Issues and Trends Surrounding the Movement of Crude Oil in the Great Lakes-St. Lawrence River Region

FEBRUARY 2015

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Great Lakes Commission
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Full report available at www.glc.org/projects/water-quality/oil-transport/

Acknowledgments

Preparation of the *Summary of Issues and Trends Surrounding the Movement of Crude Oil in the Great Lakes-St. Lawrence River Region* and the four companion issue briefs required the time and effort of numerous individuals who worked together, shared ideas, edited several drafts and provided encouragement and support to each other throughout the process. The research and writing of these briefs was truly a team effort!

Appreciation is extended to the following individuals for their contributions to this project:

Tim Eder, executive director, provided input on the project design, guidance to staff, writing and editorial support throughout the project.

Thomas Crane, deputy director, was the main author of the Summary and provided overall project management and writing support.

Michèle Leduc-Lapierre, program specialist, organized written materials and led the research effort for staff, compiled an annotated bibliography of reports and was the main author for Issue Brief 1.

Juliana Pino, policy and governance associate, was the main author for Issue Brief 2.

Dr. Susan Christopherson and Mr. Kushan Dave from Cornell University were the primary authors for Issue Brief 3.

Margaux Valenti, a 2013-14 GLC-Sea Grant Fellow, was the primary author for Issue Brief 4.

Stuart Eddy, project manager, was the co-author of Issue Brief 1 and provided research, writing and editorial support on the other briefs.

Matt Doss, policy director, provided editorial support.

Christine Manninen, communications director, provided editorial and communications support.

Laura Andrews, design manager and Jeff McAulay, web development manager, provided technical support.

Summary of Issues and Trends Surrounding the Movement of Crude Oil in the Great Lakes-St. Lawrence River Region

Executive Summary

Full report available at www.glc.org/projects/water-quality/oil-transport

Overview

The Great Lakes Commission has researched the potential benefits and risks surrounding the transportation of crude oil in the Great Lakes-St. Lawrence River region, including an assessment of the regulatory structure in the two countries. This report stems from an Action Item approved by GLC commissioners in September 2013. The report reflects the Commission's concerns over recent oil spills and the desire for information regarding the dramatic growth in North American oil production and the associated increase in oil transportation to and through the region. The final report includes a suite of findings and an appendix with four issue briefs reviewing key topics in greater detail.

Background

Domestic production of crude oil in North America (primarily from the Bakken formation, the Alberta oil sands and the Permian and Eagle Ford fields in Texas) has increased dramatically in recent years, with U.S. production in 2015 projected to be 75 percent above 2009 levels. This has challenged both industry and government with the need to transport growing volumes of crude oil from its source to refineries and points of export in both nations.

The binational Great Lakes region has become a hub of oil transportation and refining. A large volume of crude oil is also transported *through* the region to refineries in other parts of the two countries. Safety concerns related to oil transportation have increased due to spills and accidents in recent years, including the 2013 derailment and explosion of a train carrying domestic crude oil in the town of Lac-Mégantic, Québec, that caused 47 deaths, and the 2010 failure of a pipeline near Marshall, Mich., that spilled approximately 1 million gallons of crude oil from the Alberta oil sands. Since the Lac-Mégantic incident at least 19 other transportation-related crude oil spills have been reported, including at least four in a Great Lakes state or province.

The primary options for transporting crude oil are pipelines, vessels and railroads.

Pipelines

Historically, pipelines have been the preferred mode for transporting petroleum products and more oil is transported through the Great Lakes-St. Lawrence River basin by pipeline than by any other mode. Approximately 70 percent of oil sands produced in Alberta is shipped to U.S. refineries via pipeline. Pipelines are, on average, $5 to $10 per barrel cheaper than rail. As a result, the increasing production of oil sands crude in Alberta likely will drive industry toward new pipeline construction to support future transportation to the U.S. Midwest for refining. Recent pipeline failures have raised awareness of pipeline safety and drawn attention to the vulnerability of the Great Lakes to pipeline spills. These spills have also prompted response agencies to evaluate the state of preparedness within their jurisdiction and to identify areas where these programs can be improved.

