. In addition, recommended modifications were proposed that when implemented, will improve the ability of the Safety Instrumented Systems to identify and limit crude oil releases and their impact on the soil and water within the Lake Oahe High Consequence Area.

As part of the SRST technical teams Fatal Flaw Analysis, the Safety Instrumented Systems were reviewed using the following strategy.

1) **Analyze the existing design**. Understand the function, system architecture, component selection, and functional testing procedures for the SIS installed to reduce the WCD.
2) **Point out weaknesses**. Identify and challenge the assumptions made during the risk assessment and design of the SIS protective layers.
3) **Propose improvements**. Propose changes that would improve the risk reduction capabilities of the SIS and reduce the chances of pollution to the soil and water within the Lake Oahe HCA.

Lake Oahe Pipeline Safety Instrumented System Design:

Safety Instrumented Systems (SIS) were implemented on the DAPL pipeline to limit the Worst Case Discharge (WCD) volume of crude oil that would be released into the Lake Oahe crossing should a pipeline leak or break occur. As the Lake Oahe pipeline crossing was identified as a High Consequence Area (HCA), the SRST technical team recommended an Independent Third Party review to verify the installed performance of the instrumented systems given credit during the EA risk assessment to reduce the WCD crude oil volume. The SRST technical team maintains that if the systems fail to function as assumed during the risk assessment, the WCD volumes would increase dramatically, greatly increasing the risk of severe environmental consequences to Lake Oahe and the surrounding HCA.

When estimating the WCD of crude oil, a critical factor considered is the elapsed time from a pipeline break until the time when pumps are shutdown and the volume of crude oil within the pipeline is isolated. To better understand the factors that makeup the WCD timeline, and to avoid confusing it with the time

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assumed to respond to a pipeline spill considered during Emergency Response Planning, the following breakdown is presented. **Reference WCD regulation.**

WCD time = Release time + Response time

Release time: Elapsed time starting when a pipeline break occurs until the leak is discovered. During the release time, it can be assumed that the pipeline is operating at full design flowrate with an infinite supply capacity. Release time can often be hours or days as in the case where a farmer walking through his fields, discovers a pool of crude oil that accumulated without detection over a long period of time.

Response time: Elapsed time once the pipeline break is detected that includes LDS response time + ESD activation time + EIV valve stroke time to isolate the pipeline. Once a leak is detected, the elapsed time to respond and isolate is considered. This is the time most often discussed when considering capabilities of Safety Instrumented Systems.

Emergency Shutdown Safety Instrumented System design.

Following a classic Safety Instrumented System (SIS) architecture, three separate elements were integrated as a SIS to reduce Lake Oahe WCD volumes of crude oil.

1) Sensor. Leak Detection System (LDS).
2) Logic Solver. Emergency Shutdown System (ESD).
3) Final Elements. Pump Controls and Emergency Isolation Valves (EIV's).

Following is a brief analysis of each element of the Lake Oahe pipeline SIS using the strategy to analyze, point out weaknesses, and propose improvements to each element.

1. Sensor – Leak Detection System.

Described as state of the art, the Leak Detection System (LDS) was installed as the primary SIS sensor. A system made up of pressure sensors combined with crude oil flow meter information, the LDS serves to provide continuous monitoring of the pipeline flow and pressure that is intended to alert the central control room (CCR) of changes in process parameters that would indicate a pipeline rupture.

Analysis of Existing System.

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The existing system relies upon the use of a computation model based on pipeline process measurements (most likely flow and line pressure) that is not available 100% of the time. To verify that the LDS is operating as required, provisions for functional testing is required to release validate/calibrate the model to measured leaks under normal operations.

Weakness of Existing System.

<u>Measurement gaps</u>. Due to the remote location of the Lake Oahe pipeline crossing, severe weather, and limits of instrumentation availability, extended gaps in LDS coverage should be expected due to instrument faults, damage, time to repair, and required computational model recalibration. The gaps in LDS coverage increase the risk of undetected crude oil releases, extending the release time and greatly increasing the WCD volume of crude oil.

<u>Functional testing and Model Calibration</u>. Validation of the LDS model is required to ensure the LDS is operating as required. This requires extensive functional testing equipment to allow crude oil to be released and collected from the pipeline under normal operating conditions. This work is manpower intensive and given the remote location of the Lake Oahe pipeline crossing, is not likely to occur. Therefore, it is reasonable to expect large deviations in actual vs. modeled LDS measurements that may lead to leak alarms being ignored by CCR operators.

Undetectable Crude Oil Leaks. Perhaps the greatest weakness of the LDS is the lower range of crude oil leak that the system can detect. It is important to note that the LDS cannot detect leaks that are less than 2% of the full pipeline flow rate. Assuming 600,000 bbs/day pipeline production rate, a 2% undetected leak would amount to 12,000 bbs/day of crude oil. Therefore, a 1% crude oil leak 6,000 bbs/day could be released continuously, over a long period of time, without detection.

Proposed Improvements.

To address the weaknesses identified above, the following actions are recommended.

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LDS calibration: Carry out functional testing of the LDS and model calibration under normal flow conditions by removing measured amounts of crude oil from the pipeline. Carry out and document the LDS calibration in cooperation with a US Govt. approved I3P agency. If faults are detected, propose modifications to improve the LDS performance.

Oil Monitor System: The installation of an integrated OMS made up of instrumented monitoring wells along the HCA pipeline route to allow direct observation of oil accumulations due to leaks under the detectable limit. Manual observation and verification is required to ensure action is taken to reduce the leak "release time."

Existing LDS Reliability Block Diagram

LDS -- CCF -- Comms --- Logic Solver (Human Intervention) -- Comms -- Pump Controls -- EIV 1 – EIV 2 – CCF

Improved LDS Reliability Block Diagram – PFD reduced and improved leak detection range.

LDS (reduced λ_{DU}) --------- CCF -- Comms --- Logic Solver (Human Intervention) –

OMS (reduced λ_{DU}) ---------

2. Logic Solver – Emergency Shutdown System.

Described as an automated, emergency shutdown system (ESD) logic, the action taken upon detection of a leak to isolate the crude oil supply to the pipeline crossing at Lake Oahe, relies human intervention at the Central Control Room.   Control room operators must receive the LDS alarm, consider the alarm per prescriptive operations procedures, and then take action to initiate a shutdown and isolation of the pipeline. This approach to plant emergency shutdown is common in the oil and gas industry. It constitutes a hybrid design of manually initiated action combined with automated Safety Instrumented Systems to identify hazards, shutdown the source of the hazard, and safely isolate a pipeline

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or other oil and gas facility.

Analysis of Existing System.

As described above, the existing Lake Oahe pipeline crossing Emergency Shutdown System logic is a combination of automated safety instrumentation, communications links, alarms, and operator response (human decision making). Two key features stand out in the Lake Oahe ESD logic design, the need to communicate safety critical information great distances with high availability and the need for operator intervention as the primary decision maker.

Weakness of Existing System.

Communications Channels. Due to the remote location of the Lake Oahe pipeline crossing and the pipeline ESD design, critical information gathered in the field must be communicated to the Central Control Room (CCR) located in Sugarland, Texas. In a similar fashion, once a decision is made to shutdown and isolate the pipeline, that action must be communicated from the CCR to the pump controllers and Emergency Isolation Valves located near the Lake Oahe pipeline crossing.

Within the petrochemical and oil/gas industry, the communications equipment and the protocols used to carry out a Safety Function are designed to reach a high level of availability. The most common method used is dedicated, "hardwired" signals that are designed and installed to carry and confirm the safety critical information (e.g. Foundation Fieldbus for Safety Instrumented Functions FF SIF). The approach used to reach high availability targets for the pipeline isolation system was the combination of non-certified, redundant communications channels (cellular telephone and land line) in a dual-redundant fashion. Although communications availability may be improved by the use of dual-redundant, non-safety certified communications channels, the ability to verify the safety system information is not provided. Communications may be degraded resulting in information gaps, false alarms, and overall poor performance.

Human Intervention. When required to consider technical information under the stress of an emergency situation, human decision making can be seriously degraded. Studies have shown that under these

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conditions, human decision making is correct only 10% of the time. Combined with the “production” culture that is prevalent within the oil and gas industry, as a “for profit” enterprise, and the difficulties involved with shutting down and starting up a pipeline, the decision to shutdown a producing pipeline is not a decision taken easily. Therefore, even with training, the risk that an operator will fail to respond immediately and correctly to a pipeline leak is high. It has been documented again and again, that alarms are generated, communicated to the CCR and ignored or simply not responded to by the operator.

Proposed Improvements.

To address the weaknesses identified above, the following actions are recommended.

Communications Channels: In addition to the existing non-certified, communications channels from the field to the CCR, implement dedicated, hardwired, safety certified signals from the LDS sensors (LDS and OMS), to a local safety certified logic solver and to the ESD final elements. Safety protocols recommended in industry include, FF-SIF and profibus for safety instrumented systems.

Human Intervention. Implement fully automated, cause and effects based logic, within a certified safety logic solver to replace the manual human intervention required in the existing design. The reliability block diagram below demonstrates how both availability and reliability of the overall pipeline isolation function may be improved.

Existing ESD (logic) Reliability Block Diagram

Sensors (LDS) -- CCF -- **Comms --- Logic Solver -- Comms** -- Pump Controls -- EIV 1 – EIV -- CCF

Improved ESD (logic) Reliability Block Diagram

Sensors (LDS) ------ CCF – **Hardwired Comms --- Safety Certified Logic Solver – Hardwired Comms** – OMS (1oo2 with LDS) ----

3. Final Elements. Pump Controls and Emergency Isolation Valves.

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As the final elements in the Safety Instrumented System, the pump controls and emergency isolation valves must work together to safely isolate the pipeline at the Lake Oahe HCA. Shutdown and isolation of liquid filled, high velocity, pipelines must carefully coordinate the control of pump flow reductions and pipeline isolation valve closure rates to prevent the risk of pipeline damage due to surge. Therefore, when an ESD action is initiated in the CCR and communicated to the pumpstation, the pump drive is ramped down to safe levels prior to closure of the pipeline emergency isolation valves on each side of Lake Oahe. Once the flow is reduced to a safe rate, the Emergency Isolation Valves may be closed to isolate the crude contained within the pipeline from the HCA at Lake Oahe.

Analysis of Existing System (final elements).

As described above the existing Emergency Shutdown System relies on the control and careful coordination of the pump controls and the Emergency Isolation Valves. Dynamic process simulations must be carried out to confirm that the rate of pump ramp down, setting out time, and EIV valve closure speed are suitable to prevent surge in the pipeline. To take risk reduction credit for a Safety Instrumented System, the components that make up the system such as the pump controller and EIV valves, actuators, and controls must be selected and the performance verified once installed to confirm that the risk reduction credit was justified. Surge relief systems are commonly used in crude oil pipelines as an additional protection layer to ensure any unexpected pressure spikes generated due to pump or EIV failures are dissipated properly.

Weaknesses within the existing system (final elements).

The ability of the final elements (pump interlocks and Emergency Isolation Valves) to provide the level of risk reduction required to reduce the WCD volume of crude oil was not demonstrated. There was no documentation of a review of the pump controller design, maintenance, and operating procedures that verified that it was suited for use as a SIS final element. In a similar way, there was no documentation of the design, functional testing, and maintenance procedures for the EIV's (valves, actuators, and local controls) that they are suited to provide the positive isolation required during a pipeline

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leak emergency.

Proposed Improvements.

To address the weaknesses identified above, the following actions are recommended.

Pump Interlocks: In addition to the existing non-safety certified, pump controllers, utilize a safety certified logic solver to provide interlocks that will ensure the proper shutdown sequence of the pumps and the Emergency Isolation Valves. Review the dynamic flow analysis to ensure sufficient time was allocated to reduce the pipeline flowrate and close the EIV's without creating the potential for surge within the pipeline.

Emergency Isolation Valves: Review the design and selection of the valves, actuators, and local controls that make up the Emergency Isolation Valves and upgrade as required to meet a high safety availability target. Document functional test procedures and the required testing frequency to reduce the Probability of Failure on Demand (PFD). Verify performance through field testing and documentation and make design changes as required to meet the demanding risk reduction requirements necessary to reduce the WCD volume estimates.

Surge Relief Systems: Review the pipeline dynamic flow analysis, and installed Surge Relief Systems for alignment with actual operating process conditions. It is recommended to provide fully redundant surge relief skids to allow for functional testing of the Surge Relief Valves without impact to production.

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Existing Pump and EIV Reliability Block Diagram

Sensors (LDS) -- CCF -- Comms --- Logic Solver -- **Comms -- Pump Controls -- EIV 1 – EIV 2 -- CCF**

Improved Pump and EIV Reliability Block Diagram

Sensors (LDS) ------ CCF – **HW Comms --- SLS – HW Comms – PSD – EIV 1 – EIV 2 – CCF**

Summary of Recommendations.

1) **Increase the WCD release time assumption to 8 hours. This assumption reflects the actual (proven in use) performance of the Leak Detection System and the track record of the pipeline operator to identify pipeline leaks in remote locations such as the Lake Oahe pipeline crossing.**

2) **Develop a functional test and computational model recalibration procedure for the Leak Detection System based on controlled releases of crude oil from the pipeline on a quarterly basis.**

3) **Design and install an Oil Monitoring System (OMS) within observation wells drilled over the pipeline route under Lake Oahe to identify accumulations of oil above the pipeline that may be released at rates under the LDS detection limit. Vote the OIM observation well sensors with the LDS to initiate auto shutdown of the pipeline (without operator intervention required).**

4) **In addition to the existing non-certified, communications channels from the field to the CCR, implement dedicated, hardwired, safety certified signals from the LDS and OMS sensors, to a local safety certified logic solver and to the ESD final elements (pumps and EIV's).**

5) **Carry out cause and effect and transient flow analysis to define Emergency Shutdown Logic within a certified safety logic solver and pump control interlocks that will take consistent action to safely shutdown the pipeline (without the need for operator intervention).**

6) **Review the Emergency Isolation Valve design and selection of the valves, actuators, local controls, and functional testing procedures and upgrade as required to meet a high safety availability target.**

7) **Perform pipeline dynamic flow analysis, and review the installed Surge Relief Systems for alignment with actual operating process conditions. Install fully redundant surge relief skids to allow for functional testing of the Surge Relief Valves without impact to production.**

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Background Information regarding HARDWARE RELIABILITY ASSESSMENT METHODOLOGY per ESC risk study.

Definition of Safety Integrity Level

The hardware reliability of a Safety Instrumented Function (SIF) is expressed in terms of either its PFD or of its Average Frequency of a Failure per Hour (PFH[1]) (considering only dangerous failures), depending on the frequency of demands made upon it. The frequency of demand ('mode of operation') on the SIF falls into three categories:

Low demand mode (IEC 61508-4: 3.5.16) – where the safety function is only performed on demand in order to transfer the Equipment Under Control (EUC) into a specified safe state, and where the frequency of demands is no greater than one per year; or

High demand (IEC 61508-4: 3.5.16) – where the safety function is only performed on demand in order to transfer the EUC into a specified safe state, and where the frequency of demands is greater than one per year; or

Continuous mode (IEC 61508-4: 3.5.16) - where the safety function retains the EUC in a safe state as part of normal operation.

Based on the definitions given in (IEC 61508-4: 3.5.16), the mode of operation for each DAPL SIF was assumed to be LOW DEMAND.

