Cumulative Environmental Risk of Crude Oil and Natural Gas Pipelines in the 1837, 1837, 1842, and 1854 Ceded Territories

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Assessment of Cumulative Environmental Risk for Crude Oil and Natural Gas Transmission Pipelines in the Ceded Territories

The network of pipelines that crosses the Ceded Territories has not been assessed for combined environmental impacts. The purpose of this document is to provide information that will inform GLIFWC's work to protect habitats that are necessary for treaty protected natural resource harvests. Cumulative risk characterization is also important because of efforts to renew existing pipeline permits such as the special use authorization in the Chequamegon-Nicolet National Forest, and to permit new pipelines such as the Line 5 re-route in Wisconsin and the proposed Line 5 tunnel at the Straits of Mackinaw.

Since the gas and oil pipeline network in the Ceded Territories is extensive and intersects with many natural and cultural resources, cumulative risks should be considered. The construction and excavation of the right-of-way has filled wetlands, altered vegetation, modified streambanks and soils, and contributed to changes in land use. In addition to these impacts, the continued operation of crude oil and natural gas pipelines means that there continues to be a likelihood of spills and explosions anywhere along a pipeline.

Risk of a Pipeline Incident

The specific risk of a spill or explosion for any single pipeline is difficult to determine because that calculation depends on a large number of variables (e.g., subsurface stress, maintenance, chemical degradation). However, a general estimate of release risk may be made by considering the recent history of releases from crude oil pipelines within the United States. An analysis of spill risk was developed by the U.S. Forest Service (Appendix 3.1-A) and is summarized below:

> Information on crude oil pipelines operating within the Unites States from 2004 to 2017 was obtained from the Pipeline and Hazardous Materials Safety Administration (PHMSA) website (https://www.phmsa.dot.gov/). An annual average of 42,517 barrels of crude oil was released from all incidents (186 per year average) with an average unrecovered volume of 11,820 barrels or 29%. This equates to an average volume of 228 barrels released and 64 barrels unrecovered per incident. To better understand the risk in terms of the range of potential spills volumes and volumes not recovered, additional available data on individual crude oil spill incidences was downloaded from the PHMSA website for the years 2010 to 2018. This information was narrowed down to attempt to identify those that represented actual onshore crude oil pipeline spills by restricting them to incidences involving onshore pipelines. It was further narrowed down by screening out causes identified as equipment failure (non-pipeline) or operator error incorrect operation as these indicate spills that likely are not due to structural failure of the pipeline. The data does include valve sites as it did not allow differentiation between spills involving valves and the pipeline.
>
> The average annual number of reported crude oil pipeline system incidents and the number of crude oil pipeline miles from 2007 to 2017 were used to estimate an upper end

of potential release risk by assuming all incidents resulted in releases. It should also be noted that incidents include both pipelines and pipeline-associated facilities. This constitutes an annual average of one release incident per 318 miles of pipeline, or, alternatively, as much as 0.0031 incidents per mile of pipeline per year. Based on past crude oil pipeline incidents, the 1,277 miles of crude oil pipeline in the ceded territories can expect approximately 4 crude oil pipeline incidents every year. As explained in Appendix 3.1-A, this is considered an upper end estimate.

Because pipeline spills and explosion incidents have occurred, it is reasonable to assume that they will occur again as long as the pipelines remain operational. The following analysis identifies natural resources that lie within the hazard zone of crude oil and natural gas transmission pipelines and provides an assessment of the cumulative risk of spills and explosions to those resources and to tribal use of those resources. In general, the analysis follows methods detailed in an Environmental Protection Agency guidance document titled "Applying Cumulative Impact Analysis Tools to Tribes and Tribal Lands" (Appendix 3.1-B). The analysis is based on spatial relationships of geographic features, meaning that any natural feature (e.g., lake, river, species) that intersects a pre-defined pipeline hazard zone is considered at risk of being impacted by a spill and/or explosion event.

Scale of Cumulative Environmental Risk Analysis

Spatial scope may be the most important factor in an analysis of cumulative environmental risk. An analysis with a spatial scope that is too small will potentially miss impacts that may be important to quantify when developing results or conclusions. Conversely, a spatial scope that is too large will potentially provide information that is unrelated to the project under analysis. As detailed in Appendix 3.1-B, the following considerations were used to define the spatial scope of the cumulative environmental risk analysis:

1. The ceded territories where Ojibwe Tribes have reserved usufructuary rights.
2. Resources that may be impacted. The areas are defined by the hazard zone, but it should be noted that different resources will have hazard zones of different sizes. For example, the hazard zone for rivers will be larger than the hazard zone for terrestrial vegetation because oil can travel greater distances in water than over land.
3. Cultural and natural resource considerations rather than the management or regulatory interests of any agency. For example, even though the Forest Service may be considering a permitting decision on approximately 11 miles of Line 5 that runs through the Chequamegon Nicolet National Forest, the oil and gas transmission network covers a greater area. For cumulative analysis the entire network presents a risk to the ceded territories that cannot be separated from the permit area in question.

An analysis of natural resources potentially affected by releases along oil and gas transmission lines is presented at three scales.

1. The 1836, 1837, 1842, and 1854 ceded territories. Until now a comprehensive accounting of oil and natural gas pipeline related risks to treaty reserved resources in

the Ceded Territories of GLIFWC's member tribes does not exist. This analysis scale is needed in order to understand the implications of permitting decisions to tribes.
2. National Forest Lands. This focus provides an example of analysis directly related to decision making by an agency. This scale is also important because National Forests are important areas of tribal hunting and gathering activities.
3. The Line 5 crude oil pipeline. This pipeline is different from other pipelines when it comes to its environmental risk. Characterizing those differences is important given that permitting decisions are made on a pipeline-by-pipeline basis.

Crude Oil Pipeline Hazard Zone

The hazard zone for spilled oil is a combination of land and aquatic hazard zones. The land hazard zone for spills at crude oil pipelines is defined as 2,500 feet from the pipeline for a total corridor width of 5,000 feet. This distance is based on spill and explosion hazards. For oil spills, the hazard zone is calculated by adding the distance that spilled oil would typically travel over flat ground (1,214 feet from the pipeline) with an additional distance of 1,050 feet for estimated migration in groundwater. The combined distance of 2,264 feet on either side of the center line is rounded to 2,500 feet. This method was chosen after a review of existing information, particularly the Final Environmental Impact Statement for the Line 3 Replacement Project in Minnesota (MDOC, 2018). The crude oil pipeline hazard zone in the ceded territories is 423,080 acres.

The aquatic hazard zone is added to the land hazard zone because crude oil can be highly mobile in water (Hollebone, 2017). For rivers that intersect the pipeline and the land hazard zone it is assumed that the entire downstream stretch of river could be impacted by oil to and including any lakes that the river flows into. The presence of two dams in a potentially impacted river are considered sufficient to stop downstream oil flow. The entire area of lakes that intersects the land hazard zone and potentially impacted rivers are considered potentially impacted. Finally, all sections of wetlands that intersect the land hazard zone and border potentially impacted rivers or lakes, are considered as potentially impacted by spilled oil.

The explosion hazard zone is derived from the evacuation distance for oil spill (300 meters or 984 feet) and fire (800 meters or 2,625 feet) listed in the Enbridge Energy Field Emergency Response Plan for the Lake Superior Region (Enbridge, 2017). A distance of 2,500 feet on either side of the center line was selected to match the land and aquatic hazard zones described above. It is important to note that the explosion hazard zone does not include areas potentially affected by air quality impacts from (e.g. smoke). The spatial extent of air quality impacts is dependent on many site-specific factors and cannot be characterized in this analysis.

Natural Gas Pipeline Hazard Zone

The primary hazards associated with natural gas transmission pipelines are explosion and fire. The blast radius or evacuation zone is the distance from the pipeline that fire damage can be expected to occur. It is also the distance beyond which people would need to move in order to avoid burns or respiratory injuries in the event of a pipeline explosion. This distance is calculated based on the diameter of the pipe and the pressure at which natural gas is transported (Figure

3.1.1). In the ceded territories, PHMSA data indicates that diameters of natural gas pipelines range from 4 to 42 inches. Information on transportation pressure is not available. Given that operating pressures of pipelines can be increased by an operator and pipelines can be upgraded to increase capacity, a blast radius of 3,500 feet was used to represent the evacuation zone. This distance is close to the maximum distance in Figure 3.1.1 would be an appropriate evacuation zone for the majority of natural gas pipeline incidents in the Ceded Territories because it maximizes protection of human life consistent with a worst case analysis.

Recommended Minimum Evacuation Distances
For
Natural Gas Pipeline Leaks and Ruptures
(Not applicable for Butane, Propane, or other Hazardous Liquids)

Pressure (psig) \ Pipeline Size (inches)	4	6	8	10	12	16	20	22	24	30	36	42
100	91	137	182	228	274	365	456	502	547	684	821	958
200	129	193	258	322	387	516	645	709	774	967	1161	1354
300	158	237	316	395	474	632	790	869	948	1185	1422	1659
400	182	274	365	456	547	730	912	1003	1094	1368	1642	1915
500	204	306	408	510	612	816	1020	1122	1224	1529	1835	2141
600	223	335	447	558	670	894	1117	1229	1340	1675	2011	2346
700	241	362	483	603	724	965	1206	1327	1448	1810	2172	2534
800	258	387	516	645	774	1032	1290	1419	1548	1935	2322	2709
900	274	410	547	684	821	1094	1368	1505	1642	2052	2462	2873
1000	288	433	577	721	865	1154	1442	1586	1730	2163	2596	3028
1100	302	454	605	756	907	1210	1512	1664	1815	2269	2722	3176
1200	316	474	632	790	948	1264	1580	1738	1896	2369	2843	3317
1300	329	493	658	822	986	1315	1644	1809	1973	2466	2959	3453
1400	341	512	682	853	1024	1365	1706	1877	2047	2559	3071	3583
1500	353	530	706	883	1060	1413	1766	1943	2119	2649	3179	3709
1600	365	547	730	912	1094	1459	1824	2006	2189	2736	3283	3830
1700	376	564	752	940	1128	1504	1880	2068	2256	2820	3384	3948
1800	387	580	774	967	1161	1548	1935	2128	2322	2902	3482	4063
1900	398	596	795	994	1193	1590	1988	2186	2385	2981	3578	4174
2000	408	612	816	1020	1224	1631	2039	2243	2447	3059	3671	4283
2100	418	627	836	1045	1254	1672	2090	2299	2508	3134	3761	4388
2200	428	642	856	1069	1283	1711	2139	2353	2567	3208	3850	4492

Figure 3.1.1 - Minimum evacuation distances for natural gas pipelines (NTSB, 2015)

Within the evacuation zone, the analysis also includes a high consequence zone. This is an area where damage from a natural gas pipeline explosion is expected to be catastrophic and there is a high risk of death to people and wildlife. Based on available model data (Figure 3.1.2), the high consequence area for this analysis is a radius of 1,100 feet on either side of a natural gas pipeline (Stevens, 2000).