Vessels

Although there is refined petroleum transported on the Great Lakes – over 19 million metric tonnes in 2011 – no crude oil is transported on the Great Lakes at the current time. In September 2014 the first tankers transporting crude oil for export were seen on the St. Lawrence River. These transport oil sands crude shipped by rail from Alberta to Sorel-Tracy, Quebec and stored near the port. As the production of domestic crude oil grows, there has been an overall increase in crude oil transportation in the larger Great Lakes basin waterway system, which includes inland waterways, rivers and canals connected to the Great Lakes. Most concerns over waterborne transportation of crude oil on the Great Lakes relate to the risk of spills from vessels. In addition, oil from oil sands is denser than traditional oil and tends to sink in water, rather than float on the surface, significantly complicating cleanup actions. The U.S.

Coast Guard has noted that currently there is no technology available to contain or clean up a spill of heavy crude oil in fresh water. Existing Vessel Response Plans do not address this type of scenario.

Rail

Rail transport, because of its load carrying and routing flexibility, has increased in recent years due to capacity limitations in the pipeline network. The increase in rail transport is dramatic: 9,500 carloads of crude oil were carried by train in 2008 in the U.S., compared with 650,000 carloads forecasted by the end of 2014. In Canada, 500 carloads were carried in 2009 and an estimated 140,000 carloads will be carried in 2014. The transportation of crude oil via rail has garnered much attention since the Lac-Mégantic incident – safety issues being addressed relate to crew size and training; tank car designs; routes for trains carrying crude oil; and communications with state/provincial and local agencies. A key issue is the ability of the legal and regulatory regime to keep pace with the market-driven increase in oil being transported by rail.

Key Findings

The following are highlights from the report's findings focused on key issues that may warrant further study and action on the part of government agencies and industry.

Oil Extraction and Movement

- There are conflicting opinions about the characteristics of Bakken crude oil, which is relevant to the perceived safety of the transportation process by rail
- The characteristics of Alberta oil sands present particular challenges in the transportation of the product by all modes
- Bakken crude oil passes directly through the region to refineries located elsewhere

Risks and Impacts of Oil Transportation

- There is a need to better understand the relative risks of oil spills associated with increased transportation of crude oil
- The risks and costs of increased oil transportation to government agencies need to be studied and better understood
- The age and quality of infrastructure is a concern for most modes of oil transportation, which poses an increased risk for a spill or accident
- Communications between oil companies, oil transporters, regulatory and response agencies is important but is often lacking and can be better coordinated to help improve preparedness and reduce the risk from spills

Oil Transportation Programs, Policies and Regulations

- The increase in oil production and transportation, particularly rail transportation of oil, is outpacing the development and implementation of regulatory, enforcement and inspection programs
- A review of the funding and adequacy of inspection and enforcement protocols and the timeliness of spill reporting across all modes will help identify gaps in regulatory, prevention and response programs
- The Great Lakes states and provinces are not taking full advantage of opportunities to assume oversight of pipeline safety, inspection and enforcement
- Plans to retrofit and/or eliminate DOT-111 tank cars and replace them with newer, safer models will significantly improve the safety of oil transportation by rail
- Pursuing additional improvements to rail transportation safety, including adopting new technologies and dual person crew requirements may help lessen the number of rail accidents
- Proper classification of all types of oil transported by train is necessary
- Federal, state and provincial response agencies may not be adequately funded and equipped to efficiently respond to spills from different modes and in all locations
- Some mechanisms for communication, coordination and notification between jurisdictions regarding oil transportation and spills currently exist and may be expanded to further enhance preparedness and response in the region.
- Vessel Response Plans (VRPs) required under the Oil Pollution Act (OPA) represent one important component of the U.S. regulatory regime that ensures safe transportation of crude oil by vessel. It is unlikely that VRP requirements can presently be met for transport of heavy crude oil on the Great Lakes.

Recent Policy and Regulatory Developments

The table below lists major oil transportation policy and regulatory developments, through 2014, in the U.S. and Canada and among the Great Lakes states and provinces. Additional details are provided in issue brief 4.