Probability of Failure on Demand

For low demand SIFs, IEC 61508 requires calculation of the PFD of each complete SIF loop:

$PFD_{sys} = PFD_S + PFD_L + PFD_{FE}$ (IEC 61508-6: B.3.2.1)

PFD_{sys} is the probability of failure on demand of a safety function for the Electrical / Electronic / Programmable Electronic (E/E/PE) safety-related system;

PFD_S is the probability of failure on demand for the sensor subsystem;

PFD_L is the probability of failure on demand for the logic subsystem;

PFD_{FE} is the probability of failure on demand for the final element or final element subsystem.

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The overall PFD of the complete SIF is compared with its PFD target to determine whether sufficient risk reduction is provided.

Failure Rate, λ

To calculate PFD, it is first necessary to introduce the term 'failure rate'. Failure rate is denoted by λ and defined as the "*number of failures per unit time"*. For the purposes of this analysis all failures rates are measured per hour.

Failure Modes To calculate the PFD of the sensor, logic or final element subsystem using λ, its failure modes must first be examined. The number of failures is apportioned into safe and dangerous failure modes, where:

A **dangerous failure** (IEC 61508-4: 3.6.7) is defined as a failure of an element and/or subsystem and/or system that plays a part in implementing the safety function that:

a) prevents a safety function from operating when required (demand mode) or causes a safety function to fail (continuous mode) such that the EUC is put into a hazardous or potentially hazardous state; or

b) decreases the probability that the safety function operates correctly when required

A **safe failure** (IEC 61508-4: 3.6.8) is defined as a failure of an element and/or subsystem and/or system that plays a part in implementing the safety function that:

a) results in the spurious operation of the safety function to put the EUC (or part thereof) into a safe state or maintain a safe state; or

b) increases the probability of the spurious operation of the safety function to put the EUC (or part thereof) into a safe state or maintain a safe state.

It follows that the total failure rate, λ, is equal to the sum of the safe and dangerous failure rates:

$\lambda = \lambda_D + \lambda_S$

λ_D is the dangerous failure rate per hour and;

λ_S is the safe (spurious) failure rate per hour.

Diagnostic Testing

The dangerous failure rate is further apportioned into dangerous detected and

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undetected failures, where:

A **detected** failure (overt) [IEC 61508-4: 3.8.8] is defined as a failure, in relation to hardware, detected by the diagnostic tests, proof tests, operator intervention (for example physical inspection and manual tests), or through normal operation.

An **undetected** failure (covert) [IEC 61508-4: 3.8.9] is defined as a failure, in relation to hardware, undetected by the diagnostic tests, proof tests, operator intervention (for example physical inspection and manual tests), or through normal operation.

The relationship can therefore be described by:

$$\lambda_D = \lambda_{DD} + \lambda_{DU}$$

λ_{DD} is the dangerous detected failure rate per hour and;

λ_{DU} is the dangerous undetected failure rate per hour.

Note that safe failures revealed by diagnostic testing are not considered since they do not have the potential to put the SIF into a fail-to-function state and thus do not contribute to the PFD of a subsystem.

PFD and Mean Down Time (MDT)

8.4.1 General

The PFD of a single subsystem - for instance a single detector - is approximated by multiplying the dangerous failure rate, λ_D, by the Mean Down Time (MDT):

$$PFD = \lambda\, MDT$$

where MDT is the time taken to repair a fault: the Mean Time To Repair (MTTR), plus the time taken to detect it. It is assumed that, on average, a fault will occur at the mid-point of the test interval, thus the time taken to detect a fault is equal to half the test interval, $T / 2$.

Therefore, **MDT = MTTR + T/2.**

PFD for Detected Failures

In general, for failures that are detected by the diagnostic tests of a subsystem (refer to section 8.3.3,) the test interval (termed as ‘diagnostic test interval’), T_d, is typically less than one (1) hour (refer to IEC 61508-6: Annex B) and thus the time

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taken to detect a fault, $T_d/2$, is considered small in comparison with the MTTR, i.e.

$$MDT_{(Detected)} \approx MTTR$$

$$PFD_{(Detected)} = \lambda_{DD}\, MTTR$$

where MTTR is measured in hours.

PFD for Undetected Failures

For undetected failures, i.e. failures revealed only by manual proof testing, the MTTR is considered small in comparison with the time taken to detect a fault, i.e. the mid-point of the proof test interval, T_p / 2, therefore:

$$MDT_{(Undetected)} \approx \mathrm{Tp}/2$$

and

$$PFD_{(Undetected)} = \lambda_{DU}\,\mathrm{Tp}/2$$

where T_p is the proof test interval in hours.

PFD for Subsystem

The overall PFD of a single subsystem (sensor, logic or final element subsystem) comprises the PFD for undetected faults and the PFD for detected faults

$$PFD_{subsystem} = PFD_{(Undetected)} + PFD_{(Detected)}$$

DAPL DATA & ASSUMPTIONS

General Assumptions The following points summaries the general assumptions used in the analysis. Where possible, specific paragraph references provide the context of the assumption, indicating where it has been applied.

The DAPL SIS is low demand as the frequency for any scenario which will place a demand on the SIS is likely to be less than once per year therefore the LOW DEMAND PFD targets apply.

If a failure occurs, it is assumed that on average it will occur at the mid-point of the test interval. In other words, the fault will remain undetected for 50% of the test period.

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It is assumed that the test intervals are three months for the sensors, logic solver and final elements in the SIS. The EIV valves are tested by full stroke test will be carried out on a yearly basis. End to end test will be performed yearly and during which the logic solver will be tested.

The analysis assumes that all undetected failure modes will be identified by the proof test, i.e. the proof test is 100% effective and therefore maintenance procedures should ensure that this is achieved in practice.

The analysis assumes constant failure rates and therefore the effects of early failures are expected to be removed by appropriate processes.

The reliability figures used for the final element, EIV valve, assumes that EIV's will be ball valves.

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Common Cause Failure

When assessing the reliability of a subsystem in a redundant configuration, IEC 61508 requires that the effect of Common Cause Failures (CCFs) is considered.

A CCF is defined as: a *failure which is the result of one or more events, causing failures of two or more separate channels in a multiple channel system.*

An example of a CCF would be freezing weather conditions causing identical level transmitters in a 1oo2 voting configuration to fail simultaneously.

CCFs in redundant systems are accounted for using the model, which assumes a fixed proportion of failures are caused by a common cause. This proportion, termed as is estimated based on:

- the degree of channel separation;
- design with common cause awareness;
- diagnostic coverage;
- self-test frequency and other factors.

The CCF rate, according to the Beta model, is calculated as follows:

$$\lambda \text{ common cause} = \text{Beta } \lambda\text{DD} + \text{Beta } \lambda\text{DU}$$

Thus, the overall PFD due to dangerous common cause failures is given by

$$PFD_{common\ cause} = \text{Beta}\ \lambda DD\ \text{MTTR} + \text{Beta}\ \lambda DU\ \text{Tp}/2$$

Table 1. β factors used in the analysis (ref. industry standard).

System	factor
Input Subsystem (2oo3)	3%
Final Element Subsystem	5%

Note 1: The actual total λDU of the HIPS Valve is λDU = 1.50E-07 fph

References:

1. IEC 61508, Functional Safety of Electrical/ Electronic/ Programmable Electronic Safety Related Systems.
2. ESC Aramco HIPS Narrative, Maintain Potential Safety Studies.

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Appendix F

Preliminary Report: Landslides in the Vicinity of the Dakota Access Pipeline Crossing of the Missouri River Near the Standing Rock Indian Reservation

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Preliminary Report:

Landslides in the Vicinity of the Dakota Access Pipeline Crossing of the Missouri River near the Standing Rock Indian Reservation

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Executive Summary

The Dakota Access Pipeline crosses the Missouri River about one mile north of the Standing Rock Indian Reservation. The area of the crossing has landslide-prone geologic material from the exposed Fox Hills Formation. The Pierre Shale, which also consists of unstable material, is the bedrock directly beneath the Fox Hills Formation. The steep slopes and unstable soils at the crossing have resulted in landslides in the past. Numerous landslides from previous slope failures have been mapped in the area, and more are predicted to occur. Future landslides and reactivation of old landslides pose a serious risk of rupturing the pipeline. A leak in this area would threaten the water supply for the Standing Rock Sioux Tribe and cause pollution to groundwater, surface water, environmental resources, and ecological systems downstream.

Introduction

The Dakota Access Pipeline (DAPL) was built by the Texas-based developer, "Energy Transfer Partners." Figure 1 shows the route of the pipeline. In June, 2017, the DAPL began moving North Dakota oil through South Dakota and Iowa to a distribution point in Illinois. The pipeline crosses the Missouri River along the Oahe Reservoir about one mile north of the Standing Rock Indian Reservation (Figure 1). The purpose of this report is to examine the geology of the crossing area and to discuss the probability of a disrupting landslide. A leak of the DAPL near the Oahe Reservoir would threaten the drinking water supply for the Standing Rock Sioux Tribe. A pipeline leak also could have devastating effects on groundwater, surface water, and environmental resources.

An Environmental Assessment, prepared by the U.S. Army Corps of Engineers (2016), mentioned the possibility of landslides in the area where the pipeline crosses the Oahe Reservoir. A previous Environmental Impact Statement concerning a proposed bridge crossing near Fort Yates, North Dakota, was prepared by the U.S. Army Corps of Engineers (1994). The proposed bridge was not built. The U.S. Army Corps of Engineers (1994) cited slump block areas and the potential for landslides or slumping on the proposed corridors as reasons for recommending against the bridge crossings.

A 210,000-gallon leak of the Keystone Pipeline occurred in South Dakota in November, 2017 (Smith and Bosman, 2017). A 530,000-gallon leak of the Belle Fourche Pipeline occurred in North Dakota in 2016 after a landslide (Williams, 2017). Because of the possibility of landslides and subsequent leaks of the DAPL at the crossing of the Missouri River upstream from the Standing Rock Indian Reservation, the geology of the area should be investigated carefully and the potential for a leak should be assessed. In addition, an oil spill response plan should be formulated clearly.

Geology

The steep slopes leading down to the Missouri River just north of the Standing Rock Indian Reservation include the Fox Hills Formation, overlain by the Hell Creek Formation and by the Cannonball and Ludlow formations of the Fort Union Group. These nearly flat-lying Cretaceous sedimentary rocks consist mostly of clay, shale, silt, and fine-grained sandstone. They are prone to landslides, especially where they contain bentonite within the clay and shale. Figure 2 shows a geologic map of the northern part of the Standing Rock Indian Reservation, near the crossing. Figure 3 is a geologic map of North Dakota. These geologic maps show that the Fox Hills Formation is exposed along the Missouri River at the pipeline crossing near the town of Cannon Ball, and near Fort Yates. The bedrock beneath the Fox Hills Formation is the Pierre Shale, which contains shale and bentonite, and also is prone to landslides. More detailed county geologic maps are available for Sioux County (Carlson, 1982), on the western side of the Missouri River, and for Emmons County (Bluemle, 1984), on the eastern side of the Missouri River.

Landslides along the Missouri River

Landslides are extremely common on the slopes along the Missouri River. As examples, Figure 4 and Figure 5 show landslide maps for the Cannon Ball quadrangle and the Cannon Ball NW quadrangle along the Missouri River near the town of Cannon Ball, North Dakota. Landslides are designated by the red symbols. Figure 6 and Figure 7 show landslide maps near Fort Yates, North Dakota, where proposed bridge corridors were examined by the U.S. Army Corps of Engineers (1994). Figure 8 is an aerial photograph of a landslide along the Oahe Reservoir near Forest City, South Dakota. Because the geologic formations in the Cannon Ball and Fort Yates area are prone to slope failures, landslides will continue to occur in the future. Older slope failures also could be reactivated, especially during wet periods.

Landslide Hazards at the Dakota Access Pipeline Crossing of the Missouri River

The potential effects of a landslide are of paramount importance. The Dakota Access Pipeline could not withstand a landslide without rupturing, because of the great force of the weight of moving soil during a slope failure. The steep slopes and unstable soils along the Missouri River make this area susceptible to landslides. The authors visited the area on (date, year) and noted . . . Numerous landslides from previous slope failures are present in the area, and more are predicted to occur in the future.

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Summary

There was a 210,000-gallon leak of the Keystone Pipeline in South Dakota in November, 2017. In 2016, a spill of about 530,000 gallons occurred from the Belle Fourche Pipeline in North Dakota after a landslide (Figure 9). Is a similar leak imminent where the DAPL crosses the Missouri River? Energy Transfer Partners maintain that the pipeline is safe. U.S. District Judge James Boasberg stated, however, ". . . the fact remains that there is an inherent risk with any pipeline" (Nicholson, 2017). We conclude that landslides pose a serious risk to the Dakota Access Pipeline where it crosses the Missouri River north of the Standing Rock Indian Reservation. A rupture of the pipeline would threaten the drinking water supply for the Standing Rock Sioux Tribe, in addition to causing pollution to groundwater, surface water, environmental resources, and ecological systems downstream.

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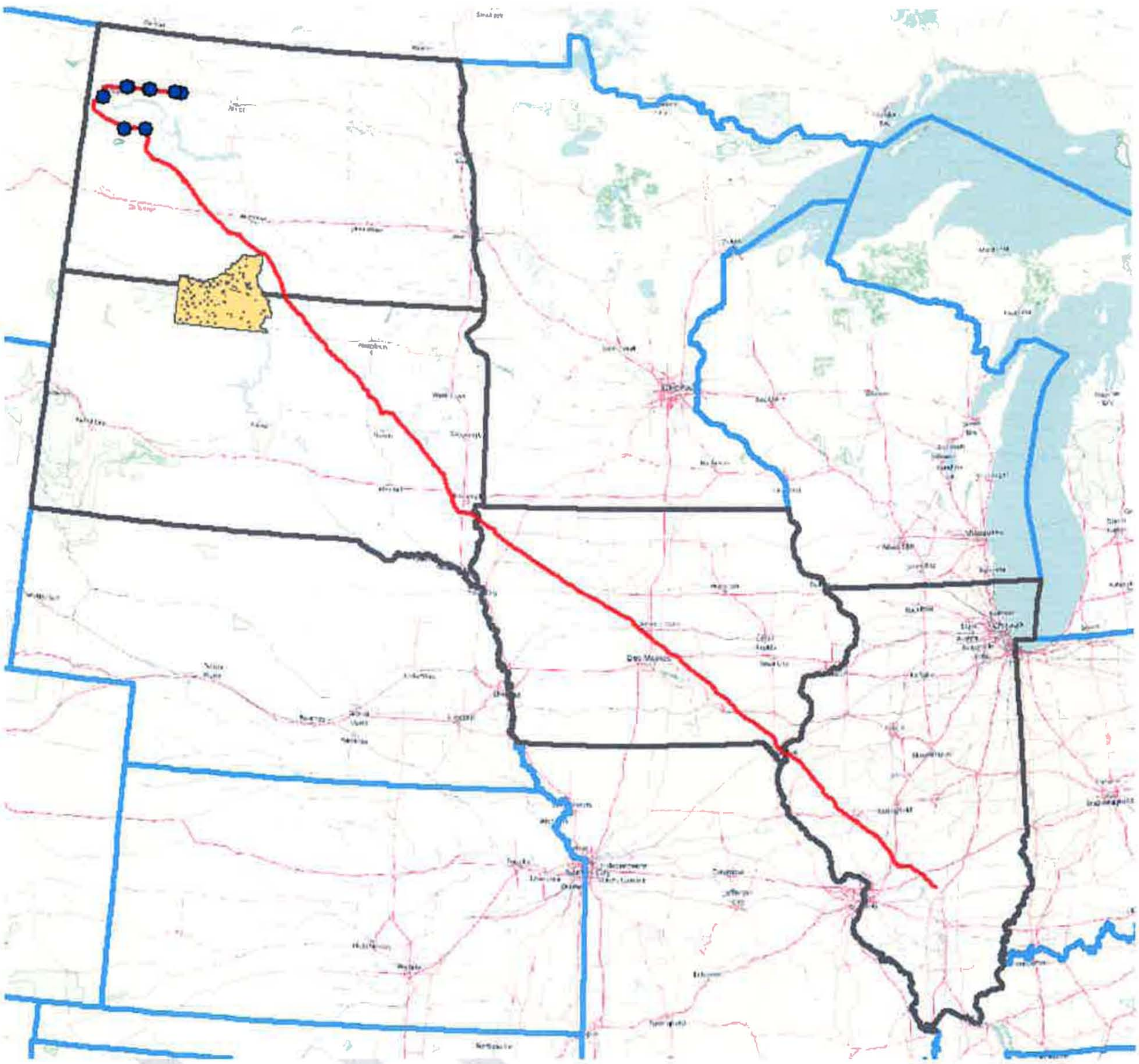

Figure 1. Dakota Access Pipeline route. The Standing Rock Indian Reservation is shown in yellow, in North Dakota and South Dakota.