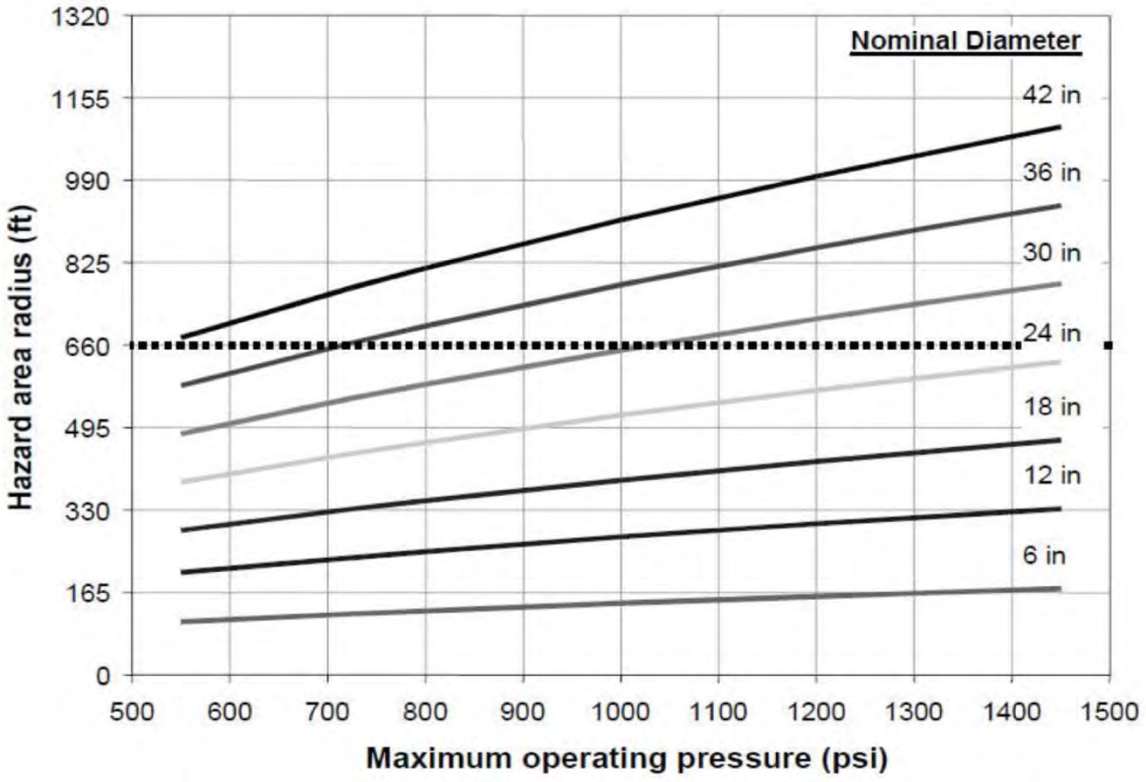

Figure 3.1.2 - Model curves for sizing high consequence areas (Stevens, 2000).

Risk to Human Health

Oil spills and explosions can affect human health through direct skin contact, inhalation, or ingestion of crude oil and gaseous byproducts. The Enbridge Line 6B spill in the area of Marshall, Michigan, involved public health responses to air quality, surface water and fish, and possible groundwater impacts (Michigan Department of Community Health, 2015). Public health was of concern because 40,000 people lived within a mile of the affected release area. Though no residents were located in the area with the highest impacts on air, nearby residences did relocate as a result of odors. An evacuation of the Notawaseppi Huron Band of the Potawatomi was ordered because of concerns about possible explosions. The resulting damage is still affecting the environment and the tribe almost 10 years later. Loss of life related to pipeline incidents can involve pipeline company employees and the general public (MDOC, 2018). Repair of an Enbridge pipeline near Clearbrook, Minnesota, resulted in the deaths of two pipeline workers in 2010 when leaking oil ignited (Duluth News Tribune, 2010). People are known to use the Line 5 pipeline right-of-way and tribal members engage in treaty harvest activities in the vicinity. The presence of the pipeline presents some level of risk in the spill and explosion impact areas.

Figure 3.1.3 - Explosion at an Enbridge natural gas pipeline that impacted the Lheidli T'enneh First Nation in British Columbia, Canada (https://globalnews.ca/news/4531677/prince-george-fire-evacuation/)

Risk at Ceded Territory and National Forest Scales

The Ceded Territories have 1,277 miles of crude oil pipelines and 6,460 miles of natural gas transmission pipelines. Oil pipelines are located in three right-of-way corridors that converge at the Enbridge Terminal in Superior Wisconsin. Natural gas transmission pipelines are widely distributed throughout the Ceded Territories (Figure 3.1.4).

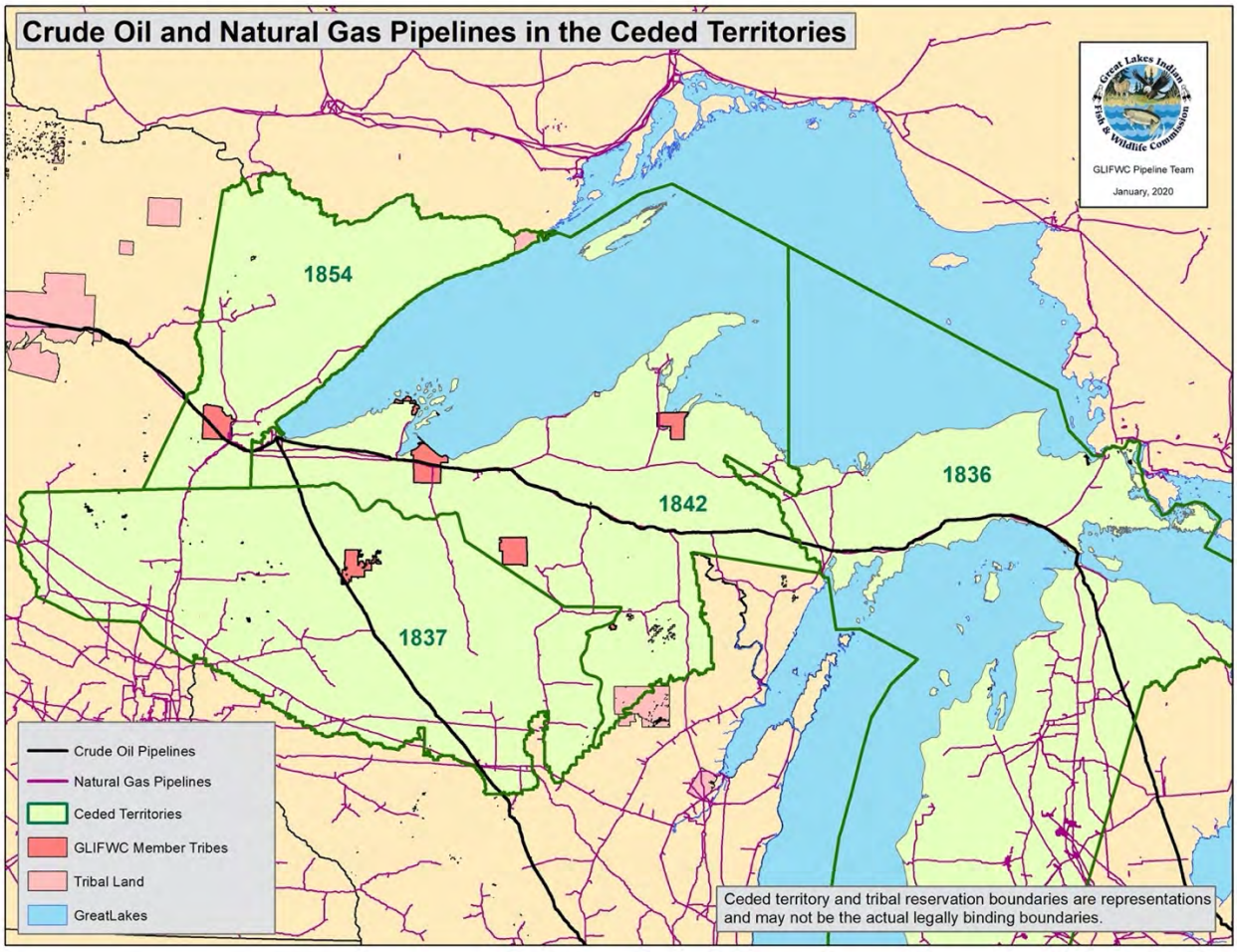

Figure 3.1.4. Crude oil and natural gas pipelines in the 1836, 1837, 1842, and 1854 ceded territories.

Crude Oil Spill Risk – Aquatic Environments

Oil released into aquatic environments is difficult to recover in large quantities because water surface and weather conditions must be sufficiently calm to permit recovery equipment to function well and for response personnel to safely operate the equipment (International Tanker Owners Pollution Federation Limited, 2016). Oil spilled into surface waterbodies generally floats initially and is transported by winds and currents depending on the waterbody type and conditions during the spill. Spills tend to spread shorter distances in standing water such as lakes and ponds with minimal currents. However, wind can increase oil dispersal in those surface waters. Currents in streams and rivers transport oil downstream, and thus impacts are likely to

occur over greater areas than in lakes or ponds. The Saskatchewan River spill of 2016 had oiling impacts up to 217 miles downstream of where oil entered the river. The distance that spilled oil travels in flowing water can be considerable (Hollebone, 2017) and the specific morphology and flow of a stream will determine downgradient oil impacts. In larger, fast-moving rivers and creeks, oil would be quickly dispersed downstream with the flow of the river, while in smaller flowing streams and backwater eddies an oil spill could have a more localized effect on the water column and surrounding habitat due to the lower volume and rate of water flow.

Figure 3.1.5 - Impacts to the river and riparian wetlands from the Kalamazoo oil spill (Photo courtesy of the USEPA Region 5).

Wetlands, including marshes, swamps, peat bogs, and fens, are particularly sensitive to oil spills. In wetlands, small areas of shallow water, finer sediments with high organic content, greater vegetation cover, and high biochemical oxygen demand (leading to anaerobic conditions) would affect the dispersion and weathering of spilled crude oil. Oil spilled into wetlands could be widely dispersed by wind or water movement and would typically become stranded on fine sediments or vegetation. In this case, oil would not likely travel as far as it would in open water. Transport out of a wetland may occur via small stream discharge points. If the spilled oil becomes entrained within anaerobic sediments, the rate of biodegradation may be significantly reduced (Boufadel et al. 2015).

The fate and transport of crude oil in groundwater is a complex process. The USGS has been conducting research into this topic at the site of an Enbridge pipeline crude oil spill in Bemidji, Minnesota. The spill occurred from a ruptured pipeline that released approximately 10,700 barrels of oil. After recovery efforts, including a pump and treat system, it is estimated

that approximately 2,000 barrels remain underground. Continued research at the USGS Bemidji research lab has shown that when spilled oil enters the groundwater system, biological activity is minimal, and the oil can be expected to remain in the aquifer for decades. Furthermore, contaminants such as benzene, toluene, ethylbenzene, xylene (BTEX), and polycyclic aromatic hydrocarbons (PAHs) are commonly present in groundwater plumes from crude oil. (https://www.usgs.gov/mission-areas/environmental-health/science/us-geological-survey-identifies-crude-oil-metabolites?qt-science_center_objects=0#qt-science_center_objects). The groundwater oil plume at the Bemidji, MN site has been relatively stable over time and biodegradation of oil is extremely slow. Revesz et al. (1995) calculated that the minimum life expectancy of the release was 110 years. However, they stated that this was an order of magnitude estimate due to expectations that calculated degradation rates used for the estimate would actually be slower in the future. It is unclear if the oil in groundwater will attenuate in the foreseeable future.

Freshwater fish are important components of aquatic ecosystems and food webs, as well as major economic resources in recreation and commercial fishing industries. Fish can be affected by oil releases through multiple exposure pathways and at multiple life stages, and the toxicity effects can be either acute, chronic, or indirectly related to contamination of habitat features (Enbridge 2016d). The Marshall, Michigan, spill resulted in 42 dead fish immediately after the spill, which was considered negligible (USFWS 2015). Though scientists and local officials debated the exact cause, roughly 100 dead fish were found following the crude oil release to Wabamun Lake (Birtwell 2008). The Pine River, Missouri spill resulted in 1,637 observed dead fish immediately following the spill. These fish tended to be larger, bottom-feeding fish, with a small proportion (<15 percent) being surface feeders. Fish mortality was noted up to 30 miles downstream of the release. Longer term effects of spills include habitat degradation and sublethal effects, including deformities. Longer term effects of the Marshall spill included declines in abundance and diversity of fish in Talmadge Creek in the year following the release. Recovery occurred shortly thereafter, but changes in fish community composition also occurred in response to spill induced habitat changes in the following three years (USFWS et al. 2015). Sublethal effects on fish were present for 27 miles downstream of the release site, as revealed by a fish health study two months following the spill (Papoulias et al. 2014). Fish consumption advisories were issued for two years as a result of crude oil exposure. In Wabamun Lake, important juvenile and spawning habitat for various species was significantly affected by oil contamination, and in the two years following the spill, increases in fish deformities were attributed to the spill.

The Pine River spill also impacted benthic organisms. Immediately following the spill event, benthic populations within the affected area were 0.1 percent of typical populations, with a complete loss of mayfly and stonefly species. By 9 months following the release, the mayfly and stonefly populations had recovered to levels observed in unaffected areas upstream of the spill (Crunkilton and Duchrow 1990). By 18 months, the mayfly and stonefly populations had recovered to levels observed in healthy Missouri streams. In a similar 18-month timeframe at a separate Missouri pipeline spill (Gasconade River, 1988, intermediate weight sweet crude), macroinvertebrate communities had not fully recovered in their diversity and abundance due to residual hydrocarbon contamination, which was particularly concentrated in sloughs (Poulton et

al. 1997). Greater recovery had occurred in riffle habitats where more frequent bed scour helped to flush oil contamination from sediments.