UNITED STATES	CANADA
Rail	
Federal • Pipeline and Hazardous Materials Safety Administration (PHMSA): ○ proposed regulations for phasing out of DOT-111 tank cars ○ standards for next generation of tank cars • Department of Transportation (DOT): ○ Notice of Proposed Rulemaking (NPRM) for Hazardous Materials: Enhanced Tank Cars Standards and Operational Controls for High-Hazard Flammable Trains ○ Advance Notice of Proposed Rulemaking (ANPRM) for Hazardous Materials: Oil Spill Response Plans for High-Hazard Flammable Trains ○ Emergency Orders ▪ stricter standards to transport crude oil by rail ▪ prohibiting shippers to switch to alternate classification involving less stringent packaging ▪ carriers must inform first responders about crude oil transported through their communities ○ Letter to American Association of Railroads outlining actions that can be taken voluntarily immediately by industry • Federal Railroad Administration (FRA) & USDOT ○ Operation Classification, primarily targeting shipments from the Bakken formation **State** • New York: ○ new targeted rail inspection and training campaign ○ multi-agency report on crude oil transportation ○ Executive Order directing agencies to petition U.S. DOT to strengthen rail car standards and to assess federal agencies' needs and risks ○ letter to governor of North Dakota urging quick action on regulations to reduce volatility of Bakken crude oil • Minnesota: ○ new laws: stricter oversight of railroad companies, more railway inspections, better emergency response training and preparedness ○ In 2014, amendment of Chapter 115E of *the Oil and Hazardous Substance Discharge Preparedness Law*: railroads must provide training for fire departments along unit train routes and specific timeframes for deploying equipment and trained staff for unit train ○ letter to the Governor of North Dakota advocating for conditioning standards to reduce volatility of Bakken crude oil	**Federal** • Transport Canada – regulation: ○ new regulations for federally regulated road and rail crossings ○ amends existing regulations to identify and address safety risks ○ companies must hold a valid Railway Operating Certificate to operate on federally regulated railways in Canada ○ amendments requiring 35 provincially regulated railway and light-rail companies operating on federal track to develop and implement Safety Management System ○ formalizing new DOT-111 tank car standards and three-year phase out of old ones ○ improving data reporting requirements for railways to proactively identify and address safety risks before accidents happen ○ monetary penalties for Railway Safety Act (RSA) violations ○ amendment to RSA to speed up approvals in emergencies – RSA allows for emergency directives to compel a railway company to cease unsafe activities or compel mitigation of immediate threats to safe railway operations • Transportation Safety Board ○ Investigation report for the Lac-Mégantic accident • Proposed settlement between victims of the Lac-Mégantic and Montreal Maine and Atlantic Canada Co., its insurance carrier, rail-car manufacturers and some oil producers. Three companies have not agreed to participate: World Fuel Services, Canadian Pacific Railway and Irving Oil.

Pipeline	
Federal • DOT Inspector General Audit of PHMSA's State Pipeline Safety Program guidelines, policies and procedures ○ Concluded that programs lack elements to ensure state inspections cover all federal requirements and pipeline operators maintain safety standards **State** • Michigan: ○ Michigan Petroleum Pipeline Task Force ○ Letter sent by attorney general and DEQ to Enbridge asking that additional anchors be installed to support the pipeline under the Straits of Mackinac. Work begun in August 2014.	**Federal** • Amendment of *National Energy Board Onshore Pipeline Regulations* requires companies to have management systems to maintain a healthy safety culture • December 2014 *Pipeline Safety Act* introduced that would implement measures to strengthen incident prevention, preparedness and response, and liability and compensation. **Provincial** • For approval of TransCanada's Energy East project: ○ Ontario: 6 conditions ○ Quebec: 7 conditions
Vessel	
Federal • Coast Guard: ○ The *2010 Coast Guard Authorization Act* directs the Coast Guard to revisit regulations addressing the transfer of oil to and from tank vessels and examine if new measures are needed in sensitive areas or during high-risk conditions. October 2013: Coast Guard issued a request for public comment, but no rulemaking has since been promulgated ○ *Development of Bottom Recovery Systems* final report stating that "current methods are inadequate to find and recover submerged oil, with responders having to reinvent the techniques on each occasion"	**Federal** • In December 2013, Transport Canada increased the maximum size of tankers allowed on the St. Lawrence River • The *Minerva Gloria* arrived in the port of Sorel-Tracy on 9/22/14 – federally permitted, it is the first tank vessel to carry diluted bitumen on the St. Lawrence Seaway for exportation. **Provincial** • Quebec: ○ 7 conditions for TransCanada's Energy East terminal in Cacouna