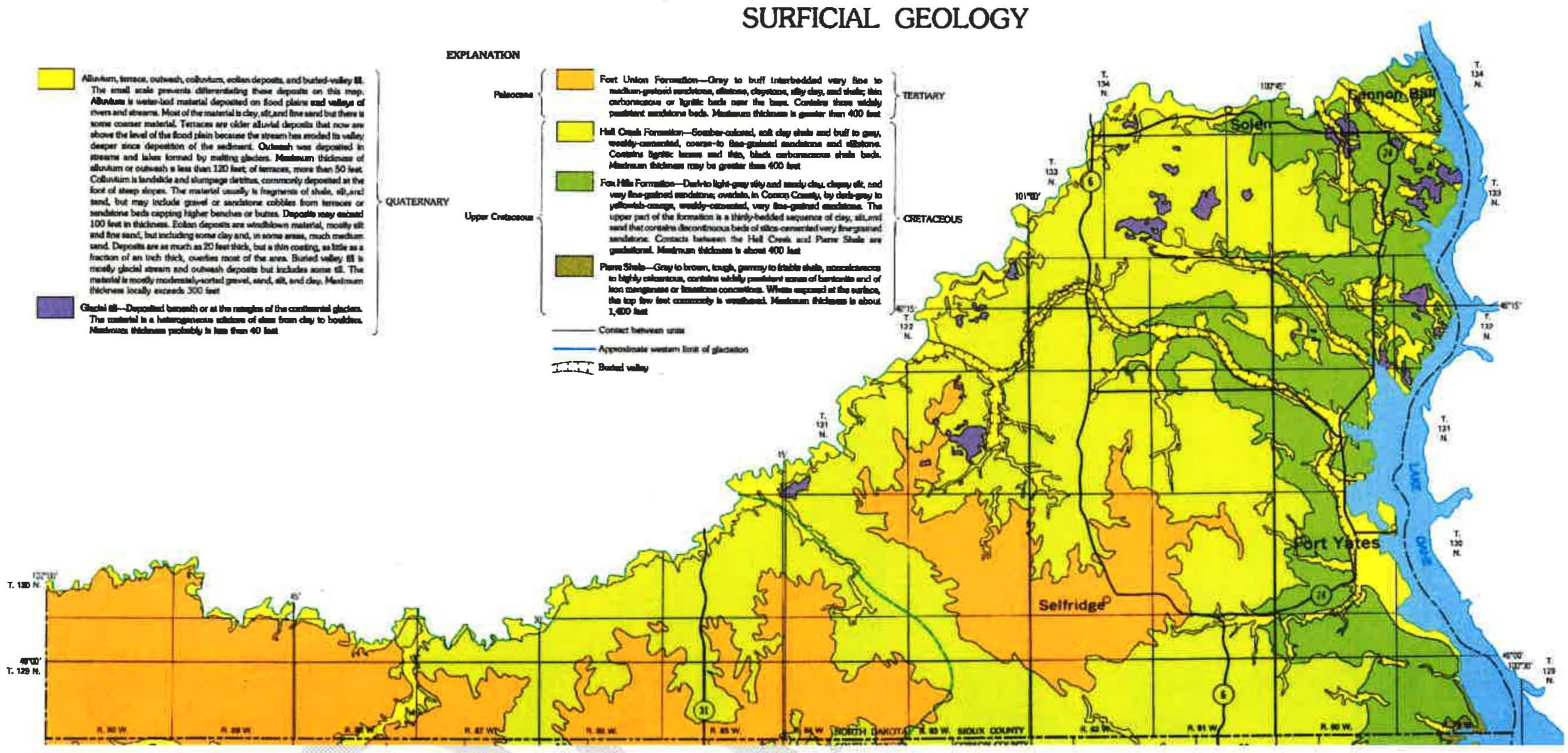

Figure 2. Geologic map of the northern part of the Standing Rock Indian Reservation (from Howells, 1982). The Fox Hills Formation is exposed along the Missouri River. The Pierre Shale underlies the Fox Hills Formation.

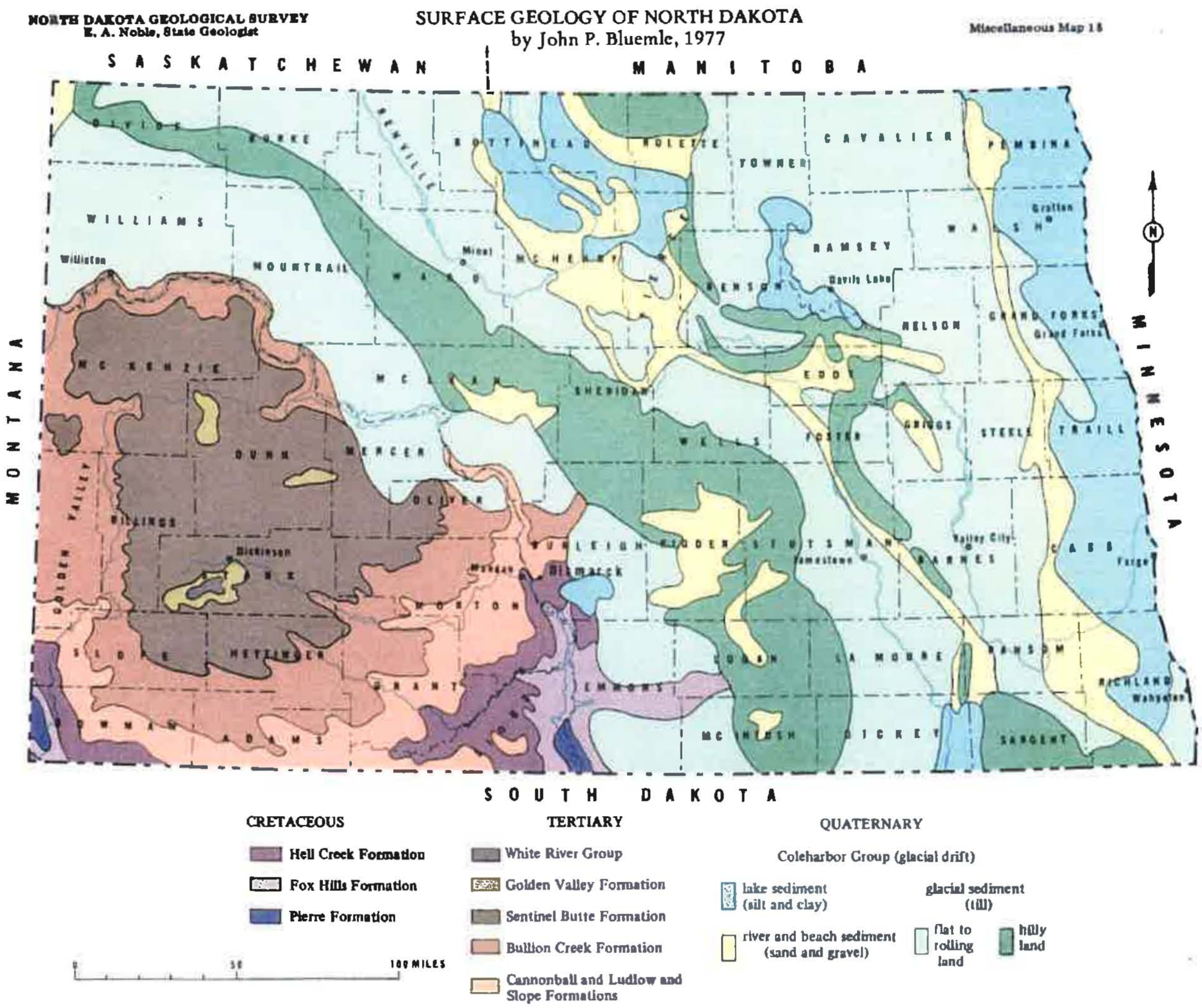

Figure 3. Geologic map of North Dakota (from Bluemle, 1977). The Fox Hills Formation is exposed along the Missouri River at the pipeline crossing near the town of Cannon Ball, between Sioux and Emmons counties. The Pierre Shale underlies the Fox Hills Formation.

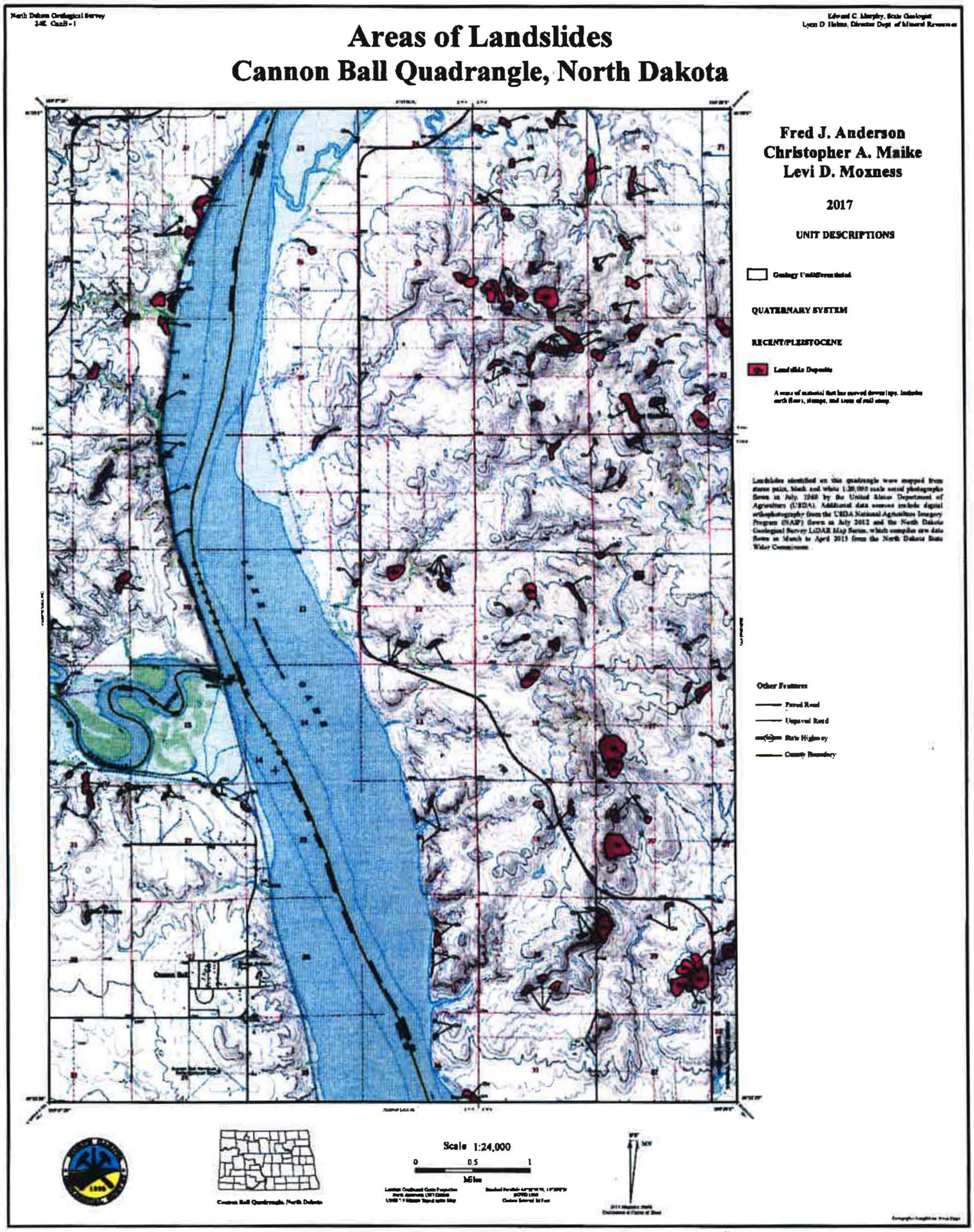

Figure 4. Landslide map of Cannon Ball Quadrangle (from Anderson et al., 2017a). Mapped landslides are shown in red.