Numerous bird species spend their time near or within waterbodies and can be highly susceptible to oil spill impacts. The Marshall, Michigan, spill affected roughly 400 birds, 52 of which died shortly after the spill (USFWS et al. 2015). An additional 144 birds affected by released oil were captured and rehabilitated, and roughly 140 birds were observed with oil effects but were not captured. Affected birds were generally waterfowl, including Canada geese, mallard ducks, and great blue herons. For comparison, of the birds affected by the Rainbow Pipeline release, approximately one-third were waterfowl and two-thirds were shorebirds and songbirds. The explosion of the Husky refinery in Superior Wisconsin also impacted birds. EPA reports indicate that 3 grackles, 3 robins, 1 starling, 1 American bittern, 2 geese, 1 redwing blackbird, and 4 unidentified birds were killed as a result of oiling. In addition, 9 geese (5 adults and 4 goslings), 3 mallards, 3 killdeer (1 adult and 2 chicks), and 1 robin were cleaned and released back into the environment. Finally, 30 adult geese and 63 goslings had to be relocated from the impacted area. It should be noted that the wildlife survey occurred several days after the explosion so these numbers of impacted birds are likely a fraction of the total impact.

Figure 3.1.6 - Great Blue Heron oiled during the Enbridge pipeline spill in Marshall Michigan (Photo courtesy of the Michigan Department of Environment, Great Lakes, and Energy EGLE).

Reptiles and amphibians are particularly vulnerable to oil spills. In the event of an oil spill, an external oil coating of skin or scales in amphibians and reptiles can lead to reduced thermoregulatory capacity and suffocation in amphibians. Amphibians may absorb toxins from oil through their skin. Exposure to toxins that occurs during egg formation in reptiles and amphibians can lead to reduced productivity and teratogenic effects. Reptiles, such as turtles, may be more susceptible to carcinogenic effects of PAHs compared to shorter-lived animals (Burns et al. 2014). The timing of a spill is important for impacts to reptiles and amphibians. Spills in winter over ice may cause fewer impacts to reptiles and amphibians. However, spills

that occur in warm periods of the year are disastrous to these animals. The Marshall, Michigan spill occurred at a time of receding flood flows in the Kalamazoo River. As a result, oil was distributed into and trapped within floodplain depressions, resulting in a substantial effect on amphibians and reptiles. Over 100 reptiles died, and nearly 4,000 turtles and 73 amphibians were captured and treated for oil effects (USFWS et al. 2015).

Figure 3.1.7 - Painted turtle oiled during the Kalamazoo oil spill (photo courtesy of EGLE).

Semi-aquatic mammals are those specially adapted to live near water and inhabit aquatic environments. While most mammals are terrestrial, the semi-aquatic variety are generally most prone to impacts from oil spills (Enbridge 2016d). The Marshall, Michigan spill reportedly killed 40 mammals, and an additional 23 were captured and rehabilitated, though it was expected that additional mammals were affected but not observed during monitoring efforts (USFWS et al. 2015). Of the affected mammals, the primary species included muskrat (45 percent), raccoon (13 percent), and beaver (13 percent). Oil spilled as a result of the 2018 refinery explosion in Superior, Wisconsin is known to have impacted water voles in the vicinity of the explosion.

Rivers and Streams

There are 4,335 river miles at risk of oiling impacts from a crude oil pipeline spill in the ceded territories. Table 3.1.1 contains an additional breakdown of miles of river at risk within National Forests and tribal reservations. Rivers and streams at risk of impacts from crude oil pipeline spills are illustrated in figure 3.1.8 and in greater detail in the spill mapbook.

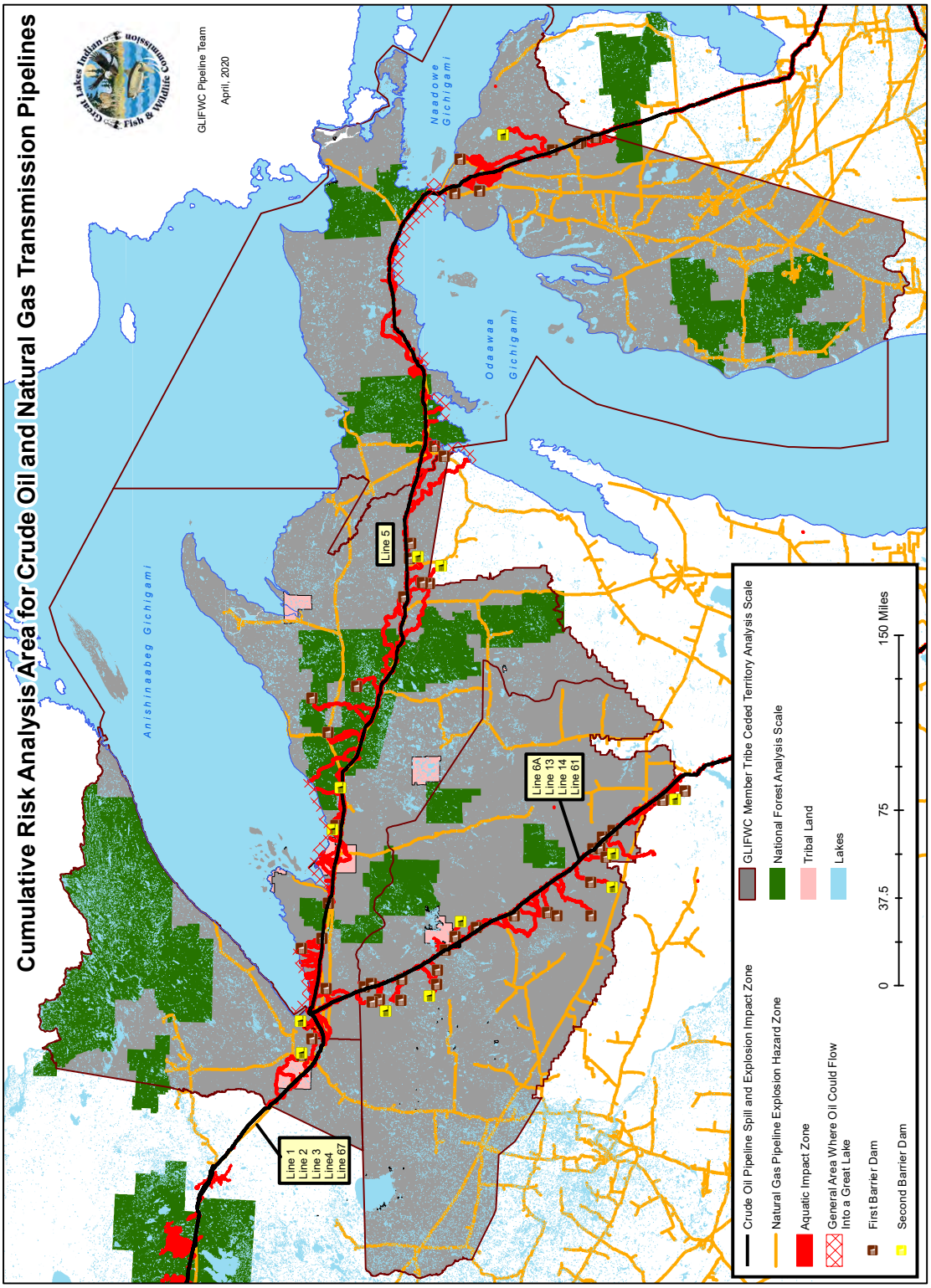

Figure 3.1.8 - Rivers and streams in the ceded territories at risk from crude oil pipeline spills.

Table 3.1.1 - Miles of rivers and streams at risk from crude oil pipeline spills

Rivers and Streams at Risk from Crude Oil Pipeline Spills		
		Miles
Ceded Territory		4,335
Fond Du Lac Reservation		74
Bad River Reservation		155
Lac Courte Oreilles Reservation		30
Chequamegon - Nicolet National Forest		37
Ottawa National Forest		444
Hiawatha National Forest		159

Seven river segments that are available for tribal spearing harvest are at risk from crude oil pipeline spills. These rivers are listed in table 3.1.2 and illustrated in the spill mapbook.

Table 3.1.2 River segments available for tribal spearing harvest at risk from crude oil pipeline spills.

RIVER	DESCRIPTION
Namekagon River, Sawyer and Washburn Counties	
Namekagon River, Washburn and Burnett Counties	From Lake Hayward in Sawyer County to Highway E (also U.S. Highway 63) in Washburn County above the Trego Flowage.
St. Croix River, Douglas, Washburn and St. Croix Counties	Croix River in Burnett County.
Yellow River, Taylor County	County, including the Yellow River below the Danbury Dam, Loon Creek from the Minerva Dam to its confluence with the Yellow River, the Clam River below the Clam River Dam, and t
Thornapple River, Rusk County	County Line.
Couderay River, Sawyer County	River at the Village of Bruce.
Flambeau River, Rusk County	extends from County Road E (outlet of Little Lac Courte Oreilles) to the Grimh Flowage.
Chippewa River, Sawyer and Rusk Counties	From Highway 27 to the tip of the island just south of Port Arthur Road.
	its confluence with the Flambeau River. Note: According to the Tribal Fish Refuge and Closed Areas document, the area between the dam to 500 ft is closed from April 1 to May31.

Eight rivers with known manoomin (wild rice) presence are at risk from crude oil pipeline spills. These rivers are listed in table 3.1.3 and illustrated in the spill mapbook.

Table 3.1.3 - Rivers with known manoomin presence at risk from crude oil pipeline spills.

County	River Name
Burnett, Douglas, Polk	St Croix River
Rusk	Rice Creek
Douglas	St. Louis River
Douglas, Washburn	Totogatic River
Ashland	Kakagon River
Ashland	Beartrap Creek
Douglas	Pokegama River/Bay
Gogebic	Ontonagon River

Lakes

There are 1,013 ceded territory lakes with 101,202 acres of open water that are at risk of oiling impacts due to a crude oil pipeline spill. Table 3.1.4 contains additional breakdown of acres of lakes at risk from crude oil pipeline spills within National Forests and Tribal Reservations. Lakes at risk of impacts from crude oil pipeline spills are illustrated in the spill mapbook.

Table 3.1.4 - Acres of open water lakes at risk of crude oil pipeline spills that are located within Tribal Reservations and the proclaimed boundaries of National Forests.

Lakes at Risk from Crude Oil Pipeline Spills			
		Lakes	Acres
Ceded Territory		553	97,262
Fond Du Lac Reservation		13	693
Bad River Reservation		8	287
Lac Courte Oreilles Reservation		1	5140
Chequamegon - Nicolet National Forest		6	108
Ottawa National Forest		120	16,424
Hiawatha National Forest		86	13,399

Crude oil spills originating from several oil pipelines, including Line 3 and Line 5, have the potential to impact the St. Louis River Estuary as well as the Lake Superior National Estuarine Research Reserve (NERR). This protected area is one of only two freshwater estuaries in the Great Lakes. The NERR includes the world's largest freshwater bay mouth sandbar and rare estuarine wetlands. It is also an area of great cultural significance to the Ojibwe tribes. The estuary itself encompasses 11,197 acres of open water and the NERR protects almost 17,000 acres of land. The risk of crude oil spills to the estuary and the NERR are depicted on page 3 of the spill mapbook.

Seventeen lakes that GLIFWC member tribes have declared for walleye fishing are at risk from crude oil pipeline spills. These lakes are listed in table 3.1.5 and illustrated in the spill mapbook.

Table 3.1.5 - Lakes declared for walleye spearing at risk from crude oil pipeline spills.

County	Lake
Chippewa	Holcombe Flowage
Rusk	Thornapple Flowage
Sawyer	Lac Courte Oreilles
Sawyer	Whitefish Lake
Sawyer	Sand Lake
Washburn	Minong Flowage
Gogebic	Lake Gogebic *
Washburn	Trego Lake
Douglas	Upper St. Croix Lake
Bayfield	Bladder Lake **
Iron	Peavy Pond
Iron	Sunset Lake
Iron	Emily Lake
Iron	Paint Pond
Iron	Tamarack Lake *
Ontonagon	Bond Falls Flowage *
Ontonagon	Victoria Pond *

Eleven lakes and sloughs with known wild rice presence are at risk from crude oil pipeline spills. These waters are listed in table 3.1.6 and illustrated in the spill mapbook.