Summary of Issues and Trends Surrounding the Movement of Crude Oil in the Great Lakes-St. Lawrence River Region

Background

The development of domestic crude oil in both the United States and Canada has become an important part of the energy policy in the two countries. As one element of a plan to reduce the dependence on imported oil, the development of domestic oil reserves is creating economic opportunities for oil companies, transportation sectors, for local communities where oil is extracted, refined and exported and all of the segments of society that benefit from less expensive and more secure oil supplies. Development of the Bakken oil formation, covering parts of two provinces and two states in the Great Plains, and the oil sands reserves in Alberta represent two of the biggest oil formations in North America. Development of these oil reserves has caused an economic boom in some areas, reducing unemployment and contributing to budget surpluses for local communities and even entire states. However, the rapid development of the Bakken oil reserves and the Alberta oil sands have created challenges in the oil fields related to protection of water supplies, the need to maintain and upgrade infrastructure, and enhance government services, among others. The transportation of oil creates additional challenges and poses risks to the Great Lakes-St. Lawrence River region, which this paper and accompanying issue briefs address.

Oil production is an important source of energy, employment, and government revenue in the U.S. and Canada. In recent years, domestic production of crude oil in the North America (primarily from the Bakken formation, the Alberta oil sands and the Permian and Eagle Ford fields in Texas) has increased at a tremendous rate. This increased production is predicted to continue into the future, creating significant challenges in transporting crude oil to domestic markets, especially to refineries. The rapid expansion of crude oil production to date has been striking: in the U.S., total production reached 7.4 million barrels per day (bbl/d) in 2013, up from 5.35 million bbl/d in 2009 – an increase of 38.5 percent[1]. The forecasted output for 2015 represents what will be the highest level of domestic production in the U.S. since 1972: 9.3 million bbl/d, a 75 percent increase over 2009 levels.[2]

The Great Lakes, their connecting channels and the St. Lawrence River represent the largest system of freshwater resources in the world. The Great Lakes have a total water surface area of nearly 95,000 square miles. They contain approximately 24.6 quadrillion liters of water (6.5 quadrillion gallons) which is 20 percent of the world's supply of fresh surface water and 95 percent of the fresh surface water in the United States. Thousands of streams and rivers drain the more than 521,000 square kilometers (201,000 square miles) of the basin and feed directly into the Great Lakes.

Along with the St. Lawrence River, the Great Lakes have played and continue to exert a profound influence in the establishment, advancement and sustainment of the regional and national economies of the U.S. and Canada. The unique geographical, ecological and climatological characteristics of the Great Lakes and the land area making up the drainage basin have shaped the socio-economic heritage of the region. For many generations the Great Lakes and the St. Lawrence River region has been a desired place for people to live, work and educate their children and an equally attractive place for many businesses and industries. In addition, the Great Lakes fulfill recreational needs of people from the vicinity of the lakes and far beyond.

There are more than 43 million people (approximately 8% of the U.S. population and 50% of the Canadian population) who depend on the Great Lakes and the St. Lawrence River for their drinking water supply. Key industries, such as agriculture, power generation, tourism, and sport and commercial fishing are prominent in the region. In addition to service and resource-based industries, manufacturing industries in the Great Lakes region include steel, paper, chemicals and automobiles. These industries rely both on oil for their operations and Great Lakes basin water for their processes. The tourism and fishing industries, in particular, rely upon clean and

uncontaminated waters. Moreover, the Great Lakes region is home to pristine natural environments and ecologically sensitive areas.

The Great Lakes-St. Lawrence River region is particularly dependent on petroleum products because of the makeup of the regional industry and business mix. However, the geography of the region, which contributes to its uniqueness, presents some challenges with regard to the transportation of oil. The Great Lakes themselves form a bottleneck or "water block" to the movement of oil. It would be impractical and risky to build a network of pipelines under the lakes, and transportation routes via land face logistical and geographical hurdles. Rail transport for instance includes routes that traverse both pristine, unpopulated areas and major metropolitan centers such as Chicago, Milwaukee, Detroit, Buffalo, Toronto and Montréal.