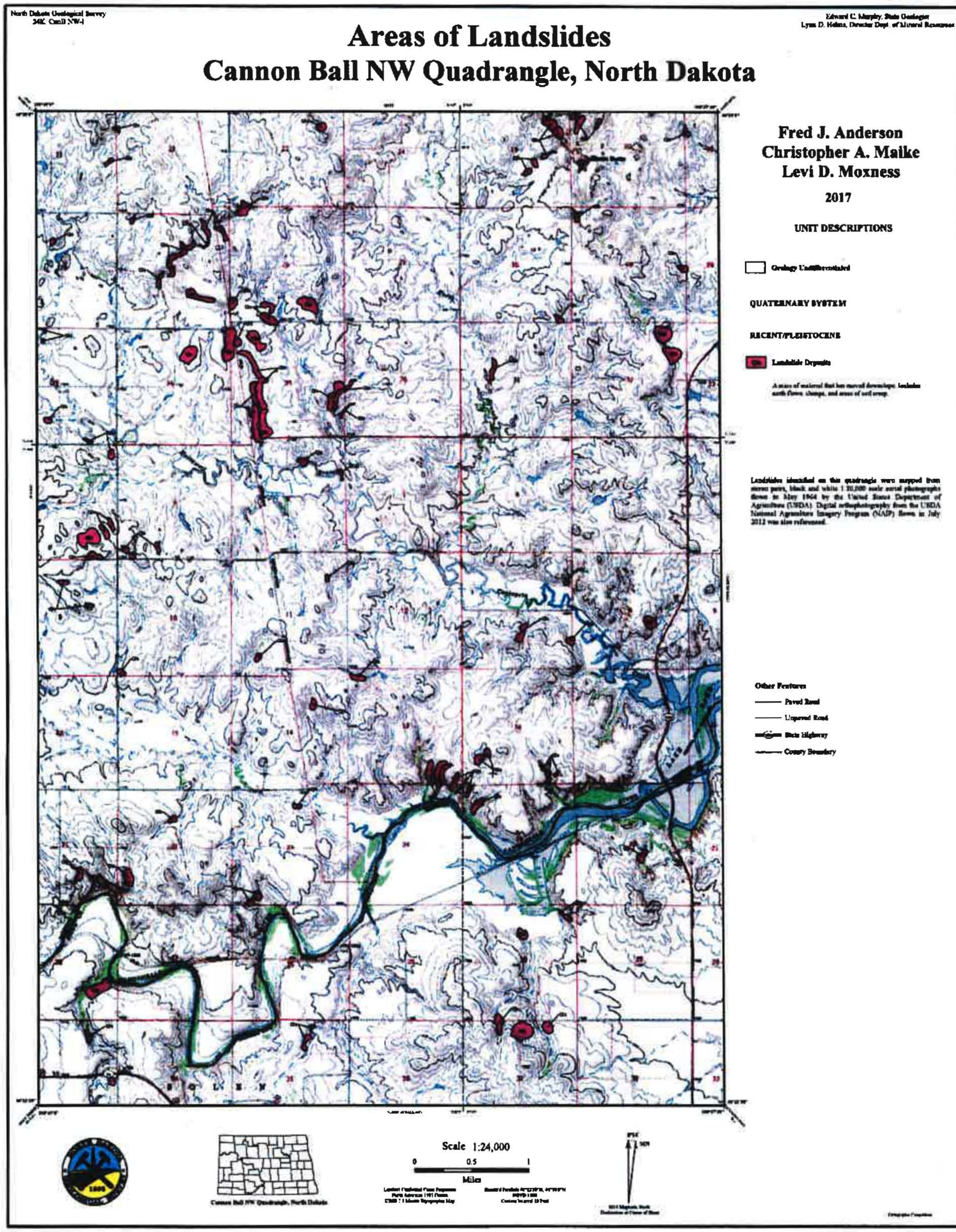

Figure 5. Landslide map of Cannon Ball NW Quadrangle (from Anderson et al., 2017b). Mapped landslides are shown in red.

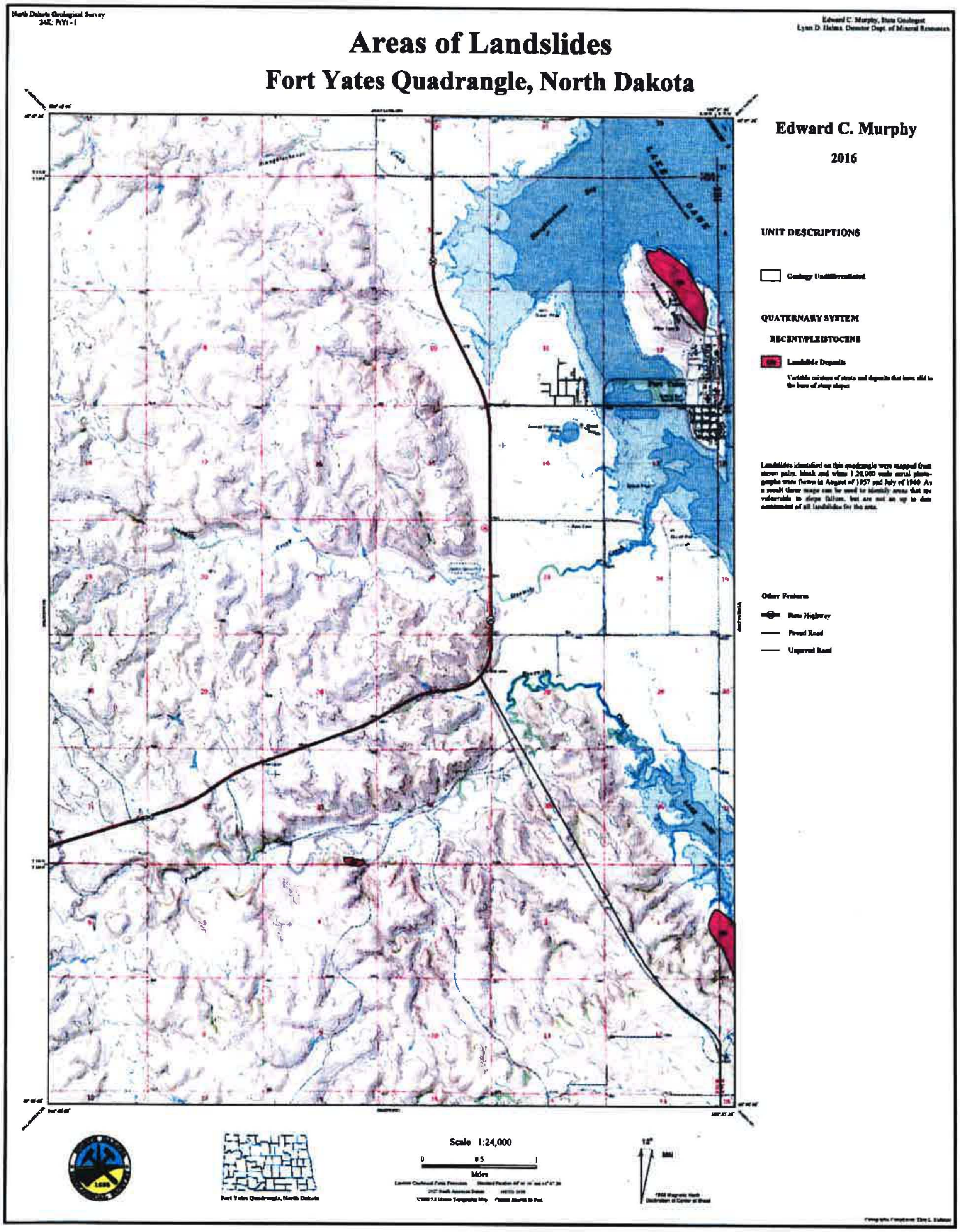

Figure 6. Landslide map of Fort Yates Quadrangle (from Murphy, 2016a). Mapped landslides are shown in red.

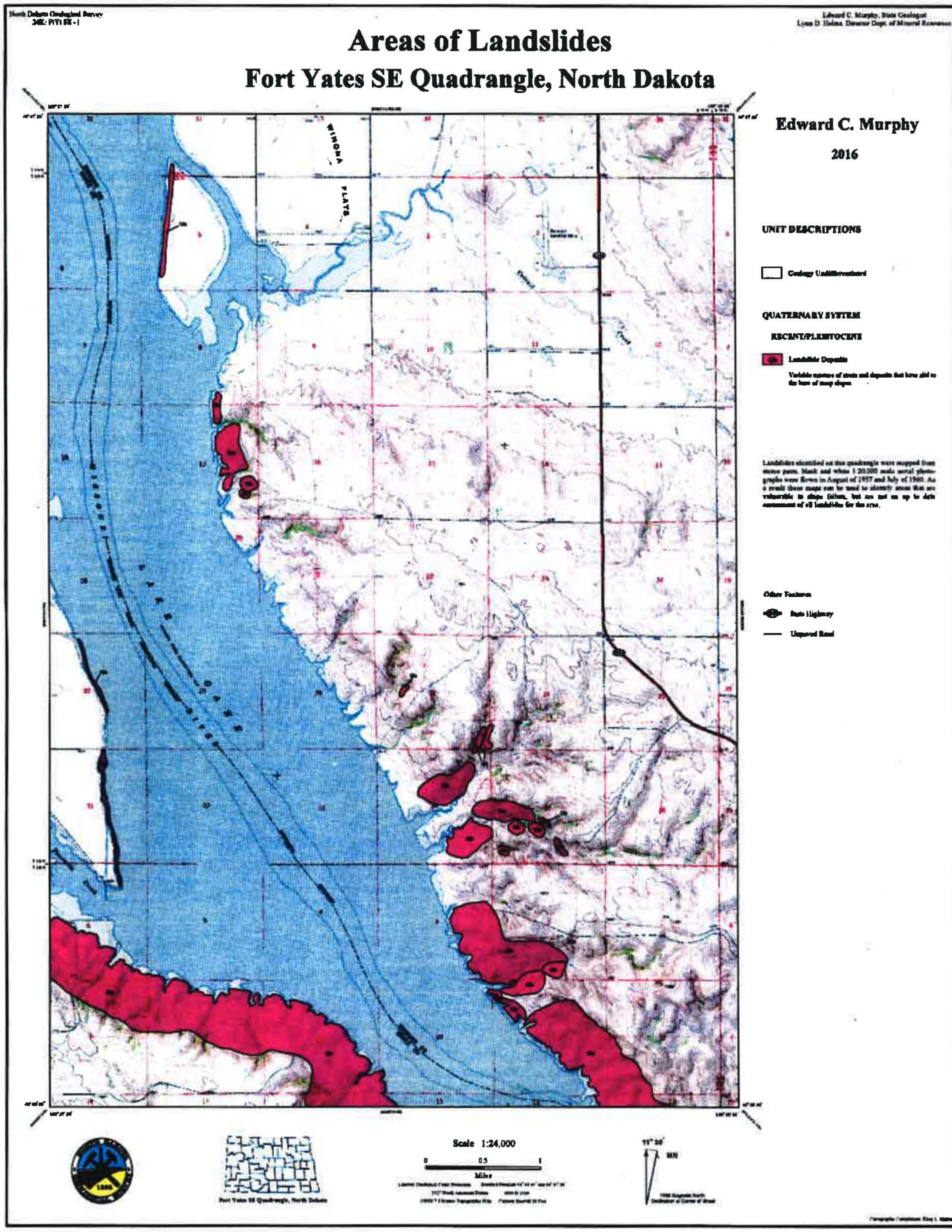

Figure 7. Landslide map of Fort Yates SE Quadrangle (from Murphy, 2016b). Mapped landslides are shown in red.

West abutment of the Forest City bridge across the Missouri River. The rise of reservoir water behind the Oahe Dam destabilized an ancient landslide in the Pierre shale, causing it to move. The huge area of lumpy topography marks the slide. —S.D. Department of Transportation

Figure 8. Aerial photograph of landslide along the Missouri River near Forest City, South Dakota (from Bump and Bang, 1986).

Figure 9. Photograph of oil leak in December, 2016, from a rupture of the Belle Fourche Pipeline at Ash Coulee Creek, a tributary of the Little Missouri River. Note landslide above creek. Photograph from North Dakota Department of Health.

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Personal Background

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Registered Professional Engineer (South Dakota, No. 4513)
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Professional Organizations and Honors

1. Fellow, Geological Society of America (Engr. Geol. Division), 1965 to present
2. Member, Association of Engineering Geologists, 1966 to present
3. Member, Association Professional Geological Scientists, 1977 to present
4. Member, South Dakota Academy of Science, 1969 to present
5. Member, National Society of Professional Engineers, 1980 to present (President: Black Hills Chapter, 1993)
6. Member, Rapid City Planning Commission, 1981-1982.
7. Recipient of Assoc. Engr. Geologists "Claire P. Holdredge Award" for book "Engineering Geology, an Environmental Approach", 1987
8. Executive Committee, Engineering Geology Division, Geol. Soc. Am., 1987-92 (Chairman in 1991)
9. Member, Pennington County Drainage Commission, 1990-92
10. Member, Technical Review Committee, Ellsworth AFB Superfund Site, 1990-99.
11. Recipient of Geol. Soc. Am. (Engr. Geol. Div.) "E.B. Burwell, Jr." award for book "Engineering geology, an Environmental Approach", 1990
12. "Engineer of the Year" by Black Hills Chapter of S.D. Engr. Soc., 1995
13. Editorial Board for "Engineering Geology" (% Elsevier Publ. Co., Netherlands), 1995 to present.

Work Experience

Engineering Geologist, Calif. Dept. of Water Resources, Oroville, CA, 1959-61.
Assistant Professor, University of Connecticut, Storrs, CT, 1965-68.
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7. Member, Restoration Advisory Board, Ellsworth AFB Superfund Site, 1990-present.
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9. "Engineer of the Year" by Black Hills Chapter of S.D. Engr. Soc., 1995.
10. Editorial Board for "Engineering Geology" (% Elsevier Publ. Co., Netherlands), 1995 to present.
11. "Drinking Water Protection" committee, City of Rapid City, 2000 to present.
12. Richard H. Jahns Lecturer, Eng. Geol. Div., Geological Society of America and Association of Engineering Geologists, 2002.
13. Distinguished Practice Award, Association of Engineering Geologists, 2003.

Work Experience

1. Engineering Geologist, Calif. Dept. of Water Resources, Oroville, CA, 1959-61.
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4. Associate Professor, S.D. School of Mines and Tech., 1970-79
5. Professor, S.D. School of Mines and Tech., 1979-1997.

6. Professor Emeritus, S.D. School of Mines and Tech., 1997-present.
7. Visiting Scientist, Division of Environmental Impact Studies, Argonne National Laboratory, Argonne, Illinois, 1977-78 (15 months)
8. Hydrologist, U.S. Geological Survey, Phoenix, AZ, Summer 1963
9. Visiting Professor, Pennsylvania State University Geology Field Camp, Red Lodge, Montana, Summer 1965
10. Glacial Geologist, Conn. Geological Survey, Middletown, CT, Summer 1967
11. Hydrogeologist, S.D. Geological Survey, Vermillion, SD, Summers 1968-72
12. Geomorphologist, S.D. Remote Sensing Institute, Summers 1973-74
13. Hydrogeologist, S.D. School of Mines & Technology research projects, Summers 1975, 1976, 1979, 1980, 1981, 1984-1993
13. Visiting Professor, Bucknell U., Lewisburg, PA., Spring Semester, 1989
14. Director, Black Hills Natural Science Field Station, 1995 to 1999.

Publications

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63. Taylor Drilling Co., Dye test in the Madison Limestone, 2010.
64. Crook County ranchers, Impacts from proposed Bakken pipeline, 2012.
65. Bearlodge Limited, Aquifer evaluation for Rare Element Resources, 2012.
66. R. Shawn Tornow, Aquifer study; re: Hanson County Dairy, % SD DENR Water Rights.
67. Fitzgerald Law Firm, Hydrology litigation in Spearfish, SD, 2014.

Arden D. Davis

Arden Davis received a B.A. degree in geology from the University of Minnesota and M.S. and Ph.D. degrees in geological engineering from South Dakota School of Mines and Technology. Dr. Davis currently is Professor Emeritus in the Department of Geology and Geological Engineering at South Dakota School of Mines and Technology. Since 1982 he has served as Instructor, Assistant Professor, Associate Professor, Professor, and Chairman of the Department of Geology and Geological Engineering. During that time he has worked on digital modeling of ground-water flow as well as transport and dispersion of subsurface contaminants. He taught courses in ground water, digital modeling of ground-water flow and contaminant transport, ground-water geochemistry, analytical methods in ground water, engineering and environmental geology, and geological engineering design.

Dr. Davis is a Registered Professional Engineer in South Dakota. He has served as associate editor and reviewer for the journal of Ground Water, and as a book reviewer for the Bulletin of the Association of Engineering Geologists. He also was chairman of the Council of Education and the Accreditation and Curricular Issues Committee of the Society for Mining, Metallurgy, and Exploration. From 2002 to 2007, Dr. Davis served on the Engineering Accreditation Commission of ABET. In 2007, he was appointed to the ABET Board of Directors and served a three-year term. In 2010, he was re-appointed to the ABET Board of Directors for a second three-year term.