Table 3.1.6 - Known manoomin waters at risk from crude oil pipeline spills.

County	Lake/Slough
Chippewa, Rusk	Holcombe Flowage
Ashland	Unnamed (Northeast) Slough
Ashland	Wood Creek Slough
Ashland	Bad River Sloughs
Ashland	Honest John Lake
Washburn	Trego Flowage
Douglas	St.Croix (Gordon) Flowage
Douglas, Washburn	Minong Flowage
Douglas	Upper Saint Croix Lake
Douglas	Allouez Bay
Gogebic	Slate River Slough

Wetlands

There are two categories of wetlands that are at risk of impacts from pipeline spills of crude oil in the ceded territories. First, there are 12,340 wetlands totaling 145,560 acres located inside the 5000-foot hazard zone surrounding the crude oil pipelines. Second, there are 5,743 riparian wetlands that are hydrologically connected to rivers and lakes within the aquatic hazard zone. These potentially impacted riverine and lacustrine wetlands total 270,526 acres in the ceded territories. Table 3.1.7 contains additional breakdowns of wetlands at risk from pipeline crude oil spills in the ceded territories.

Wisconsin's wetland inventory includes information on small wetlands that do not have acreage or delineation information. These are often small wetlands that despite their size, may have significant biological significance. There are 7,258 of these wetlands located within the 5,000-foot hazard zone. The size and ecosystems supported by these wetlands is largely unknown. Wetlands at risk of impacts from crude oil pipeline spills are illustrated in the spill mapbook.

Table 3.1.7 - Wetlands at risk from crude oil pipeline spills.

Wetlands at Risk from Crude Oil Pipeline Spills			
		Wetlands	Acres
Ceded Territory		12,340	145,560
Fond Du Lac Reservation		437	4,636
Bad River Reservation		394	2,431
Lac Courte Oreilles Reservation		54	252
Chequamegon - Nicolet National Forest		25	38
Ottawa National Forest		625	11,943
Hiawatha National Forest		282	19,324
		Riparian	Acres
Ceded Territory		5,743	270,526
Fond Du Lac Reservation		139	3,424
Bad River Reservation		318	3,535
Lac Courte Oreilles Reservation		70	388
Lac Vieux Desert		1	16
Chequamegon - Nicolet National Forest		1	2
Ottawa National Forest		349	23,254
Hiawatha National Forest		135	28,192
Total Wetlands at Risk		18,083	416,086

Groundwater

To help illustrate the potential impacts to groundwater we use a groundwater model developed by the United States Forest Service (USFS) for the Chequamegon-Nicolet National Forest (CNNF). Modeling results indicate that the water table largely mirrors surface topography with a groundwater mound located below the Bayfield highlands. Groundwater flow is dominated by gravity because there are no pumping sites within the National Forest boundary. Figure 3.1.9 illustrates the location of the groundwater mound and particle tracking points show the general direction of groundwater flow away from the mound.

As an example of how oil might travel with groundwater, oil spilled along the section of Line 5 that is located within the CNNF would quickly infiltrate the sandy soils. Some oil would become bound with the sand but it is highly likely that oil would reach the water table. The groundwater model indicates that an oil plume would move away from the spill location along two general flow paths and flow along the pathways is expected to continue for hundreds of years. The model indicates that spilled oil could daylight at surface water bodies and existing water supply wells (Figure 3.1.9). It is important to note that even if the spilled oil never intersects a surface water body, the groundwater aquifer would remain contaminated for the foreseeable future. The full USFS modeling report is available in Appendix 3.1-A.

The USGS research site in Bemidji, Minnesota is the only location in the Great Lakes region that has information on ongoing effects of oil spills to groundwater. In addition, a groundwater model for the ceded territories is not available to identify areas at risk of impacts from spilled oil traveling through groundwater. Additional research would be needed to determine if past oil spills in the ceded territories have ongoing, unidentified groundwater impacts.

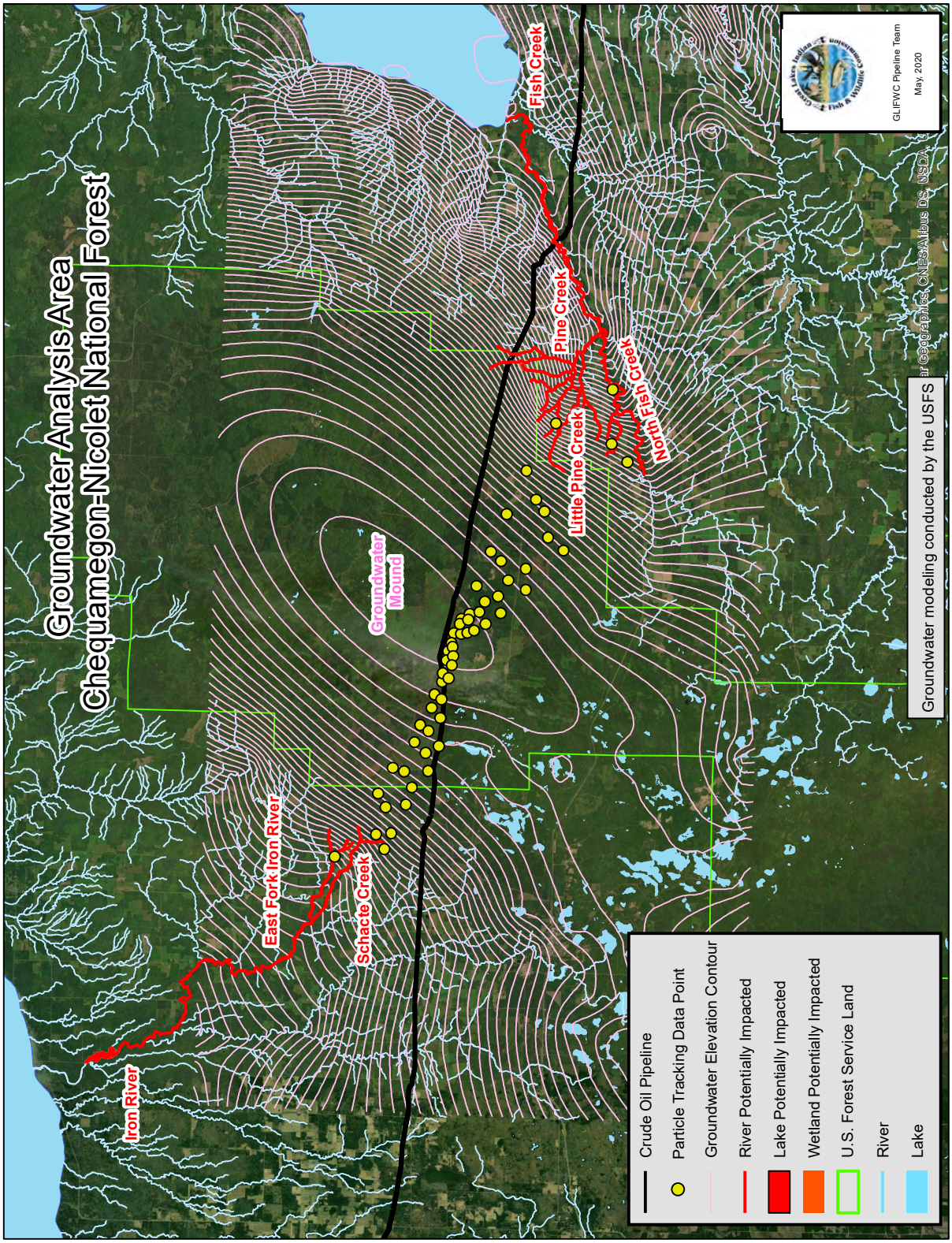

Figure 3.1.9 - Modeled crude oil spill from the section of Line 5 that crosses the proclaimed boundary of the Chequamegon-Nicolet National Forest.

Crude Oil Spill Risk – Terrestrial Environments

Crude oil releases to the ground surface can have harmful effects on soil and important resident microorganisms (Enbridge 2016). Remediation of spilled oil usually involves the removal of affected material from the area resulting in permanent impacts to soil structure. After a series of oil spills near Great Slave Lake in Alberta, Canada, soil tilling, burning, and fertilizer applications were used to remediate the soils. Twenty-five years later, oil concentrations within the first foot in soil depth were still high. More recently, bioremediation techniques have been developed where microbial communities are used to promote biodegradation. These techniques have had success over long periods of time (Hemmings et al, 2015).

Figure 3.1.10 - 2018 Keystone XL pipeline oil spill in South Dakota (https://www.argusleader.com/story/news/crime/2018/04/07/keystone-pipeline-spill-south-dakota-twice-big-first-thought/496613002/).

At impacted areas around Great Slave Lake, oil-contaminated deciduous plants showed effects within hours of oil exposure and evergreen vegetation took weeks to show stress. Regrowth in oil-exposed plants was less robust than would typically occur. Plants in oil-saturated soil showed no regrowth. After a single growing season, recovery varied between 20 and 55 percent, depending on the oil treatment rate. A similar study in the Northwest Territories involving light-crude application revealed changes in species composition and diminished vegetation cover in the test area after 10 years (Robson et al. 2004). A test release of heavy crude in Caribou-Poker Creek Watershed of Alaska, in 1976 showed that mosses and lichens died shortly after the release, but some specific grass species persisted.

Oil spills affect terrestrial animal species through mortality or displacement. Impacts to specific species will be highly site and species specific and cannot be characterized in detail in this analysis with the available data.

The area of uplands potentially impacted by crude oil pipeline spills in the ceded territories was obtained by subtracting acres of wetland from the land terrestrial hazard zone acreage. Table 3.1.8 contains additional breakdowns of uplands at risk from pipeline crude oil spills in the ceded territories.

Table 3.1.8 - Acres of uplands in the crude oil pipeline land hazard zone.

Upland Areas at Risk from Crude Oil Pipeline Spills		
		Acres
Ceded Territory		277,520
Fond Du Lac Reservation		4,137
Bad River Reservation		5,025
Lac Courte Oreilles Reservation		2,450
Chequamegon - Nicolet National Forest		7,307
Ottawa National Forest		29,756
Hiawatha National Forest		11,027

There are crude oil pipeline hazard zones that are located on public or protected lands. Table 3.1.9 lists some of those areas as well as the acres located within the hazard zone. Protected areas at risk of impacts from pipeline explosions are illustrated in the explosion mapbook. Additional information would be needed to characterize the environmental risk of crude oil spills to these areas and to determine if crude oil pipelines are compatible with local management goals.

Table 3.1.9 Acres of lands in the USGS Protected Areas Database (PADUS) that are potentially impacted by a crude oil pipeline spill.

Area Database (PADUS)	Acres
Atlanta State Forest Area	20
Bean Brook Fishery Area	90
Bennet Communication Tower	10
Benson Creek Fishery Area	4
Brule River State Forest	827
Bullock Ranch Flooding State Wildlife Management Area	860
Cisco Branch Ontonagon National Wild and Scenic River	744
Critical Dune Barrier dunes	1342
Critical Dune Exemplary dune associated plant comm	1397
Crystal Falls State Forest Area	7911
Cut River Bridge	36
Dingman Marsh Flooding State Wildlife Management Area	503
Douglas County Wildlife Area	309
Escanaba State Forest Area	1598
Flambeau River State Forest	145
French Farm Flooding State Wildlife Management Area	406
Gaylord State Forest Area	8087
Genes Pond Flooding State Wildlife Management Area	252
Grayling State Forest Area	3571
Gwinn State Forest Area	406
Jump River Fishery Area	8
Kirtlands Warbler Wildlife Management Area	621
Little Brevort Lake Scenic Site	437
Middle Branch Ontonagon River	786
North Country National Scenic Trail	8
Pershing Wildlife Area	7
Pigeon River Country State Forest Area	4171
Presque Isle River National Wild and Scenic River	288
REM-Namekagon River	84
REM-Weirgor River	122
Sand Lake Rearing Station	83
Sand Lake Tower Site	1
Sault Ste. Marie State Forest Area	10715
Shingleton State Forest Area	3153
South Branch Paint River National Wild and Scenic River	319
South Shore Lake Superior Fish and Wildlife Area	304
St. Croix National Scenic Riverway	504
St. Louis River Stream Bank Area	105
Statewide Habitat Area	11
Statewide Habitat Area	59
Statewide Non-point Easement Program	21
Statewide Public Access	22
Sturgeon River National Wild and Scenic River	386
Tuscobia State Trail	12
unnamed - private lands managed by DNR	33
Wagner Falls Scenic Site Park	260
Whitefish River National Wild and Scenic River	63
Wild Rivers State Trail	96
Wyman Nursery	95

Crude Oil and Natural Gas Pipeline Explosion Risk

Tribal, Public and Protected Lands

The land area at risk from an oil pipeline explosion totals 423,080 acres in the Ceded Territories. The land area at risk from a natural gas transmission pipeline explosion totals 3,331,762 acres. The combined explosion risk area for both pipeline types is 3,536,902 acres. Explosion hazard areas include portions of the Fond Du Lac, Lac Courte Oreilles, Keweenaw Bay Indian Community, and Bad River Reservations as well as portions of the Chequamegon-Nicolet, Ottawa, Hiawatha, Superior, and Huron-Manistee National Forests (Table 3.1.10). While the analysis here focuses on tribal and National Forest lands as examples, there are additional large areas of public lands in state and county forests. Figure 3.1.11 depicts land ownership in relation to the explosion hazard area with greater detail in the explosion mapbook. The combined area of the USGS protected lands database at risk of being impacted by an explosion from crude oil and natural gas pipelines is 373,593 acres.