During his career at South Dakota School of Mines and Technology, Dr. Davis worked extensively on ground-water projects and geological engineering site evaluations. He has been an investigator in more than fifty funded research projects. He also has given technical assistance to the South Dakota Department of Environment and Natural Resources in the review of mining plans and ground-water contamination problems, including Superfund sites. He and his co-researchers hold a U.S. patent for removal of arsenic from water, and they have applied for a second patent for removal of metals from water. As a consultant he provided expert witness testimony in cases involving water quality, environmental contamination, and disposal of waste. He gave expert witness testimony in regard to the Bakken Pipeline in Wyoming, the Transcanada Keystone Pipeline in eastern South Dakota, and the Keystone XL Pipeline in western South Dakota.

In his service to South Dakota School of Mines and Technology, Dr. Davis has acted as Geological Engineering Program Coordinator and ABET Coordinator for geological engineering accreditation. This included revision of the geological engineering curriculum, origination and teaching of new engineering design courses, and preparation of ABET reports. He also is active in ground-water protection efforts, and in 1998 received the Virginia Simpson Award for community service in the area of environmental protection. In 2007, he received the Ennenga Award for Excellence in Teaching. In 2014 he received the Ivan Rahn Education Award from SME, and in 2015 he was presented with the Distinguished Service Award of the Environmental Division of SME. South Dakota School of Mines and Technology presented him with the Presidential Award for Outstanding Professor in 2015.

Arden D. Davis

Academic rank:	Professor Emeritus of Geological Engineering	
Education:	B.A. - 1971	University of Minnesota (Geology)
	M.S. - 1979	South Dakota School of Mines and Technology (Geological Engineering)
	Ph.D. - 1983	South Dakota School of Mines and Technology (Geological Engineering)

Registered Professional Engineer (South Dakota; No. 4663)

Experience:	2015 - present	Professor Emeritus
	2006 - 2015	Professor
	2002 - 2006	Chairman Dept. of Geology and Geological Engineering S.D. School of Mines and Technology
	1995 - 2002	Professor S.D. School of Mines and Technology
	1989 - 1994	Associate Professor S.D. School of Mines and Technology
	1984 - 1989	Assistant Professor S.D. School of Mines and Technology
	1982	Instructor
	1976-1982	Teaching and Research Assistant
	1978	Shell Development (Shell Oil Company)

Teaching: Digital Modeling of Ground-Water Flow Systems, Ground Water, Ground-Water Geochemistry, Geochemistry, Analytical Methods in Ground Water, Advanced Ground Water, Engineering Field Geology, Geological Engineering Design Project I

Consulting: Ground-water hydrologist and geological engineering consultant for numerous projects over past thirty years involving ground-water contamination, aquifer evaluation, pipeline routing, low-level radioactive waste site evaluation, spring-flow measurements, and mine site development.

Funded research: Projects involving ground-water contamination, ground-water resource evaluation, aquifer vulnerability, water quality, and mine waste.

Community service: Ground-water protection efforts (see following pages).

Theses: Fifty two M.S. theses and twelve Ph.D. dissertations supervised.

Consulting:

2016	Water rights application
2015	Siting of pipeline; water rights application
2014	Spring discharges
2013	Spring discharges
2012	Expert witness testimony – proposed pipeline
2011	Spring discharges
2010	Madison aquifer well for municipal water supply.
2009	Expert witness testimony: springs and potential effects of nearby wells.
2008	Ground-water model for permit application.
2007	Siting of new Madison wells for public water supplies in the Black Hills.
2006	Modeling of ground-water flow and biodegradation of benzene.
2005	Modeling of ground-water flow and gasoline contamination.
2004	Ethylene dibromide contamination; expert witness.
2003	Alliance of Architects and Engineers; expert witness.
2002	Alliance of Architects and Engineers; expert witness.
2001	Consolidated Engineers & Materials Testing; GeoTek; expert witness.
2000	Hillcrest Spring Water; Rapid City Landfill; expert witness.
1999	Boyd County LLW Monitoring Committee; Gill Landfill modeling.
1998	Boyd County LLW Monitoring Committee; Rapid City Landfill.
1997	Boyd County LLW Monitoring Committee; Terra, Inc., modeling.
1996	Terra, Inc., modeling; Boyd County LLW Monitoring Committee.
1995	Terra, Inc.; modeling for City of Ida Grove, Iowa; Vogel Paint and Wax.
1994	Keystone Gold Project, Keystone, South Dakota. Dunbar Resort: proposed railroad grade, Deadwood, South Dakota. Vogel Paint and Wax Superfund Site, Maurice, Iowa.
1993	Keystone Gold Project, Keystone, South Dakota. Vogel Paint and Wax Superfund Site, Maurice, Iowa. Low-level radioactive waste site evaluation and modeling.
1992	City of Rapid City: criteria for private wastewater disposal facilities. Nitrate contamination from mine waste.
1991	Corrosion problems during geothermal heating.
1990	Low-level radioactive waste site evaluation. South Dakota Department of Environment and Natural Resources: cyanide contamination.
1989	Wastewater facility site evaluation. South Dakota Department of Environment and Natural Resources: review of mine plan, northern Black Hills.
1988	Expert witness: gasoline contamination of ground water.
1987	South Dakota Department of Environment and Natural Resources: modeling of gasoline contamination. Utility Engineering Company: aquifer test evaluation. Gasoline contamination of ground water.
1986	South Dakota Department of Environment and Natural Resources.

1985 South Dakota Department of Environment and Natural Resources: ground-water contamination.
1983 Rosebud Sioux Tribe: aquifer evaluation.
1981 Save Wyoming Water: drawdown calculations.
South Dakota Public Utilities Commission: aquifer evaluation.
1981 Evans Plunge, Hot Springs, South Dakota: spring discharges.
1979 U.S. Environmental Protection Agency; Engineering Science, Inc.

Community Service:

Assisted City of Rapid City and Pennington County in determining aquifer vulnerability in the Rapid City area. Assisted U.S. Environmental Protection Agency and South Dakota Department of Environment and Natural Resources as member of Technical Advisory Team, Gilt Edge Superfund Site.

Selected Publications:

Davis, A.D., 1986, Deterministic modeling of dispersion in heterogeneous permeable media: Ground Water, v. 24, no. 5, p. 609-615.

Davis, A.D., 1987, Determination of mean transmissivity values in the modeling of ground water flow, in Proceedings of International Conference on Solving Ground Water Problems with Models: National Ground Water Association, Dublin, Ohio, p. 1162-1174.

Davis, A.D., and Riding, D.R., 1989, A three-dimensional model of ground-water flow in the Madison aquifer at Annie Creek mine, northern Black Hills, South Dakota, in Proceedings of International Conference on Solving Ground Water Problems with Models: National Ground Water Association, Dublin, Ohio, p. 409-423.

Rizk, Z.S., and Davis, A.D., 1991, Impact of the proposed Qattara Reservoir on the Moghra aquifer of northwestern Egypt: Ground Water, v. 29, no. 2, p. 232-238.

Davis, A.D., 1992, Review of "Finite Element Techniques in Ground Water Flow Studies," in Bulletin of the Association of Engineering Geologists, v. 29, no. 4, p. 431-432.

Davis, A.D., 1994, Education of future ground-water professionals: Ground Water, v. 32, no. 5, p. 706-707.

Rahn, P.H., Davis, A.D., Webb, C.J., and Nichols, A.D., 1996, Water quality impacts from mining in the Black Hills, South Dakota, USA: Environmental Geology, v. 27, no. 1, p. 38-53.

Rahn, P.H., and Davis, A.D., 1996, An educational and research well field: Journal of Geoscience Education, v. 44, p. 506-517.

Rahn, P.H., and Davis, A.D., 1996, Gypsum foundation problems in the Black Hills area, South Dakota: Environmental and Engineering Geoscience, v. II, no. 2, p. 213-223.

Davis, A.D., Heriba, A., and Webb, C.J., 1996, Prediction of nitrate concentrations in effluent from spent ore: Mining Engineering, v. 48, no. 2, p. 79-83.

Davis, A.D., and Zabolotney, G.A., 1996, Ground-water flow simulations for the determination of post-mining recharge rates at the Belle Ayr Mine: Mining Engineering, v. 48, no. 11, p. 80-83.

Davis, A.D., and Rahn, P.H., 1997, Karstic gypsum problems at wastewater stabilization sites in the Black Hills of South Dakota: Carbonates and Evaporites, v. 12, no. 1, p. 73-80.

Webb, C.J., Davis, A.D., and Paterson, C.J., 1998, Comprehensive inventory of known abandoned mine lands in the Black Hills of South Dakota: Mining Engineering, v. 50, no. 7, p. 84-86.

Davis, A.D., Webb, C.J., and Durkin, T.V., 1999, A watershed approach to evaluating impacts of abandoned mines in the Bear Butte Creek basin of the Black Hills: Mining Engineering, v. 51, no. 9, p. 49-56.

Davis, A.D., Long, A.J., and Wireman, M., 2000, Sensitivity of the Madison aquifer to contamination in the Rapid City area of the Black Hills, in Strobel, M.L., and Davis, A.D., eds., Hydrology of the Black Hills: South Dakota School of Mines and Technology Bulletin No. 20, p. 12-19.

Davis, A.D., Capehart, W.J., Hjelmfelt, M.R., Kenner, S.J., Johnson, C.S., and Naus, C.A., 2000, Coupling of a ground-water model to atmospheric and surface-water models in the complex terrain of the Black Hills, in Strobel, M.L., and Davis, A.D., eds., Hydrology of the Black Hills: South Dakota School of Mines and Technology Bulletin No. 20, p. 65-72.

Davis, A.D., Long, A.J., and Wireman, M., 2002, KARSTIC: a sensitivity method for carbonate aquifers in karst terrain: Environmental Geology and Water Science, v. 42, no. 1, p. 65-72.

Davis, A.D., and Webb, C.J., and Beaver, F.W., 2003, Hydrology of the proposed National Underground Science Laboratory at the Homestake Mine in Lead, South Dakota: Preprint 03-59, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado.

Webb, C.J., Davis, A.D., and Johnson, C.S., Environmental evaluation of the Belle Eldridge Mine near Deadwood, South Dakota: Mining Engineering.

Davis, A.D., Beaver, F.W., and Stetler, L.D., 2003, Engineering problems of gypsum karst along the Interstate 90 development corridor in the Black Hills of South Dakota, in Johnson, K., and Neal, J., eds., Evaporite Karst and Engineering Problems in the United States: Oklahoma Geological Survey Circular 109, p. 255-261.

Webb, C.J., and Davis, A.D., 2003, Arsenic remediation of drinking water using modified limestone: ACS Paper 726161, American Chemical Society.

Davis, A.D., Webb, C.J., and Nelson, K.C., 2004, Acid rock drainage and the potential for impacts at selected abandoned mine sites in the Black Hills National Forest: Preprint 04-49, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 3 p.

Davis, A.D., and Webb, C.J., 2005, Progress toward a National Underground Science and Engineering Laboratory at the Homestake Mine in Lead, South Dakota: Preprint 05-33, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 3 p.

Miller, S.L., Kenner, S.J., Davis, A.D., and Silva, A.J., 2005, Characterization of naturally occurring acid rock drainage and impacts to the North Forks of Rapid Creek and Castle Creek in the Black Hills near Rochford, South Dakota: Proceedings, South Dakota Academy of Science, v. 83, p. 83-89.

Davis, A.D., and Webb, C.J., Progress toward a Deep Underground Science and Engineering Laboratory at the Homestake Mine in Lead, South Dakota: Mining Engineering.

Miller, S.L., Davis, A.D., and Lisenbee, A.L., 2005, Vulnerability (risk) mapping of the Madison aquifer near Rapid City, South Dakota (abstract), in Kuniansky, E.L., ed., U.S. Geological Survey Karst Interest Group Proceedings: U.S. Geological Survey Scientific Investigations Report 2005-5160, p. 163.

Stetler, L.D., and Davis, A.D., 2005, Gypsum and carbonate karst along the I-90 development corridor, Black Hills, South Dakota (abstract), in Kuniansky, E.L., ed., U.S. Geological Survey Karst Interest Group Proceedings: U.S. Geological Survey Scientific Investigations Report 2005-5160, p. 134.

Epstein, J.B., Davis, A.D., Long, A.J., Putnam, L.D., and Sawyer, J.F., 2005, Field Trip Guide 2, Karst features of the northern Black Hills, South Dakota and Wyoming, in Kuniansky, E.L., ed., U.S. Geological Survey Karst Interest Group Proceedings: U.S. Geological Survey Scientific Investigations Report 2005-5160, p. 232-282.

Davis, A.D., Webb, C.J., Dixon, D.J., Sorensen, J.L., and Dawadi, S., 2006, Arsenic removal from drinking water by limestone-based material: Preprint 06-034, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 3 p.

Davis, A.D., Webb, C.J., Dixon, D.J., Sorensen, J.L., and Dawadi, S., 2007, Arsenic removal from drinking water by limestone-based material: Mining Engineering, v. 59, no. 2, p. 71-74.

Davis, A.D., Webb, C.J., and Sorensen, J.L., 2007, Environmental reclamation and monitoring of the abandoned Belle Eldridge Mine near Deadwood, South Dakota: Preprint 07-39, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 3 p.

Webb, C.J., Campbell, C., Davis, A.D., Dawadi, S., Dixon, D.J., and Sorensen, J.L., 2006, Arsenic remediation of drinking water using limestone-based material: American Chemical Society, Division of Environmental Chemistry, ACS Symposia Paper 941321.

Davis, A.D., 2006, Case 4: Geological engineer, in Baura, G.D., Engineering ethics: an industrial perspective, Chapter 16, Case studies: Elsevier Academic Press, Burlington, Massachusetts, 220 p.

Davis, A.D., Webb, C.J., Dixon, D.J., Sorensen, J.L., and Dawadi, S., 2007, Arsenic removal from drinking water by limestone-based material: Mining Engineering, v. 59, no. 2, p. 71-74.

Davis, A.D., Webb, C.J., Sorensen, J.L., and Valder, J.F., 2007, Environmental monitoring of the abandoned Belle Eldridge Mine near Deadwood, South Dakota: Preprint 07-39, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 3 p.

Chintalapati, P.K., Davis, A.D., Hansen, M.R., Sorensen, J.L., and Dixon, D.J., 2009, Encapsulation of limestone waste in concrete after arsenic removal from drinking water: Environmental Earth Science, v. 59, no. 1, p. 185-190.

Davis, A.D., Roggenthen, W.M., Stetler, L.D., Hladysz, Z., and Johnson, C.S., 2009, Post-closure flooding of the Homestake Mine at Lead, South Dakota: Mining Engineering, v. 61, no. 3, p. 43-47.

Davis, A.D., Dixon, D.J., and Webb, C.J., 2010, Arsenic in water from mine workings and wells of the Keystone area in the Black Hills of South Dakota: Preprint 10-020, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 5 p.

Davis, A.D., Dixon, D.J., Webb, C.J., and Betemariam, H., 2010, Removal of arsenic and heavy metals from mine drainage and ground water in the Black Hills of South Dakota: Manuscript TP-10-039, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 4 p.

Davis, A.D., and Elifrits, C.D., 2010, The importance of ABET engineering accreditation to SME: Mining Engineering, v. 62, no. 5, p. 77.

Davis, A.D., Dixon, D.J., Webb, C.J., and Betemariam, H., 2011, Removal of arsenic and heavy metals from mine drainage and ground water in the Black Hills of South Dakota: Technical Paper 11-022, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 4 p.

Valder, J.F., Long, A.J., Davis, A.D., and Kenner, S.J., 2012, Multivariate statistical approach to estimate mixing proportions for unknown end members: Journal of Hydrology, v. 460-461, p. 65-76.

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Betemariam, H., 2013, Laboratory testing of arsenic and heavy metals removal from mine drainage and ground water in the Black Hills of South Dakota: Environmental Earth Sciences, DOI 10.1007/s12665-013-2956-0, Springer, published online 06 December 2013.

Davis, A.D., Webb, C.J., Sorensen, J.L., and Dixon, D.J., Thermodynamic constraints on arsenic and heavy metals removal from water with limestone-based material: Technical paper13-035, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado, 4 p.

Betemariam, H., Stone, J.J., McCutcheon, C., Penn, M.R., DeSutter, T., Davis, A.D., and Stetler, L.D., 2013, Geochemical behavior and watershed influences associated with sediment-bound mercury for South Dakota lakes and impoundments: Journal of Water, Air, and Soul Pollution, v. 224, no. 4.

Davis, A.D., Webb, C.J., Sorensen, J.L., Dixon, D.J., and Betemariam, H., 2014, Laboratory testing of arsenic and heavy metals removal from mine drainage and ground water in the Black Hills of South Dakota: Environmental Earth Sciences, v. 72, no. 2, p. 355-361 (previously published online by Springer, 06 December 2013).

Webb, C.J., and Davis, A.D., 2017, Remediation of arsenic in drinking water (Chapter 3), in States, J.C., ed., Arsenic: Exposure Sources, Health Risks and Mechanisms of Toxicity: John Wiley and Sons.

Rahn, P.H., Detwiler, A.G., and Davis, A.D., 2017, Tritium in groundwater in the Black Hills of South Dakota: Environmental Earth Sciences, 76: 762. https://doi.org/10.1007/s12665-017-7082-y

Selected Presentations:

Rahn, P.H., and Davis, A.D., 1991, Hydrogeology of a proposed low-level radioactive waste disposal site near Butte, Nebraska: Association of Engineering Geologists, Proceedings of 34th Annual Meeting, Chicago, Illinois.

Wang, J., Hjelmfelt, M.R., Capehart, W.J., Kenner, S.J., and Davis, A.D., 1998, Coupled atmospheric-hydrologic numerical simulation of a flash flood event: Part 1. Atmospheric simulation: American Meteorological Society, Hydrology Conference, Phoenix, Arizona.

Davis, A.D., and Long, A.J., 1998, Ground-water issues in the coupling of a subsurface flow model to atmospheric and surface-water models in complex terrain: GEWEX Continental-Scale International Project, Annual Meeting, St. Louis, Missouri.

Davis, A.D., Webb, C.J., and Nelson, K.C., 2004, Acid rock drainage and the potential for impacts at selected abandoned mine sites in the Black Hills National Forest. Presented at 2004 SME Annual Meeting, Denver, Colorado.

Webb, C.J., and Davis, A.D., Arsenic remediation of drinking water using modified limestone: American Chemical Society, Anaheim, California.

Miller, S.L., Davis, A.D., and Lisenbee, A.L., Long, A.J., Putnam, L.D., Lester, J.D., and Hargrave, R.G., 2004, Vulnerability mapping of the Madison aquifer near Rapid City area, South Dakota: Western South Dakota Hydrology Conference, Rapid City, South Dakota, April, 2004.

Lisenbee, A.L., Davis, A.D., Paterson, C.J., Stetler, L.D., Miller, S.L., and Hargrave, R.G., 2004, Geologic atlas of the Rapid City West 7.5-minute quadrangle: Western South Dakota Hydrology Conference, Rapid City, South Dakota, April, 2004.

Davis, A.D., and Webb, C.J., 2005, Progress toward a National Underground Science and Engineering Laboratory at the Homestake Mine in Lead, South Dakota: Annual Meeting, Society for Mining, Metallurgy, and Exploration, Salt Lake City, Utah, February, 2005.

Davis, A.D., Webb, C.J., Dixon, D.J., and Sorensen, J.L., 2006, Arsenic removal from drinking water by limestone-based material: SME Annual Meeting, Technical Program: Limestone – Nature's Miracle Rock; March, 2006, St. Louis, Missouri.

Davis, A.D., 2006, Modeling of natural biodegradation of gasoline contamination at a site in eastern South Dakota: Presented at 18th Annual Environmental and Ground Water Quality Conference, March, 2006, Pierre, South Dakota.

Sorensen, J.L., Davis, A.D., Dixon, D.J., and Webb, C.J., 2006, Development of an agglomeration process to increase the efficiency of limestone-based material for removing metals from drinking water: Presented at 18th Annual South Dakota Ground-Water Quality Conference, March, 2006, Pierre, South Dakota.

Sorensen, J.L., Davis, A.D., Dixon, D.J., and Webb, C.J., Controlling factors on arsenic removal from water by limestone-based material: Western South Dakota Hydrology Conference, April, 2006, Rapid City, South Dakota.

Webb, C.J., Campbell, C., Davis, A.D., Dawadi, S., Dixon, D.J., and Sorensen, J.L., 2006, Arsenic remediation of drinking water using limestone-based material: American Chemical Society, Division of Environmental Chemistry, Symposium on Current Status of Research on Arsenic Remediation, 231st National Meeting, March 26-30, Atlanta, Georgia.

Davis, A.D., Dixon, D.J., and Sorensen, J.L., 2006, Fixed-bed adsorption column studies and engineering scale-up design of a limestone-based metals removal technology: Eastern South Dakota Water Conference, Brookings, South Dakota, November, 2006.

Valder, J.F., and Davis, A.D., 2006, Pumping test and assessment of the Deadwood aquifer at Jewel Cave National Monument, Custer County, South Dakota: Geological Society of America, Annual Meeting, October, 2006, Philadelphia, Pennsylvania.

Hocking, C.M., Lisenbee, A.L., and Davis, A.D., 2007, Vulnerability of the Madison aquifer, Hayward quadrangle, South Dakota: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Johnson, D., Lisenbee, A.L., and Davis, A.D., 2007, Aquifer characteristics of Precambrian basement rocks in the Pactola Dam quadrangle, South Dakota: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Lisenbee, A.L., Francisco, E.M., Davis, A.D., and Pellowski, C., 2007, Vulnerability of the Inyan Kara aquifer, Hermosa and Hermosa NW quadrangles, Black Hills Development Corridor: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Francisco, E.M., Lisenbee, A.L., and Davis, A.D., 2007, Aquifer vulnerability in the Blackhawk quadrangle, South Dakota: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Davis, A.D., Webb, C.J., Sorensen, J.L., and Valder, J.F., 2007, Environmental monitoring of the abandoned Belle Eldridge Mine near Deadwood, South Dakota: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Valder, J.F., and Davis, A.D., 2007, Pumping tests in the Deadwood aquifer at Jewel Cave National Monument, Custer County, South Dakota: Western South Dakota Hydrology Conference, April 19, 2007, Rapid City, South Dakota.

Davis, A.D., and Elifrits, C.D., 2011, ABET Geological Engineering and Mining Engineering Criteria Training: Society for Mining, Metallurgy, and Exploration, February 26, 2011, Denver, Colorado.

Davis, A.D., Webb, C.J., Sorensen, J.L., and Dixon, D.J., 2013, Thermodynamic constraints on arsenic and heavy-metals removal from water with limestone-based material: Annual Meeting, Society for Mining, Metallurgy and Exploration, Denver, Colorado, February, 2013.

Davis, A.D., Lisenbee, A.L., Price, M.H., Aurand, A., Bednar, J., and Tekle, M., 2013, Water-quality sampling of Precambrian crystalline aquifers in the central Black Hills: Western South Dakota Hydrology Conference, Rapid City, South Dakota, April 18, 2013.

Davis, A.D., and Elifrits, C.D., The importance of ABET engineering accreditation to SME: Presented to the SME Board of Directors, February, 2013.

Davis, A.D., Elifrits, C.D., Keaton, J.R., and Sweigard, R., SME Program Evaluator Training: Presented to geological engineering and mining engineering program evaluators, SME Annual Meeting, Denver, Colorado, February, 2013.

Davis, A.D., Lisenbee, A.L., and Price, M.H., Smith, G.R., Walega, E.A., and Tiruneh, H.W., Groundwater quality in Precambrian crystalline aquifers of the central Black Hills: Western South Dakota Hydrology Conference, Rapid City, South Dakota, April, 2014.

Davis, A.D., Groundwater resources and potential issues in northwestern South Dakota: New Horizons Oil and Gas Conference, Rapid City, South Dakota, April, 2014.

Davis, A.D., Elifrits, C.D., Skaggs, G.L., and Sweigard, R., SME Program Evaluator Training: Presented to geological engineering and mining engineering program evaluators, SME Annual Meeting, Denver, Colorado, February, 2014.

U.S. Patent:

Webb, Cathleen Joyce, Arden Duane Davis, and David John Dixon, "Method and composition to reduce the amounts of arsenic in water," United States Patent 7,790,653, 7 September 2010.

Provisional U.S. Patent Application:

Webb, Cathleen Joyce, Arden Duane Davis, and David John Dixon, "Method and composition to reduce the amounts of heavy metal in water," United States Patent and Trademark Office, Provisional application for patent, SDSM-1064434, Serial no. 61/393,806.

Related research:

Grainger Prize for Sustainability: HydroTech Engineering and Rohm & Haas (collaboration): Limestone-based arsenic-removal method; selected for Round II of competition.
Recent Research Funding:

National Science Foundation: SGER: Characterization of the Precambrian Aquifer at the Homestake DUSEL: Dr. Larry D. Stetler, Dr. Arden D. Davis, and Dr. Rohit Salve (Lawrence Berkeley Laboratory), $75,000.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Acidic Leaching Tests to Determine Arsenic Mobility from Concrete-Encapsulated Limestone Waste: Dr. Arden D. Davis, Dr. M.R. Hansen, and Dr. David J. Dixon, $12,131.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Investigation of Arsenic Removal from Water by Microbiologically Induced Calcite Precipitation: Dr. Arden D. Davis, Dr. Sookie S. Bang, and Dr. David J. Dixon, $13,983.

U.S. Bureau of Land Management: Belle Eldridge Mine Sampling and Monitoring, Phase III, $4,500 (additional); Arden D. Davis, Principal Investigator.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Development of an agglomeration process to increase the efficiency of limestone-based material to remove metals from drinking water: Dr. Arden D. Davis and Dr. David J. Dixon, $10,897.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Fixed-bed adsorption column studies and engineering scale-up design of a limestone-based metals removal technology for small water supply systems: Dr. Arden D. Davis and Dr. David J. Dixon, $12,918.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Leaching tests for encapsulation of waste after arsenic removal from drinking water: Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. M.R. Hansen; $11,873.

U.S. Department of the Interior, National Park Service; Jewel Cave Pumping Test; Dr. Arden D. Davis, Principal Investigator; $8,800.

U.S. Bureau of Land Management: Belle Eldridge Mine Sampling and Monitoring, Phase III, $4,500 (additional); Arden D. Davis, Principal Investigator.

West Dakota Water Development District: Determination of historic ground water pollution problems, Part II: Pactola Dam, Rapid City West, and the North One-Half of Rockerville quadrangles; $9,162; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer susceptibility study of the Pactola Dam quadrangle, South Dakota: Part II – Precambrian: $9,112; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer mapping (1:24,000) of the Hermosa NW quadrangle; $13,538; Dr. Alvis L. Lisenbee, Principal Investigator; Dr. Arden D. Davis and Dr. Larry Dr. Stetler, Co-Principal Investigators.

West Dakota Water Development District: Preliminary aquifer vulnerability and susceptibility study of the Blackhawk quadrangle; $15,988; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Geologic mapping of the Mt. Rushmore quadrangle, South Dakota; $14,970; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

West Dakota Water Development District: Aquifer vulnerability study of the Rockerville quadrangle, South Dakota; $14,763; Dr. Alvis Lisenbee, Principal Investigator; Dr. Arden D. Davis, Co-Principal Investigator.

Phase I Small Business Innovation Research Grant, U.S. Environmental Protection Agency, Limestone-Based Material for Arsenic Removal from Drinking Water: Dr. Cathleen J. Webb, Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. Terrence L. Williamson; $100,000.

Phase II Small Business Innovation Research Grant, U.S. Environmental Protection Agency, Limestone-Based Material for Arsenic Removal from Drinking Water: Dr. Cathleen J. Webb, Dr. Arden D. Davis, Dr. David J. Dixon, and Dr. Terrence L. Williamson; $225,000.

National Science Foundation, Statewide Partnership to Support Technology Innovation and Entrepreneurship in South Dakota (PFI), University of South Dakota: Arsenic Removal from Drinking Water; John C. Lofberg, Dr. Arden D. Davis, and Dr. David J. Dixon; $35,826.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase IV: Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth Price; $44,000.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase III: Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth Price; $41,000.

U.S. Geological Survey 104b Grant Program / South Dakota Water Resources Institute: Investigation of the Contribution of Coliform Contamination in Runoff from Scoured Bed Sediments: Dr. Jennifer L. Benning, Dr. Scott J. Kenner, and Dr. Arden Davis, $14,913.

West Dakota Water Development District: Crystalline Aquifers of the Central Black Hills, South Dakota: Phase II; Dr. Laurie Anderson, Principal Investigator; Dr. Alvis L. Lisenbee, Dr. Arden D. Davis, and Dr. Maribeth H. Price, Co-Principal Investigators; $33, 020.

Pete Lien and Sons, Inc: Optimization and characterization of iron-loaded limestone as a medium for the removal of arsenic from drinking water; Dr. Arden D. Davis, Principal Investigator; Dr. David J. Dixon, Co-Principal Investigator; $8,800.

City of Custer, South Dakota: Water Sampling of Crystalline and Alluvial Aquifers at Custer, South Dakota: Dr. Arden D. Davis, Principal Investigator; Dr. J. Foster Sawyer, Dr. Alvis L. Lisenbee, and Dr. Maribeth H. Price, Co-Principal Investigators; $25,000.

U.S. Department of the Interior, Bureau of Land Management: Environmental Monitoring of the Belle Eldridge Mine: Dr. Arden D. Davis, Principal Investigator; $5,000.

Appendix G

Declarations of
Steve Sitting Bear, Butch Thunder Hawk, Cedric Goodhouse, Evelyn Goodhouse, Geraldine Agard, and Theo Iron Cloud

Declaration of Steven Sitting Bear

1. I am an enrolled member of the Standing Rock Sioux Tribe. I am currently working for the Tribe as External Affairs Director. In my current position, I am generally responsible, under the Tribal Chairman's direction, for coordinating the Tribe's interactions and relations with other governments and various private organizations. My previous position was as the Deputy Director of the North Dakota Indian Affairs Commission.

2. Apart from my service in the military, and my time as a college student, I have lived most of my life on the Standing Rock Sioux Nation. I live on the Standing Rock Reservation today, in Fort Yates, North Dakota.