Table 3.1.10 - Acres at risk of impacts from a crude oil or natural gas pipeline explosion.

Combined Crude Oil and Natural Gas Pipeline Explosion Hazard Areas		
		Acres
Ceded Territory		3,563,902
Fond Du Lac Reservation		21,413
Bad River Reservation		20,795
Lac Courte Oreilles Reservation		2,702
Keweenaw Bay Indian Community		6,128
St. Croix Reservation		408
Chequamegon - Nicolet National Forest		55,368
Ottawa National Forest		122,184
Hiawatha National Forest		100,201
Huron - Manistee National Forest		89,265
Superior National Forest		6,297

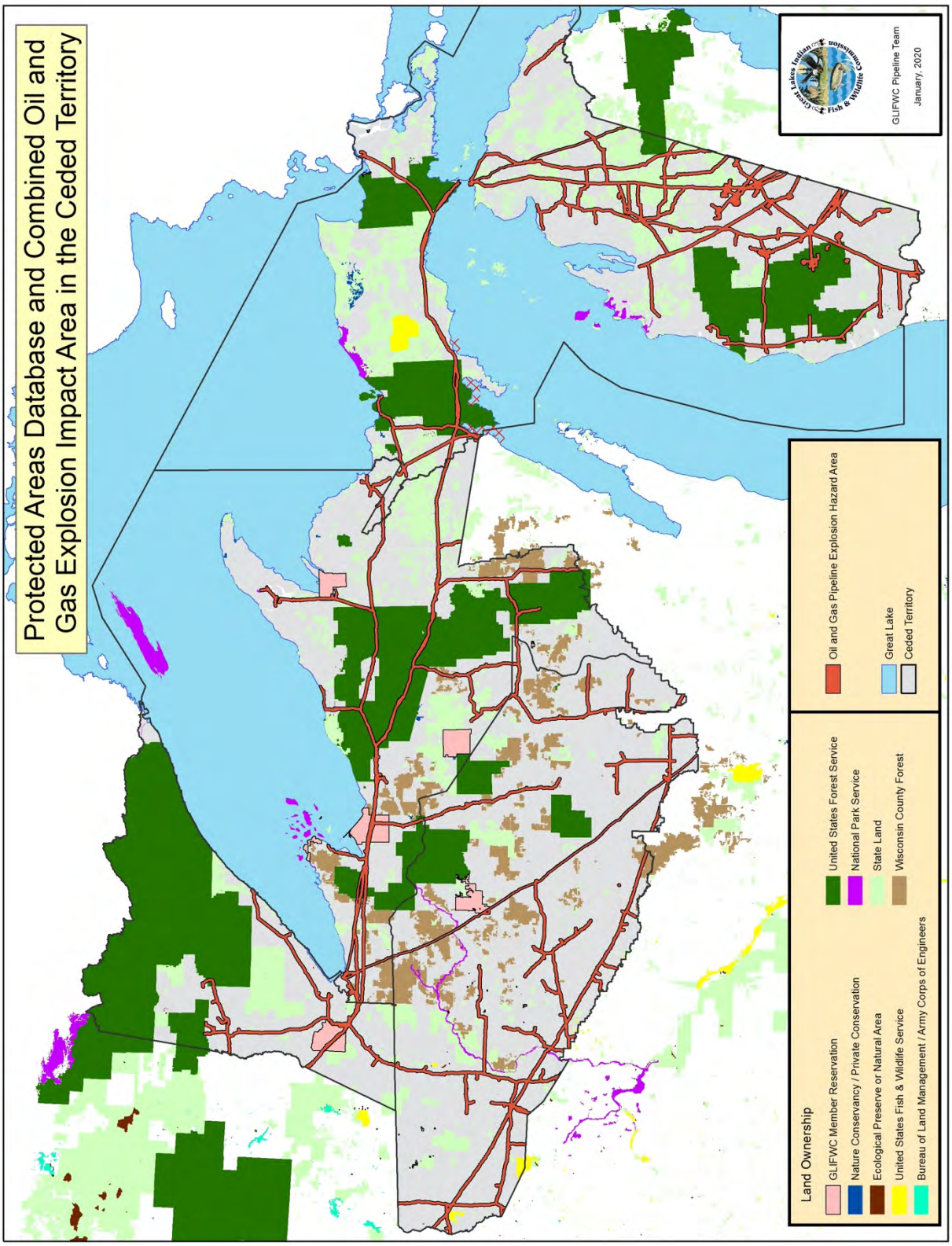

Figure 3.1.11 - Explosion hazard area for crude oil and natural gas pipelines in the 1836, 1837, 1842, and 1854 ceded territories.

Rivers and Streams

The Ceded Territories have 2,003 miles of rivers and streams that are at risk of impacts from a crude oil pipeline explosion. There are 7,492 miles of rivers and streams within the evacuation zone of natural gas pipelines and 2,273 of those miles are in the high consequence zone. The combined crude oil and natural gas explosion impact area (evacuation and high consequence) for the Ceded Territories contains 8,762 miles of rivers and streams. Table 3.1.11 contains additional breakdown of miles of rivers and streams at risk from pipeline explosions within National Forests and Tribal Reservations. Rivers and streams at risk of impacts from pipeline explosions are illustrated in the explosion mapbook.

Table 3.1.11 - Miles of rivers and streams that are located within the explosion hazard areas of crude oil and natural gas pipelines.

Miles of Rivers and Streams At Risk from Pipeline Explosions				
	Crude Oil	**Natural Gas**		**Combined Risk Zones**
		Evacuation Zone	**High Consequence Zone**	
Ceded Territory	2,003	7,492	2,273	8,762
Fond Du Lac Reservation	9	17	6	22
Bad River Reservation	47	82	30	97
Lac Courte Oreilles Reservation	13	0	0	13
Keweenaw Bay Indian Community	0	28	9	28
Chequamegon - Nicolet National Forest	3	46	11	47
Ottawa National Forest	164	401	119	426
Hiawatha National Forest	76	232	72	279
Huron - Manistee National Forest	0	210	54	210
Superior National Forest	0	8	3	8

Lakes

There are 491 lakes with 47,785 acres of open water at risk of impacts from an oil pipeline explosion in the Ceded Territories. There are 6,016 lakes with 223,564 acres of open water that are located within the evacuation zone for natural gas pipelines and of those, 2,127 lakes with 77,345 acres of open water are located in the high consequence area. Combined crude oil and natural gas explosion impact area for the Ceded Territories contains 6,202 lakes with 237,075 acres of open water. Table 3.1.12 contains additional breakdown of acres of lakes at risk from pipeline explosions within National Forests and Tribal Reservations. Lakes at risk of impacts from pipeline explosions are illustrated in the explosion mapbook.

Table 3.1.12 - Number of lakes and acres of open water that are located within the explosion hazard areas of crude oil and natural gas pipelines.

Lakes At Risk from Pipeline Explosions								
	Crude Oil		Natural Gas Evacuation Zone		High Consequence Zone		Combined Risk Zones	
	Lakes	Acres	Lakes	Acres	Lakes	Acres	Lakes	Acres
Ceded Territory	491	47,785	6,016	223,564	2,127	77,345	6,202	237,075
Fond Du Lac Reservation	11	553	30	143	16	48	32	660
Bad River Reservation	6	17	7	18	6	16	7	18
St. Croix Reservation	0	0	2	2,772	2	2,772	2	2,772
Keweenaw Bay Indian Community	0	0	21	27	6	4	21	27
Chequamegon - Nicolet National Forest	5	23	69	2,601	30	1,874	69	2,601
Ottawa National Forest	93	811	232	14,850	85	628	241	14,959
Hiawatha National Forest	85	9,070	157	16,179	61	1,060	201	16,278
Huron - Manistee National Forest	0	0	136	1,304	41	462	136	1,304
Superior National Forest	0	0	22	1,988	10	1,452	22	1988

Of the lakes listed above, 39 are known to support manoomin (wild rice) (Table 3.1.13) and 57 are lakes that Tribes have declared for walleye spearing (Table 3.1.14). An explosion at one of the pipelines could impact tribal members as they harvest these important resources as well as damage the resources themselves. These lakes are depicted in the explosion mapbook.

Table 3.1.13 - Wild Rice waters at risk of crude oil and natural gas pipeline explosion.

County	Lake		County	Lake
Burnett, Douglas, Polk	St Croix River		Douglas	Fasteland Road Ponds
Douglas	St. Louis River		Lincoln	Wisconsin River
Vilas	Mud Creek		Burnett, Washburn	Yellow River
Barron	Rice Creek		Forest	Rat River (GLIFWC long term study)
Douglas	Pokegama River/Bay		Chisago	Mud Lake
Lincoln, Oneida	Wisconsin River (above Lake Alice)		Isanti	Grass
Vilas	Wisconsin River		Isanti	North Stanchfield
Forest	Little Rice Lake		Morrison	Pelkey
Burnett	Clam Lake, Lower		Isanti	Rice
Burnett	Big Sand Lake		Sherburne	Long Pond
Burnett	Memory Lake		Pine	Stanton
Burnett	Mud Hen Lake		Crow Wing	Unnamed
Oneida	Spur Lake		Chisago	North Sunrise Pool
Polk	Little Butternut Lake		Pine	Fox
Oneida	Cuenin Lake		Morrison	Popple
Forest	Scattered Rice Lake		Morrison	Coon
Polk	Balsam Lake		Kanabec	Twin
Polk	Unnamed Pond			Mississippi River
Lincoln	Alice Lake			Mississippi River
Burnett	Clam Lake, Upper		Pine	Snake River

Table 3.1.14 - Walleye waters at risk of crude oil and natural gas pipeline explosion.