3. Throughout my life, hunting and fishing Treaty rights have been a central part of my family's way of life. Treaty hunting and fishing provides subsistence that is important to sustaining our communities, while also serving as an important way to transmit our values and culture across generations.

4. As a child, I had family in both Fort Yates and Cannonball – two Standing Rock communities adjacent to Lake Oahe where I spent much of my time hunting and fishing. I spent considerable time in both communities. My family in those days for the most part lived in poverty. Money was very scarce, and the housing we lived in was in poor condition.

5. During all those years, my family survived by exercising our Treaty right to hunt and fish on the Reservation. We particularly relied on hunting as a primary method to feed the family. This was clearly a subsistence activity – basically we had to hunt or we would not eat, and there were nights where we went to bed hungry. In those days, our primary game was deer. But we also hunted for antelope, rabbits, grouse, turkey and even prairie dogs. We had to do this to provide food for the table, and this hunting was not just for recreation.

6. Since Treaty hunting provided a major part of our diet, it was important to ensure that we had enough to eat for the winter. While those families in our communities who were fortunate enough to have freezers used those to freeze deer meat for the winter, we did not always have that option. My Grandmother's house did not have consistent refrigeration accessible – partly because electricity was not consistently available. Instead, my Grandmother dried meat to preserve it for the long winters. I can recall long ropes that were hung in my Grandmother's home. She would hang them across every wall, every open space she could reach. When we came home with a deer, she would cut the meat into strips, and hang those strips on the ropes to dry. This was how we ate in the winters – the dried meat that we brought home from hunting was prepared by my Aunts and Grandmother. The other parts of the animal were also used for various needs and activities. For example, my Grandmother and Aunts tanned the deer hides and used the leather for making outfits for my sister and me to wear at pow-wows. Horns and other animal parts were used for other ceremonial purposes.

7. As a boy, at a very young age I was taught the ethics of hunting and fishing with respect to our culture and traditional ways. I was taught that everything has a Nagi' – a spirit – and it is important to respect the land, the water, the air and all living things. I remember a time when one of my Uncles took me hunting as a young boy. I was thirsty so I drank a soda pop, and I when I was done, I threw the can on the ground. My uncle told me very directly that this was not acceptable – that we must respect the land. My Uncle said that much of our lands have been taken, and it is most important to respect and protect the land we have left. I was taught that our ancestors fought to save these lands and waters for us, and we must preserve them so that our children's children will one day be able to provide for themselves as well. Everything my family

hunted and fished for, we used and we were thankful for because without it, some may have starved.

8. After I graduated from Standing Rock High School, I joined the military. I served in the United States Marine Corps as an Infantryman and completed two Western Pacific Tours. After the military, I enrolled in college. As it turned out, as a young father I did not have the funds to complete college at that time, so I returned to the Reservation. But jobs on the Reservation were extremely scarce. So, I turned to the activities I knew from my childhood – hunting and fishing. I became a hunting guide for non-Indians who wished to hunt on the Reservation. I saved the money I earned as a hunting guide and that enabled me to return to college. I graduated with honors from the University of North Dakota in 2012 with dual bachelor degrees in Sociology and Criminal Justice Studies. If it were not for the hunting and fishing resources on the Reservation that provided a way for me to enhance my economic situation, I would not be where I am today.

9. In 2012, I founded an organization called Hunting the Rock. The purpose of this organization is to teach the youth of Standing Rock about hunting and fishing. I started this organization because hunting and fishing played a central role in sustaining my family. Also, I had relatives who took me hunting and taught me the cultural principles involved as a young boy. But my mentors passed on while I was still young, and after that I had to develop my physical hunting skills largely on my own. Once my primary mentors were gone, for a period of time as a young man I began to focus somewhat less on their cultural teachings – and for a while I hunted beyond what was needed for subsistence. Members of our Tribal community saw this, and they made sure that I understood the great significance of following the teachings of our ancestors. I appreciated their guidance in encouraging me back to the proper path, and I made

sure after that to conduct all of my hunting and fishing consistent with the ethical and cultural principles I had been taught.

10. Based on this overall experience, I have come to understand the importance of providing ongoing mentorship with respect to Treaty hunting and fishing. In founding Hunting the Rock, I want to pass along the hunting and fishing skills that I have learned to the younger generation, so that they can continue the ways that sustained our people for generations. Today, we have hundreds of youth who have taken part in our Hunting the Rock events. The traditional ways are important and must be sustained. In addition, hunting and fishing are active outdoor activities that foster both an appreciation of the natural world, and a healthy lifestyle. So, this organization has events to teach the youth about the fundamentals of hunting and fishing. In learning these things, the youth gain self confidence in their abilities and a stronger connection with Tribal traditions and culture. I have heard from many families on the Reservation that they want their youth to learn how to be self-sufficient, and hunting and fishing provides a sound foundation in that regard. I find it very gratifying to help our youth learn and become more confident and self-sufficient, with a greater understanding of the traditional ways of our ancestors.

11. I have been hunting and fishing at Standing Rock for 30 years. I have learned the importance of subsistence hunting and fishing to our people. For example, the Tribe has a program to provide deer or other game to Tribal members who are elderly or disabled and cannot hunt for themselves. Each year, I participate in this program, hunting deer or antelope for elderly or disabled Tribal members who need it. The number of animals I personally take for other Tribal members varies – usually 2-6 per year. In each case, I skin the game, and butcher it for every possible ounce of meat. Then I label the cuts of meat and date them and bring the meat to

the people. This is a lot of work, but it is worth it to help the Tribal members who need this. While some of the people freeze this meat, others still use drying techniques like my Grandmother used when I was a boy. Either way, this is an important source of food which helps people get through the winter.

12. The practice of having hunters take deer and other game for the subsistence of our elderly and disabled is very widespread at Standing Rock. Essentially, every Tribal hunter I know at Standing Rock (and I personally know most of the Tribal member hunters) participates and helps in this way. This is all for the subsistence and well-being of our elderly and disabled. Many people at Standing Rock (including me) also fish for the elderly and disabled for subsistence purposes.

13. While there is game at Standing Rock throughout the Reservation, it is my experience that the vast majority of hunting takes place along the rivers, including especially along Lake Oahe. These areas are heavily wooded and game is most plentiful.

14. I have been involved with Treaty hunting and fishing on the Reservation for most of my life. It has provided subsistence for my family, a source of economic progress when I needed it, and a basis for maintaining and transmitting our cultural values. In my view, if the hunting and fishing resources on the Reservation were impaired by an oil spill, it would be an absolutely devastating event for the Tribe. These resources are still very widely relied upon by many of our Reservation families for subsistence today. There are still many families that dry meat for the winters – so if there were no fish and game, many people would face dire food shortages. It would only increase dependence on the government. And, as we work to teach our youth the values of our people, including the importance of self-reliance, if there were no fish and game as a result of an oil spill, those efforts would be greatly undermined. What would I tell

our youth in the face of an oil spill that destroyed our game and fish? Our ancestors lived their lives by relying on this game and fish for centuries, but now (I would have to explain) the game and fish are gone and you must look elsewhere to sustain your families and our culture. That is a conversation that I hope never becomes necessary.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on July 13, 2017 at 1:06 cst.

Steven Sitting Bear

Steven Sitting Bear

Declaration of Butch Thunder Hawk

I, Butch Thunder Hawk, declare as follows:

1. My name is Butch Thunder Hawk. I am an enrolled member of the Standing Rock Sioux Tribe. I was born in 1946 and grew up on the Standing Rock Reservation in Cannonball.

2. When I was growing up, I learned from my grandparents and other elders about how to hunt, and fish, and gather plants from our Reservation. The waters of the Missouri River were especially important for all of these activities. Before the Army Corps built the Oahe Dam in the 1950s and flooded our Reservation, my family and other families relied heavily on the bottomlands along the Missouri River for food and water. For generations, our people built their homes and lived along the bottomlands and we had access to food sources from plants, game, fish and also water. We also used plants for medicines and teas.

3. We drank the water directly from the Missouri River. I remember when I was young, while I was in elementary school, there was an older gentleman who had a team of horses and a wagon that carried water barrels. He would travel through our community and ask families if they needed water. And he would go to the Missouri River to fill the barrels. As kids, we rode with him to the river and helped him fill the barrels, and then helped him deliver the water to our families and the rest of the community.

4. Because of the Missouri River, the bottomlands along the river were rich with trees, game, plants and fruit.

5. Plants have been an important source of food and medicine for us. Along the river, in the bottomlands and in ravines, we found and gathered plums, chokecherries, juneberries, and wild raspberries. These would be preserved, made into jams and jellies, and used for food. I also remember my grandma and aunts using plants and mints to make teas. We did not drink soda or pop, but had many different kinds of tea, made from the plants that our families gathered. The plants and flowers along the river have also been important because of their use as medicine.

6. In addition to providing food and medicine, gathering wild fruit and plants, along with hunting and fishing, is also an important part of our culture and traditions. For example, in July, August and September, when certain fruits or berries were ripe, we would go out as a family – grandmas, parents, aunts, uncles and children. These were important community events. As children, we played in the ravines, but we also helped gather fruit and plants, and hunted and fished. There would be big harvest. At these events, some people would come back with deer or pheasant. Others would have plums, berries and other plants. Everyone would share and everyone would benefit. These were important parts of our traditions and the ways in which we defined ourselves, passed on traditions and knowledge from generation to generation, and supported each other as a community.

7. Our elders taught us the proper way to gather plants. We only took what we needed to survive. And there was always a prayer before gathering was done. We were also taught how to take a plant so that it would continue to grow. There were certain ways to pick certain berries that were rare like sand cherries. I remember how we gathered wild turnips. We did not use metal shovels, but special digging sticks. And although we took the root, we were taught to always put the flower back into the hole that was dug. There were special rules for gathering medicine plants such as cutting them a certain way instead of pulling them out by the roots. Also, it was very important that we do not take more than we need – to ensure that we leave some for other people, especially in future years.

8. There is special traditional knowledge among our people about using plants for medicine. The older women in our Tribe had extensive traditional knowledge and knew where to find plants, how to harvest them, and how to use them for healing illnesses. I am not a medicine man, but I grew up learning from some of these women, my aunties, so I still know where to go to find important plants and how to use them.

9. When the Army Corps built the dam and flooded our Reservation, we lost the best of our lands. Our people were forced to leave their homes along the river, and move to higher ground on the plains. They were given $650 to move, and the houses where they were forced to relocate were called "650-houses."

10. The flooding of our land also took away the best opportunities we had to gather plants for food and medicine. Before the dam was build, the plants that provided us with food and medicine were abundant and everywhere along the Missouri River. Now with the Dam there are less, and we have to find them in different places. Many are still located near the Missouri River and the rivers and creeks that connect to the lake. But because many important plants have become scarce, those that remain are more precious and need protection.

11. If there was an oil spill in Lake Oahe, it would be devastating. Any oil spill would do great damage to the remaining plants and resources along the river. Those that are left might be lost forever.

12. An oil spill would also harm to our culture and religion and the important way in which we view water, plants and the land. The water of the Missouri River is a lifeline. It connects the land, the plants, the fish and the game.

13. In our Treaties with the United States, we were promised the land so that we could survive. Our Treaty rights to hunt, fish, and gather are essential for our survival. They feed our people directly and spiritually. The land and water is for future generations. Our Creator put plants and animals on the land for a reason. It is for our survival, not to e destroyed by big money or big business or oil.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 11-7-17 2017 at 1:32 pm, North Dakota.

Butch Thunder Hawk

Declaration of Cedric Goodhouse

I, Cedric Goodhouse, declare as follows:

1. I am an enrolled member of the Standing Rock Sioux Tribe. I am 65 years old. I have lived almost all my life on the Standing Rock Sioux Reservation.

2. I grew up in Wakpala, a town on the South Dakota portion of the Reservation. The place where I grew up is now all permanently flooded as a result of the Oahe Dam that was built in the 1950s. The loss of these lands is very painful for me and for many others in the Tribe.

3. The Missouri River has always been important to us and it still is. When I was young, my family would go to the river daily. We would take a wagon with barrels to fill with water. And at that time, we could drink the water directly out of the river. There would be places in the river where there were pools, and when the water swirled in, it would also settle. The water in these pools was so clear that you could see the river bottom and the fish. I remember how my older brother would sharpen a stick and catch fish by spearing them.

4. Along the river, there were trees and we would collect wood for fuel. I remember that, as kids, we would help our Grandpa to collect saplings which we would wrap on either end so that they could then be hung on the wall of the house and used as kindling during the winter.

5. Along the river, we also picked berries depending on the season. Some berries aren't ready until the fall, like buffalo berries and wild grapes. Wild grapes are not sweet until after the first cold and we would pick them after the first cold spell. Other times of the year, we would pick juneberries and sand cherries. We collected chokecherries and made patties out of them. We would gather other plants too. One was a type of fern. In May or June, as these ferns first began to flower and looked like a fist, my Mom would take the tops and put it in soup.

6. We gathered different kinds of mushrooms and wild asparagus. We also gathered plants for medicines to keep us well. There is a plant that is good for the kidneys. My Mom would harvest the root, hang it to dry, and later boil it for medicine. We also used crocus. We took the middle part of the flower and used it like a talc.

7. Along the river, our family would also shoot rabbit and other game for food, like pheasant and deer of all kinds—mule deer, white-tailed deer and black-tailed deer. Today, the Tribe regulates hunting, and there is a specific hunting season to conserve the herd. In the past, we could take deer all year round, but we also knew when and how to hunt deer so that we did not damage the deer population. We knew which deer were reproducing and which ones were not by their color. The ones that were no longer reproducing and could be taken were the ones that no longer changed color, and their hide stayed a yellow-greyish color. In addition to the meat, we used the hide to make *Wakesa* and to braid ropes.

8. We also used plants to make dyes. There is a nut that was used to make a black dye, and certain flower petals are used to make yellow.

9. I remember many times when we would go to the river with our Mother and would spend the whole day there. She would bring a frying pan and some lard. She would make fry bread and she would then cook whatever fish or game we caught.

10. We never needed to go into town for food or medicine. During the fall, my Mother and my Aunt would dry meat for the winter. I remember meat hanging to dry all over the house. And if, during the winter, we were lacking food, we would just go over the hill and hunt.

11. In the evenings, we always ate together as a family. We prayed and ate, and my father and uncles would tell us stories that are important part of our traditions.

12. I, and others in my family, still do these things, although with the flooding of the river, it is much harder to find plants and game is more scarce. We still gather turnips, sage, and mushrooms and different types of plants for tea. We still go to the Missouri River to get water that we use for sweats and other ceremonies. There is still something to gather every season. There are still women in our Tribe who use porcupine quills and do quill work for traditional clothing or for ceremonial items.

13. The drums that we use for ceremonies are made of tanned hide. I have several drums that need to be fixed. I have let the hunters in our Tribe know this fall, so that they can bring their deer hides to me to tan so I can fix the drums.

14. I have taught our traditions to my children and grandchildren, nieces and nephews. We still fish. We still collect chokecherries and make patties. And when we are out gathering I show them what I was taught about the plants and what to do with them.

15. We only take what we need. Because these are now scarce, it takes time to gather them. Next year, we will be holding a memorial, so we have from now until then to prepare and to gather what we need to be able to feed 100 people—to make 100 cherry patties.