County	Lake		County	Lake
BENTON	MAYHEW L		POLK	BALSAM L
CHISAGO	SOUTH LINDSTROM L		BURNETT	DUNHAM L
CHISAGO	NORTH CENTER L		BURNETT	UPPER CLAM L
CHISAGO	LITTLE L		BURNETT	BIG SAND L
CHISAGO	NORTH LINDSTROM L		GOGEBIC	SUNDAY L
CHISAGO	GREEN L		GOGEBIC	ALLEN L
CHISAGO	LITTLE COMFORT L		GOGEBIC	L GOGEBIC
TAYLOR	RIB L		BAYFIELD	BLADDER L
ONEIDA	MINOCQUA L		BAYFIELD	LONG L
ONEIDA	TOMAHAWK L CHAIN		ISANTI	SKOGMAN L
LINCOLN	L ALICE		ISANTI	FLORENCE L
ONEIDA	GEORGE L		ISANTI	FANNIE L
ONEIDA	HASBROOK L		ISANTI	NORTH STANCHFIELD L
ONEIDA	GILMORE L		HOUGHTON	TORCH L
ONEIDA	SWEENEY L		HOUGHTON	PORTAGE L
ONEIDA	PICKEREL L		IRON	SUNSET L
ONEIDA	RAINBOW FL		IRON	EMILY L
VILAS	LITTLE ST GERMAIN L		IRON	IRON L
ONEIDA	PLANTING GROUND L		FOREST	TRUMP L
ONEIDA	TOWNLINE L		MORRISON	PIERZ FISH L
DUNN	TAINTER L		MORRISON	PELKEY L
BARRON	BIG MOON L		MARQUETTE	GREENWOOD RES
BARRON	LOWER TURTLE L		FOREST	SILVER L
BARRON	UPPER TURTLE L		PINE	STANTON L
BARRON	BEAVER DAM L		PINE	CROSS L
BARRON	BEAVER DAM L		BARAGA	BEAUFORT L
BARRON	LOWER VERMILLION L		BARAGA	KING L
PRICE	DUROY L		ONEIDA	CLEAR L
ST CROIX	CEDAR L		ONEIDA	L JULIA (RHINELANDER)

Wetlands

Wetlands at risk from an oil pipeline explosion total 145,457 acres in the Ceded Territories. Wetlands at risk from a natural gas transmission line explosion total 630,265 acres in the Ceded Territories and of those, 187,029 acres are within the high consequence hazard zone. Combined crude oil and natural gas impact area for the Ceded Territories contains 92,297 individual wetlands covering 675,047 acres. In the Wisconsin portion of the ceded territories, there are 7,258 small wetlands within the crude oil explosion hazard zone and 27,584 small wetlands within the natural gas explosion hazard zone. Wetlands at risk of impacts due to explosion are summarized in Table 3.1.15 and in the explosion mapbook. These small wetlands do not have acreage information in the Wisconsin Wetland Inventory. Table 3.1.15 also contains additional breakdown of acres of wetlands at risk from pipeline explosions within National Forests and Tribal Reservations.

Table 3.1.15 - Number of wetlands that are located within the explosion hazard areas of crude oil and natural gas pipelines.

Wetlands At Risk from Pipeline Explosions								
	Crude Oil		**Natural Gas**				**Combined Risk Zones**	
			Evacuation Zone		**High Consequence Zone**			
	Wetlands	**Acres**	**Wetlands**	**Acres**	**Wetlands**	**Acres**	**Wetlands**	**Acres**
Ceded Territory	12,340	145,457	85,076	630,265	33,474	187,029	92,297	675,047
Fond Du Lac Reservation	442	4,725	923	8,366	379	2,409	973	9,004
Bad River Reservation	395	2,434	817	4,695	385	1,804	862	4,822
St. Croix Reservation	0	0	17	91	3	24	17	91
Keweenaw Bay Indian Community	0	0	27	312	14	124	27	312
Lac Courte Oreilles Reservation	61	279	0	0	0	0	61	279
Chequamegon - Nicolet National Forest	25	38	1,168	8,403	423	2,287	1,191	8,438
Ottawa National Forest	629	12,012	1,472	23,875	550	6,821	1,558	24,505
Hiawatha National Forest	287	129,648	723	37,937	357	10,056	827	39,679
Huron - Manistee National Forest	0	0	1,758	9,412	701	2,586	1,758	9,412
Superior National Forest	0	0	156	1,016	60	207	156	1,024

Risk Associated with the Enbridge Line 5 Crude Oil Pipeline

This section describes the environmental risks of Line 5. This analysis scale is appropriate given the unique geographic setting of this pipeline compared to the other pipelines in the ceded territories. This focus is also necessary because of the need to evaluate risk of this line as part of the permitting of existing and new line segments.

The 454 miles of Line 5 account for 36% of all crude oil pipeline miles in the ceded territories. It is also the only pipeline that does not share the right-of-way with other crude oil pipelines. Line 5's isolation means that it is solely responsible for a large percentage of the risk to natural resources from future oil spills. These include:

- 65% of all Ceded Territory acres that are at risk of oiling and explosion impacts.
- 82% of all Ceded Territory inland lakes that are at risk of oiling and explosion impacts.
- 52% of all Ceded Territory river miles that are at risk of oiling and explosion impacts.
- 70% of all Ceded Territory wetland acres that are at risk of oiling and explosion impacts.

Another way of describing this risk is to say that if Line 5 was to be decommissioned, the environmental risk to the ceded territories from crude oil pipeline spills and explosions would be reduced by the percentages listed above. Natural resources at risk are detailed in table.

Line 5 also has risks that are almost completely absent for the other pipelines in the Ceded Territories. Line 5 is the only crude oil pipeline in the ceded territories that crosses National Forest lands. If Line 5 was to be decommissioned, there would no longer be any risk of oiling or explosion to the lands and waters located within the Chequamegon-Nicolet, Ottawa, and Hiawatha National Forests. Line 5 is also the pipeline that presents the greatest risk to the Great Lakes. Line 5 is located entirely within the Great Lakes watershed and there are areas where oil spilled from this pipeline could flow into Lake Superior, Lake Michigan and/or Lake Huron through tributaries that have no flow interruptions such as lakes or dams (figures 3.1.12 and 3.1.13). A report from the Great Lakes Commission characterizes the risk of crude oil spills from Line 5 to shorelines of Lake Superior (Marty and Nicol, 2017). The project developed an environmental sensitivity index which combines data on physical, biological and human environments. This index is then spatially overlayed with oil transportation infrastructure in a GIS. The results are maps of environmental sensitivity to oil spilled from the different conveyance methods, including the Line 5 pipeline. Data from this study are also mapped in figures 3.1.12 and 3.1.13.

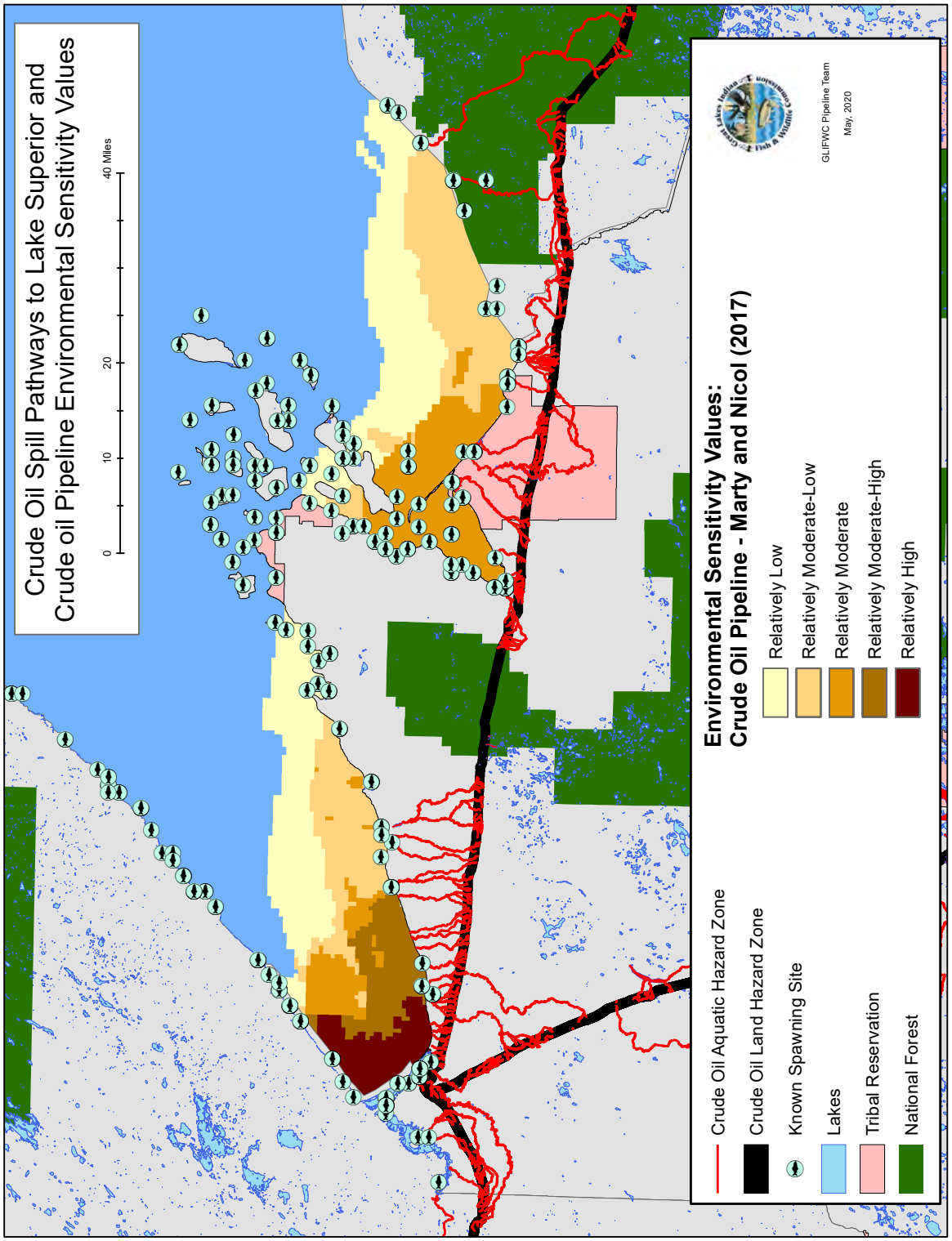

Figure 3.1.12 - Crude oil spill pathways from Line 5 to Lake Superior.

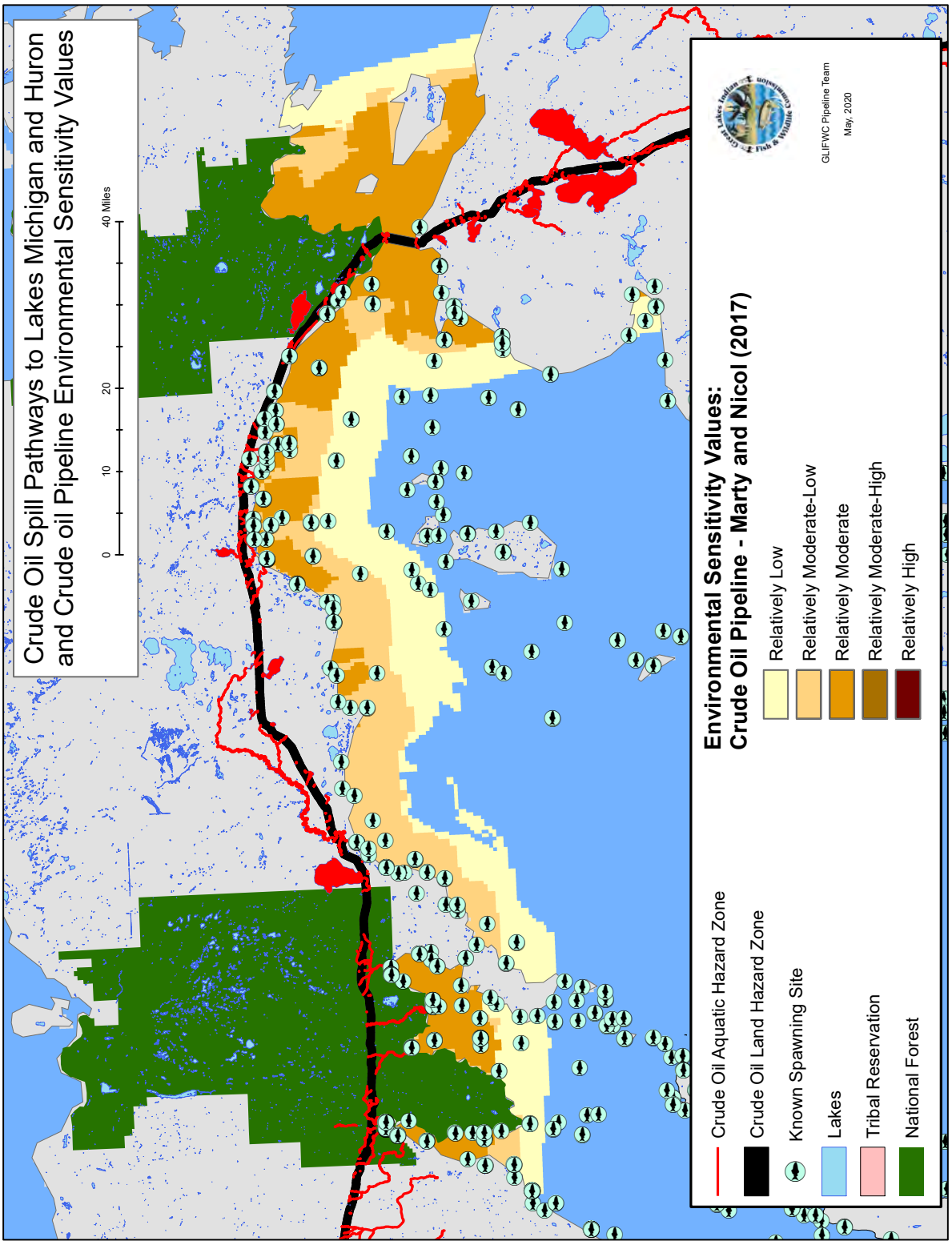

Figure 3.1.13 - Crude oil spill pathways from Line 5 to Lakes Michigan and Huron.