16. I have taught my sons (JD and Rick) how to hunt in the way of our traditions. To teach them, we went out very early—at 4 or 5 in the morning—and just sat and waited along a ridge. One time as we were waiting, we saw a deer and my son wanted to shoot it. But I told him to wait and to look at the color of the deer's hide to know whether or not it was ok to take this deer. And we waited to take a deer that was safe to take. It is important that our children have these experiences and learn these traditions.

17. When I spend time with my grandchildren, we get up and out early and do all of these things. I also teach them how to make things in the traditional way. We are also

traditional Lakota singers. When my grandchildren are with me, we shut off the TV and tell them to turn off their phones and we sing. Their Grandmother writes the Lakota words of the songs on paper, and what they mean in English, and we then sing those words before we put a drum to the song. These are traditional songs—some for gathering, others about important places and events in our history and culture. I teach all these things so that they will know them and practice our traditions—just as my parents and grandparents taught me.

18. Because of the Dakota Access oil pipeline, our people are now living in unnecessarily stressed conditions. It is real stress and it is unnecessary. That pipeline's route should have gone straight east and then south and it never would have had to cross the water. We always felt like the Army Corps never looked at the middle ground – so that the pipeline could be built without crossing the water.

19. I worry about the oil pipeline and an oil spill. We have tried our best to work with the Army Corps to make sure that they understand how important the land and the water and the game, fish and plants that are sustained by the water, is to us, and how we use and rely on these resources. I have tried to tell them about what all of these mean to us -- how we were not given a bible, but we were given these stories and traditions which are tied to the land and water and which we have passed on from generation to generation. We have spent time with the Corps to explain these things, and some Corps officials have even taken sweat with us. But there are always new people working for the Corps, who were not told and who do not know or understand what we have shared, or who are not the same people who are making the decisions that affect our lands and our waters. I make this statement in the hope that it will help the Corps understand how important the land, the water, the plants, fish and game are to us and why we cannot risk an oil spill.

20. After the first Oahe Dam I said, "how can it get any worse?" Then, the Dakota Access Pipeline happened. It is another generation of extreme stress they put upon us. They don't see it, but it would be different if it affected other people. They say, "oh, those people can move." But where would we move when the pipeline breaks? Haven't we moved enough? They don't understand that we are tied to this place and it is all we have left.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 11/2 2017 at Fort Yates, North Dakota.

Cedric Goodhouse

Declaration of Evelyn "Sissy" Goodhouse

I, Evelyn "Sissy" Goodhouse, declare as follows:

1. My name is Evelyn "Sissy" Goodhouse. I am 59 years old, and an enrolled member of the Standing Rock Sioux Tribe. I have lived on the Standing Rock Sioux Reservation all of my life.

2. Being raised in the Cannonball community on the Reservation, I was taught by my parents and grandparents how to live from the land and the water—especially along the Missouri River. The things I learned I have taught to my children and grandchildren and to my students at the Standing Rock Community Grant School in Fort Yates. What we did, and what we do with plants, fish and game, are what are ancestors did and are a part of our lives.

3. I was born before the Oahe Dam flooded our Reservation. Although I was a little girl at the time, I remember when it happened, and when my family had to move out of our home along the river, away from the river to a "650 house."

4. When I was growing up, my family was poor. We survived because we had wild game, fish, berries and plants.

5. When you walked along the river, you could get anything and everything you needed to eat. I remember how my Dad would walk along the river. He carried his gun and when he came home he would always have some kind of wild game—beaver, rabbit, or deer. He hunted for his Mother too (she lived next to us) to make sure that she had food for herself and for the 9 grandchildren who lived with her.

6. On these walks along the river, my Dad would also bring back berries and plants. My Dad also fished. He always had a setline in the River.

7. In addition to meat and fish, we gathered onions, turnips and squash. We found mushrooms that grew in the trees along the river. I remember my Dad cutting wood from those trees, to heat our house.

8. In summer, as kids, we would take off and walk along river, and we always came back with berries or wild grapes. Our Grandmas used the berries to make chokecherry patties—this is something sweet and a traditional food. We ate very healthy.

9. We dried meat and always had dried deer and antelope. We also dried turnips and squash to have them over the winter. We dried fish and berries. My Grandma dried fish in the sun. She lived in a log house and the logs were big, so we could climb onto the roof and put the cherries on the roof to dry.

10. As poor as we were on my mother's side, we always had food from the land and the river and we were always able to host powwows. Food is an important part of these traditional celebrations. At powwows, we feed everyone, and there were giveaways that included giveaways of food like dried meat. This is still done today and our traditional foods are an important part of our powwows. In Cannonball, this was a community effort. Everyone shared at the pow-wows and had to help each other.

11. We also used plants to make tea. My Grandma, where she lived, would get leaves from different trees and make tea. We always had tea.

12. Many plants are used for medicine. My Grandma and aunties would dig roots from certain plants, and chew them up to make a salve for cuts. We collected every kind of berry, and on the buffalo berry tree, there is a mushroom that is used to smudge to deal with strokes. We also use this today all the time in our ceremonies like the sundance and sweatlodges; even throughout our daily lives. We also had *wastemina* (sweet flower). In

addition to rubbing it, would chew it like toothpaste. We also gathered bitterroot, and sweet grass. My uncle also showed us a kidney medicine from a plant that has small flowers. You pick them and boil them. I have used this medicine and it works to cure a kidney infection.

13. I remember how my Grandma used other plants, like crocuses. I still look for these. You just use the inside of the plant, rub it on your hands to help with irritated skin. Today, however, you have to look hard for these plants.

14. We also gathered mouse beans. These are beans that mice would collect. The mice stash these beans, put them in bushes which would look like a little mound with grass on it but covered with poison ivy or poison oak. We learned how to find these. You use a forked branch and flip the top and find the beans. You could probably find some now, in the late fall.

15. My family and I still gather plants. When we find chokecherries or buffalo berries, we collect them. I recently came across a plant, which is used by young ladies to make their hair healthy. I also found wild rhubarb and wild onions—which we put in food and soups. When we see these things, we gather them.

16. When we pick berries, mushrooms and plants we don't take a whole bunch. You only take some. Grandma taught us to be careful not to be greedy. Now we have to really look at what plants we have and try to preserve them somehow. But we still have favorite spots where can still find these.

17. Our children and grandchildren also do all of these things. My husband Cedric taught our boys about hunting. He always tells the boys that when deer turns a certain color, don't shoot because they may be reproducing. You need to know the color of the deer to know whether it is ok to take them. This is also true for other game like antelope.

18. Like my Dad, our son still fishes along the river. Our son goes ice-fishing and get a lot of fish during the winter. My son also goes ice-fishing. He grew up with the river, and also has a deep-rooted feeling for the river. His sons—ages 5 and 6—do so too. My grandchildren, one who is only in first grade, ask us to take them fishing. And everyone knows how to swim.

19. I know how important the river to our people because of what I hear from my students. Last year, I got a message from a teacher in Arkansas who asked about how the students felt about the Dakota Access pipeline. My students, junior and seniors, wrote back. I remember one who responded by saying that "we will go swimming until we cannot swim anymore in the river." This really struck me. We don't have swimming pools. Like us, our kids find places to swim in the river, and they fish, and they make their entertainment along the river. What this student said really reminded me of how safe we always feel in the river. It sustains us. An oil pipeline threatens this.

20. The lands, especially along the river are also sacred because our relatives, our ancestors, are buried there. This is true along the Missouri River and also on the other side, north of the Cannon Ball River. What is sacred below is sacred above too—extending into the sky.

21. We have to keep our earth and soil and water clean so we can use it for medicine. If oil gets into the ground, then we cannot use the plants for medicine. There are things that we have to use which must be pure. For example, we boil sage water and make sage tea. There are times in certain ceremonies, where it is important to wash using sage water, and the water and sage must be clean. My son and other men also get rocks by the river for the sweat lodge.

22. We teach all these traditions to our grandchildren. My youngest grandchild, who was born in May, will know his history. We will tell him everything and we want him to know

everything about fish, and wild foods. When my husband and I take care of our grandchildren, we do traditional things and eat traditional foods.

23. I worry about whether these things will be there for them. I worry about being able to give them medicine to stay healthy, or to get beans, or set lines to fish at the river. What about hunting—will they be able to go to the river to hunt? When I heard about the pipeline, I thought of my dad hunting and feeding us from right where the pipeline crosses—it is very upsetting.

24. An oil spill would be devastating for our culture and traditions. Our men are used to hunting, they are used to providing meat for food, and our women to use the meat, fish and plants to make a home. Our people really live by that. So, when you look at our hunting and fishing, we have to be able to do that. Our prayers, plants, and water are all tied together Our relatives are buried on these lands. We gave up a lot of land to be here and to be safe.

25. I pray hard so that my grandchildren know these things and can sing in our traditional way. I want them to be able to be happy to do these things. But we need to do more to educate the Corps and others about this and our rights, and that the promises made in the treaty are real and true -- so that our lands and waters are protected.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 11/2 2017 at Ft. Yates North Dakota.

Evelyn "Sissy" Goodhouse

Evelyn "Sissy" Goodhouse

Declaration of Geraldine Agard

I, Geraldine Agard, declare as follows:

1. My name is Geraldine Agard. I am an enrolled member of the Standing Rock Sioux Tribe. I am 64 years old and have lived almost all my life on the Standing Rock Reservation.

2. I, and many other members of the Standing Rock Sioux Tribe, are very traditional and live a traditional life. I learned these traditions as I grew up. When I was young, we relied on all kinds of fish, game and plants for subsistence as well as ceremonial purposes. We ate every kind of game and fish including deer, antelope, duck, pheasant, grouse , prairie chicken, rabbit, beaver, and turtles.

3. We also relied heavily on plants. We gathered wild mushrooms, wild turnips, plum cherries, buffalo berries, sand cherries and gooseberries.

4. As a child, I also learned from my mother and grandparents how to preserve food. We made *papa saka*, which is dried deer jerky. We preserved berries by boiling or drying them. We learned to do these things to survive throughout the year, especially through the winter.

5. Hunting, fishing and gathering were done on a communal basis. In our culture, we share what we have with our families and with those in need.

6. I remember how this was done when I was young. I come from a family of ten. My Dad owned a grain truck. He would make arrangements with a group of young men who he would pick up early on a Saturday morning to hunt. I was a tomboy and would go with them to spot game. I had my Dad's binoculars to spot the hunters and look for game. My Dad would say, just wait, and after a while, we would hear the guns go off as the men got deer. We would then pick them up with the deer that they shot. That deer taken in that group hunt would then be shared, and that is how we all fed our families.

7. My family and many other tribal families still hunt deer and depend on deer for both subsistence and ceremonial purposes. We also still hunt duck, and other wild birds, as well as small game and fish to put food on the table.

8. In our religion, for any kind of ceremony, we need and use traditional foods. This includes deer papa and berries and corn to make *wasna or pemmican*. We still gather wild mushrooms that grow on trees. We still gather wild turnips, berries, and plums.

9. Today, the Tribe manages hunting and fishing on the Reservation by issuing licenses. I and many other members of the Tribe rely on these licenses to take deer and antelope and fish. As an elder, I do not hunt. But I get the tribal licenses and then appoint a designated hunter to use that license to provide me with an antelope and deer. My brother is now also an elder eligible to have designated hunters, and because of the importance of antelope and deer meat, I plan to make sure that my brother also gets a designated hunter to shoot deer for us.

10. Everyone within the Tribe still depends on deer meat. People in need call me and ask me for deer meat, and berries *wojapi* or pudding. Just last week, in mid-October, someone called me for *gabla* (to make dried deer meat). I share the food that I have with my family and with those who are in need.

11. I have taught my son and my nieces our traditions and how to prepare food in the traditional way, and they come to me for help. My nieces call me with questions, like how to boil berries and cherries and how to remove the pits. I teach them what I was taught by my parents and grandparents. I teach them that everything you do teaches patience, and you do these things not just for yourself but for your families and for those less fortunate. The way we eat is what keeps us who we are. It keeps us Lakota. Without the traditional foods, we don't exist as a people.

12. I fear an oil spill from the Dakota Access pipeline. An oil spill would threaten everything we rely on. I do not understand why the company or the Corps would allow this, except that it is all about money. But for us, it is all about food.

13. I have worked in our Tribal government and have dealt with the Army Corps over the years. The Army Corps could have worked to help us regarding the proposed pipeline, but they didn't. They could have protected us, but instead they are allowing the company to get rich with all the risk on the Tribe. For us, our traditions are more important than money.

14. Because of the oil pipeline, I question what future there will be for our people. I have grandchildren, and I worry about whether they will be able to hunt, fish and gather plants and berries that are sustained by the Missouri River the way our people have always done. These traditions regarding hunting, fishing and gathering define us as a people. We have our own culture, religion, and traditions that we live by, and they are deeply rooted in hunting, fishing and gathering.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 11/2 2017 at Ft. Yates North Dakota.

G. Agard

Geraldine Agard

Declaration of Theo Iron Cloud

I, Theo Iron Cloud, declare as follows:

1. I am an enrolled member of the Standing Rock Sioux Tribe. I am 79 years old and have lived almost all my life on the Standing Rock Sioux Reservation.

2. When the Treaties were signed with the United States, our grandparents were there. The United States promised us that we would have the lands for as long as the grass grows. But those promises were broken.

3. In the 1950s the Corps flooded our best lands along the Missouri River, and took the trees that we traditionally used to build our houses. We were forced to move. My husband, Vernon, hid from the Corps so that they would not be able to serve their papers on him. But his 80 acres of land are still in the water.

4. By flooding our best lands, the Corps also destroyed many of our traditional foods. Along the river bottom, in the elm trees, we got mushrooms. We also collected wild onions, wild carrots, and squash. We also collected mouse beans. These are like lima beans. They are collected by mice and stored. We knew how to look for the mounds where the mouse hid them and we gathered those beans. We also gathered plants for medicines.

5. Over the summer and into September, we gathered berries. We would preserve the fruit right away. We would use old curtains, and put the berries on them to dry. Some fruit, we would slice first, and then put them on a cloth on a table to let them dry. We did this with squash and wild turnips too. We dried them so that we would have the food through the winter. We use the dried food by frying and baking them. These berries grew best along the river bottom before the land was flooded.

6. The river was, and still is, an important place to find game, like deer, rabbit, beaver and raccoon. We dried the meat so we would have it through the winter. We also relied on the river for fish, which is still important.

7. These traditional foods kept us healthy. Many of us now suffer from diabetes, but diabetes was not a problem in the past.

8. We still dry meat and berries. I taught my daughters how to do these things too, and how to use every part of an animal that is taken. I remember my Aunt telling me that when you become a mother, you also become a teacher. My daughter knows this too. She knows that it is now up to her to teach her children. I help her in doing this.

9. The game that we take is also used for traditional cultural and ceremonial purposes. My husband Vernon, from the time when we were first married, has tanned and painted hides in the traditional way to make boxes for me and our daughters and knife sheaves for our sons. I still have that box and I use it to hold sacred items, like eagle feathers and ceremonial clothes.

10. When we are asked how we use the water or how we view the Missouri River, we answer—Mni Waconi. We have heard this term since we were little and it is the only way to describe how important the River is to us. We know how to live off the land and the water, and the game, fish and plants which are given life by the water. We know how to take care of ourselves. But we cannot survive if the water is polluted.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge. Executed on 11-2 2017 at ______, Wakpala, South Dakota.

Theo Iron Cloud

Theo Iron Cloud