The analysis conducted by Marty and Nicol (2017) indicates that some of the most environmentally sensitive areas of the south shore of Lake Superior are also some of the most vulnerable to pipeline oil spills. This includes Chequamegon Bay which could be impacted by a spill occurring within the administrative boundaries of the Chequamegon Nicolet National Forest. The entire report is available in Appendix 3.1-C.

Of all the areas at risk of oiling from a Line 5 spill, the potential impacts of an oil spill at the Straits of Mackinac is the only area that has been well studied. Modeling done at the University of Michigan Water Science center indicates that over 700 miles of Great Lakes shoreline could be impacted by a Line 5 spill with devastating effects to tribal, commercial and recreational fishing, as well as long term damage to tourism in the area (Figure 3.1.14)(Schwab, 2016). Modeling of oil spill impacts is not available for other areas at risk in Lakes Superior and Michigan.

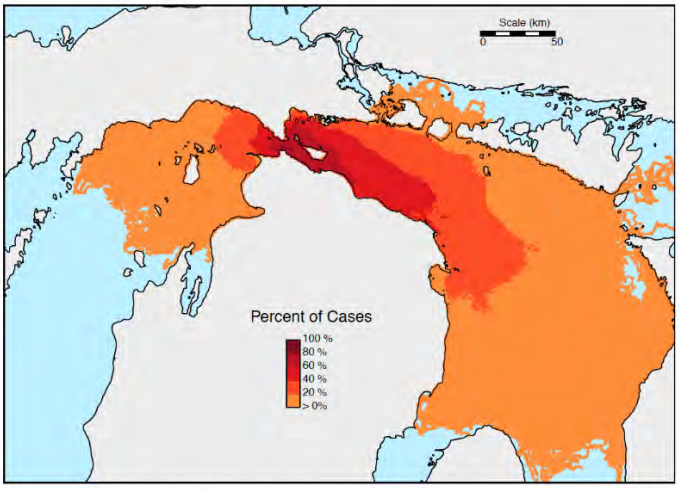

Figure 12. Percent of cases in which oil is present at *any* time after initial release.

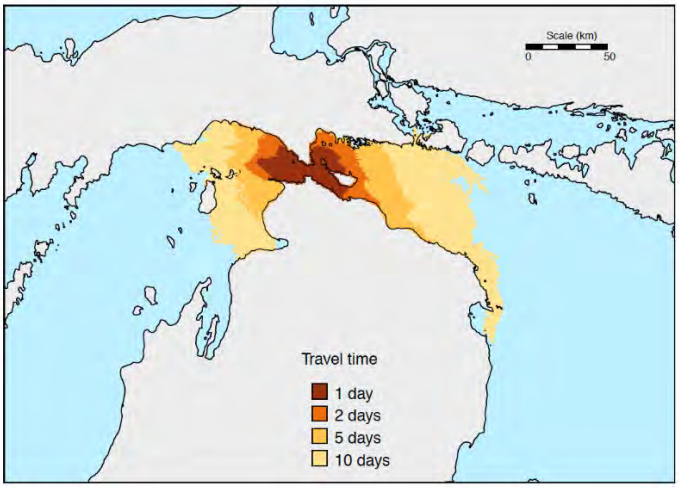

Figure 13. Minimum travel time (up to 10 days) to a location from *any* case.

Figure 3.1.14 - Modeled extent of oiling from a spill at the Straights of Mackinac section of Line 5 (Schwab, 2016).

In addition to ecological impacts to Lake Superior, an oil spill in the sensitive areas identified above could be catastrophic to the tribal commercial fishery. This treaty guaranteed fishing activity is not only central to the cultural identity of tribes but also a critical economic activity and source of income for the Great Lakes area in general. Figures 3.1.15 - 3.1.19 show the tribal harvest data for areas of the Great Lakes in the ceded territories that could be impacted by a Line 5 oil spill. The data clearly indicate a substantial risk to tribal fishing. Additional work would be needed to fully account for the economic consequences of a spill to tribes as well as losses to the regional economy.

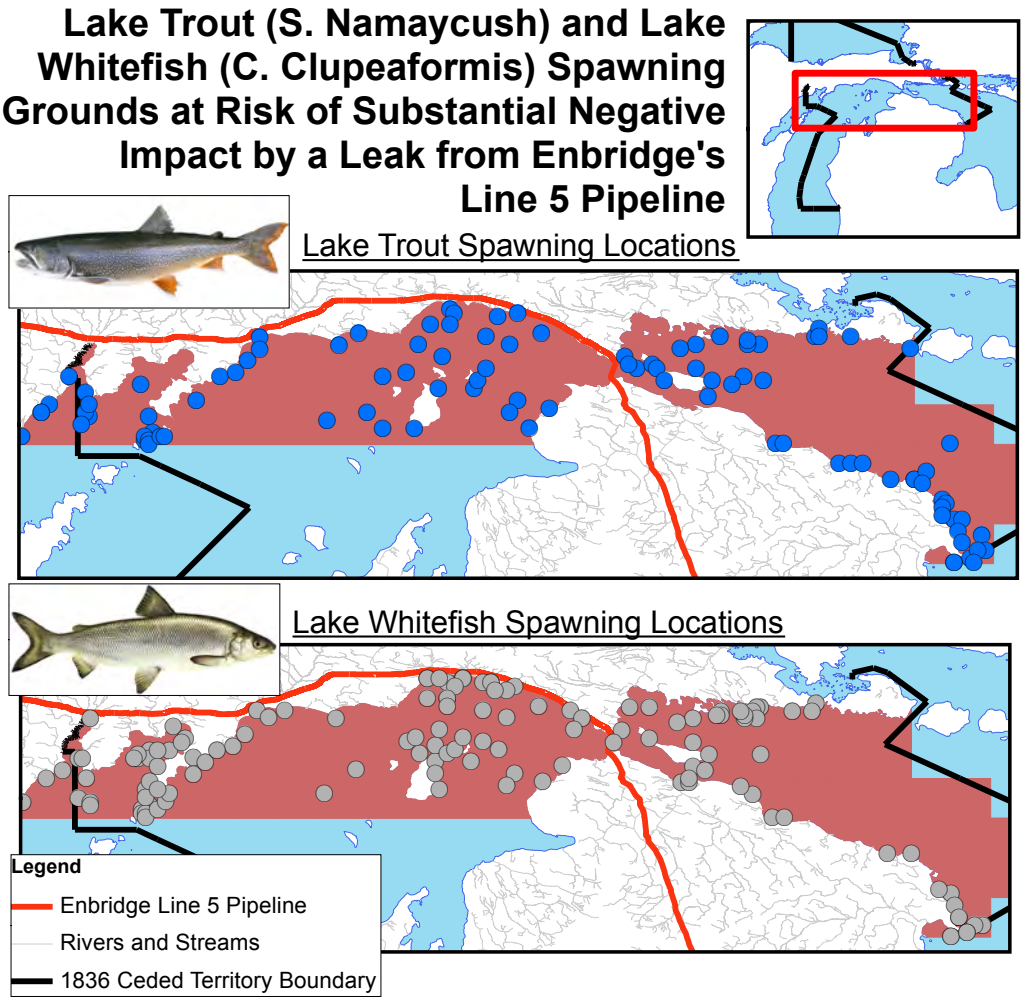

Figure 3.1.15 - Known spawning locations for lake trout and whitefish potentially impacted by a Line 5 crude oil spill at the Straights of Mackinac (Kevin Donner, Little Traverse Band of Odawa Indians, Personal Communication).

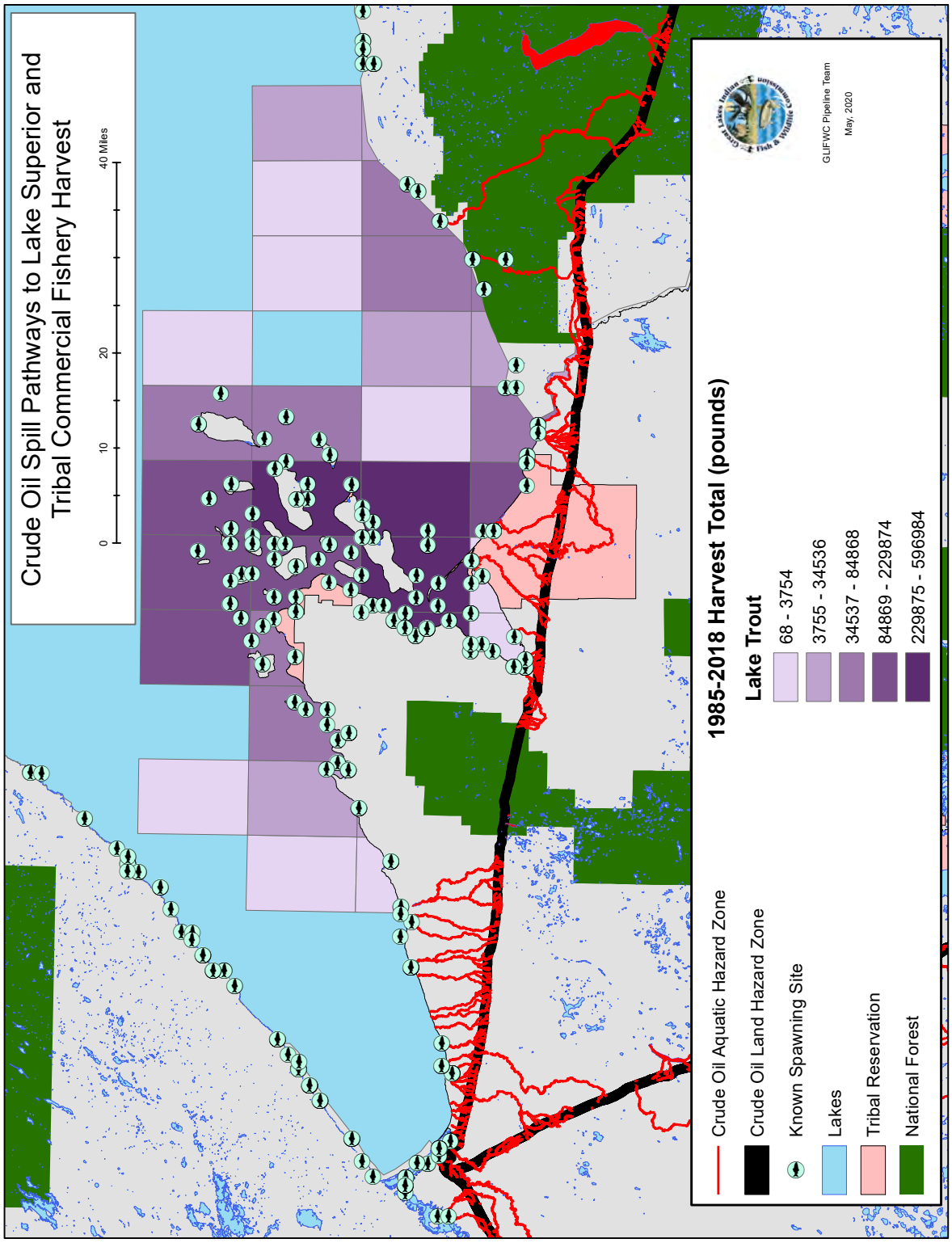

Figure 3.1.16 - Crude oil spill pathways from Line 5 to Lake Superior and potential impacts to known spawning sites and tribal commercial fishing for lake trout.

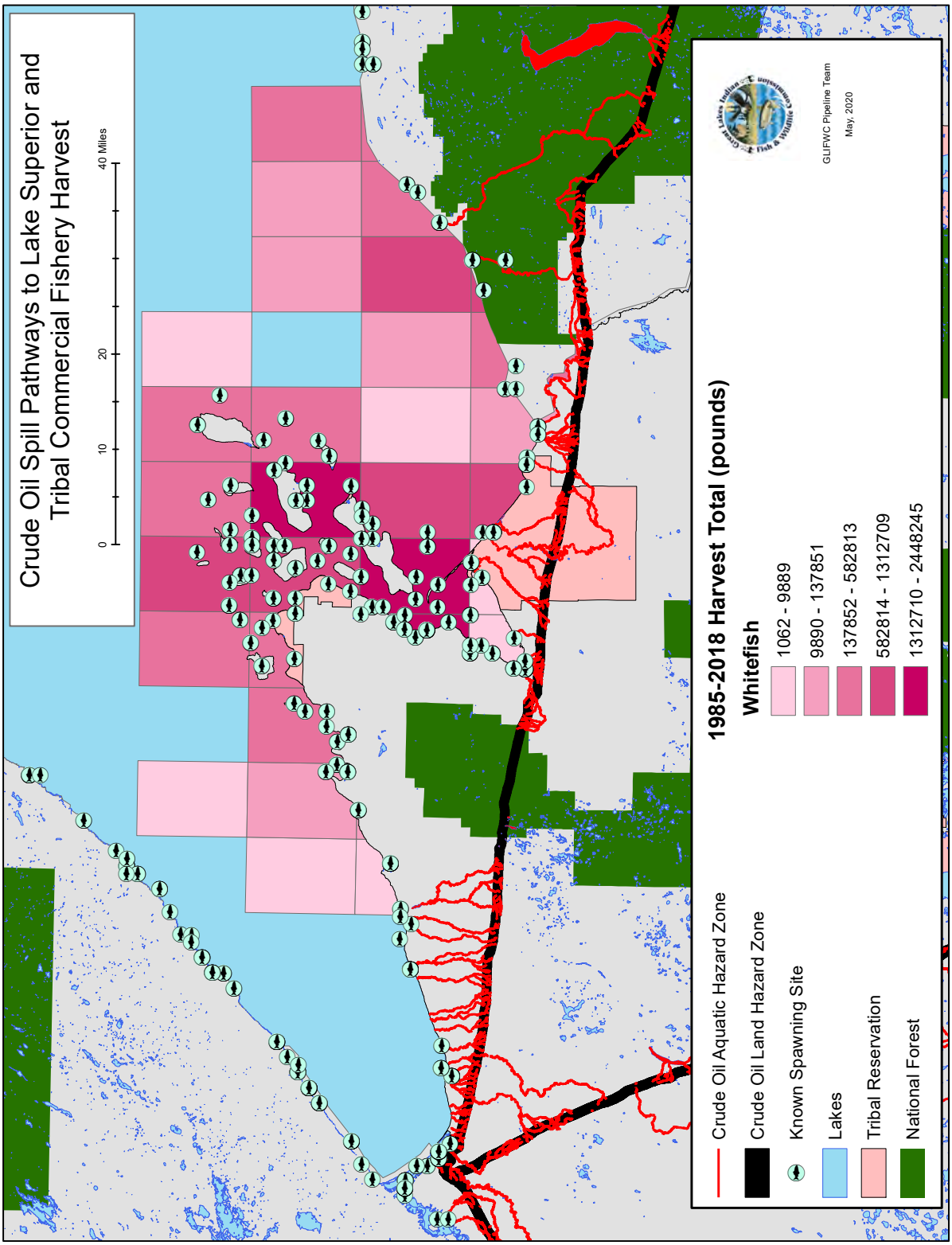

Figure 3.1.17 - Crude oil spill pathways from Line 5 to Lake Superior and potential impacts to known spawning sites and tribal commercial fishing for whitefish.

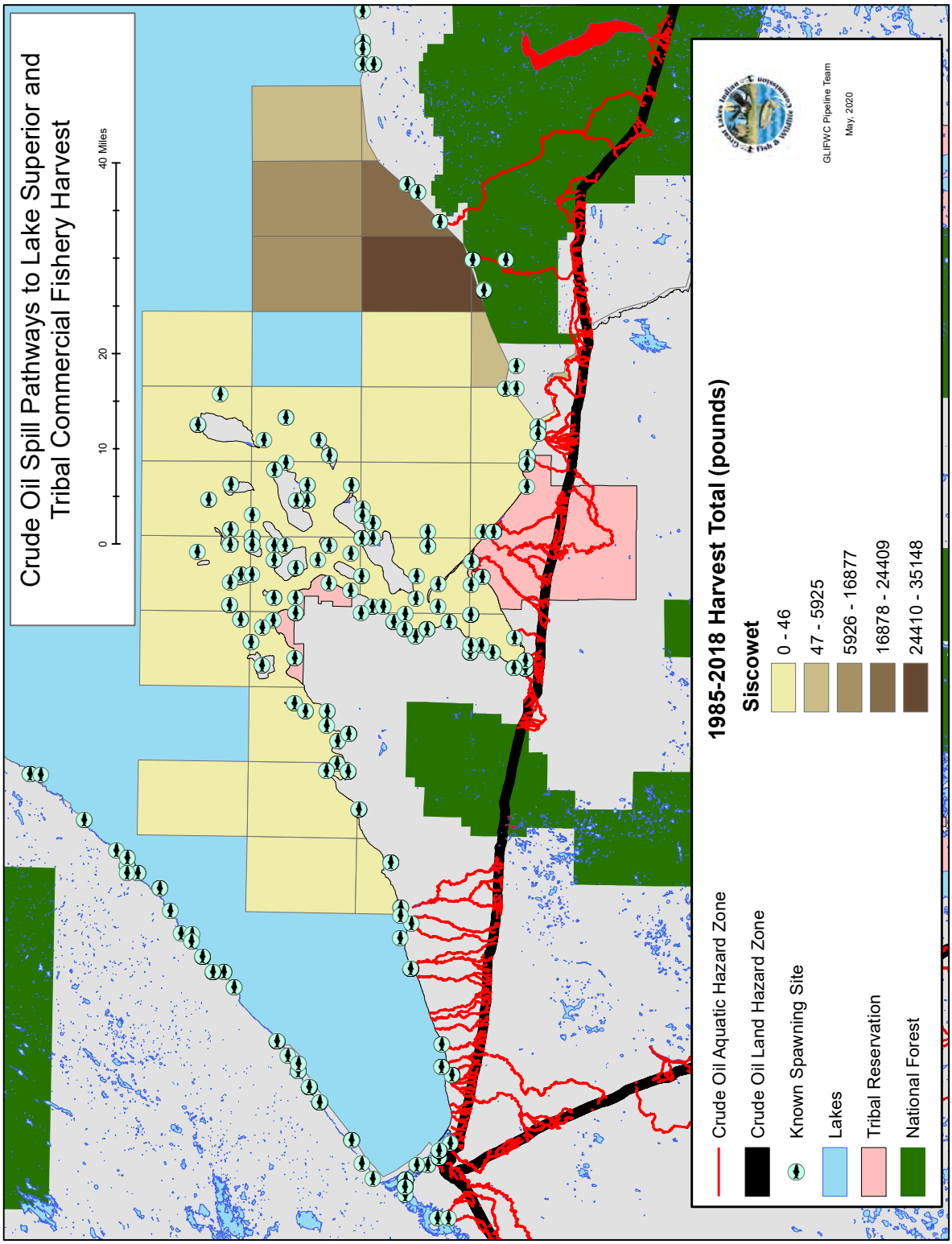

Figure 3.1.18 - Crude oil spill pathways from Line 5 to Lake Superior and potential impacts to known spawning sites and tribal commercial fishing for siscowet.

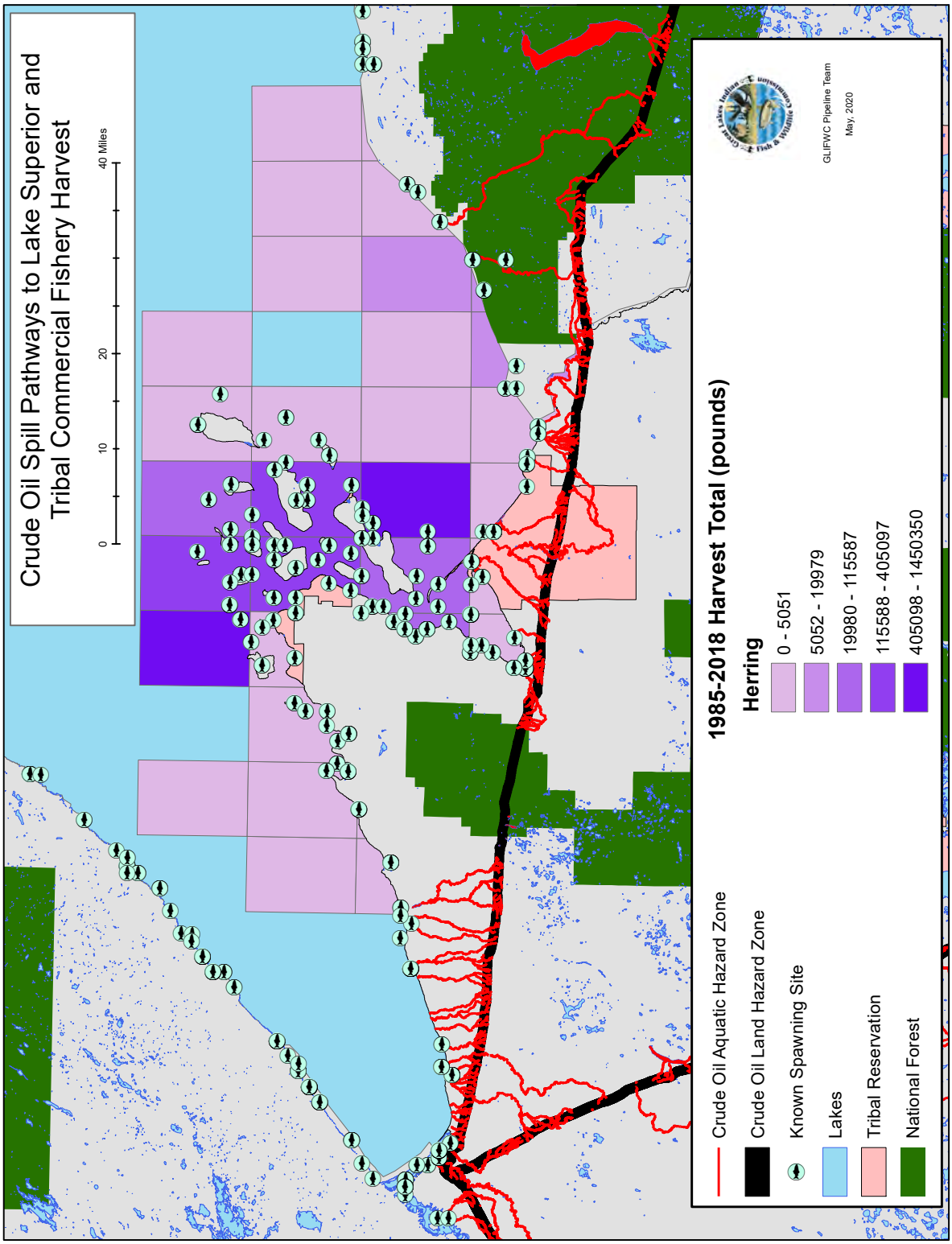

Figure 3.1.19 - Crude oil spill pathways from Line 5 to Lake Superior and potential impacts to known spawning sites and tribal commercial fishing for herring.

Conclusion

This report presents a step towards understanding the risk of crude oil and natural gas pipelines to the ecological integrity of the Ceded Territories. The analysis is based on accepted published methods and defines hazard zones, those areas in the ceded territories that could be impacted by crude oil spills and explosions. Further characterization is made by identifying areas of known tribal natural resource harvest activity and areas of known environmental importance. Mapbooks provide a visualization of potential areas of impact shown overlain with identified areas of resource harvest and/or of particular ecological significance.

The identification of these important resources provides context to the risk of a pipeline failure and is critical to GLIFWC's role in protecting habitats that are necessary for treaty protected natural resource harvests. This information is also important for state and federal agency permitting decisions related to existing and new pipelines in the region. Line 5 does not exist in a vacuum; it is part of a larger pipeline network that has consequences for the whole region, including three Great Lakes, hundreds of inland lakes, hundreds of miles of rivers and streams, and thousands of acres of wetlands.

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