While the region's economy is dependent on oil, it is equally dependent on water. The region is blessed with a globally unique, water-rich natural environment. The abundance of high-quality fresh water is an important reason that business and industry have chosen to locate here. The Great Lakes and St. Lawrence River support a huge international economy and marketplace that includes a large and growing sector for global trade, commerce and exchange of people, ideas and technologies. One of the biggest challenges is to identify growth-oriented, water-dependent industries (i.e., the "Blue Economy") to contribute to a more balanced regional economy supporting healthy service, financial and tourism/recreation sectors, among others. Since the future economy will continue to rely in part on oil and petroleum products, the challenge for the region is to acknowledge and support contributions of the oil industry to society and the economy, but to also properly understand the current risks associated with oil consumption and transportation to the region.

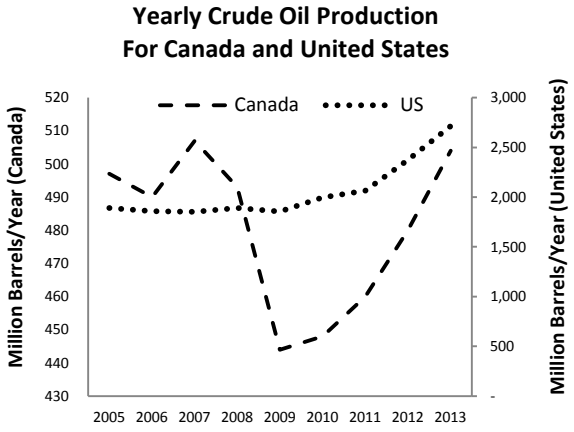

Figure 1: Yearly crude oil production in Canada and United States.[3]

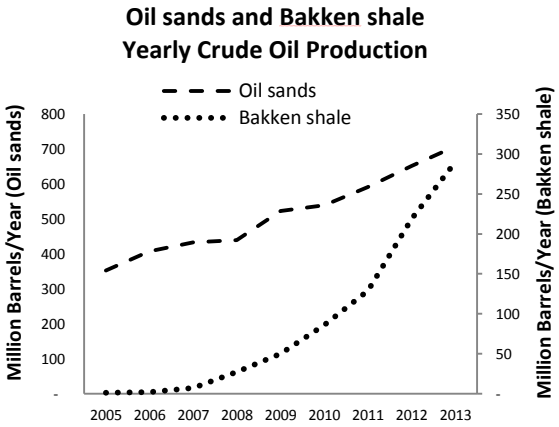

Figure 2: Oils sands and Bakken shale yearly crude oil production.[4]

The risks and benefits of oil transportation vary greatly depending on several factors, such as the type and amount of oil transported, where the oil is refined and the mode of transportation used to get the oil to its destination. Advances in oil extraction technologies have increased production of two types of oil specifically of high interest to the Great Lakes region. One is oil sand, the other is shale oil.

Oil sands reserves in North America are found primarily in Alberta, Canada. Oil sands crude is a nonconventional type of oil that, when initially extracted, is made up of inorganic material, water and bitumen, a viscous form of petroleum. Approximately 70 percent of oil sands products from Canada is sent to refineries in the Midwest. As of 2009, 26 refineries were equipped to process this type of crude oil, 12 of them located in Great Lakes states.

Shale oil, also called light tight oil, is another type of nonconventional crude oil and is found in low permeability sedimentary formations. It is much more volatile than other types of crude oil and has a flash point that resembles that of gasoline, making it very flammable and potentially explosive. A large amount of the shale oil extracted in the

U.S. comes from the Bakken formation in North Dakota. In the Great Lakes region there are also several small oil reserves in Ohio, Pennsylvania and New York, as well as some shale oil production in northern Michigan.

Even though the physical characteristics of oil sands crude and shale oil differ markedly, both have the same United Nation's International Dangerous Goods classification (UN1267). This single classification gives very broad criteria and restrictions for transportation. However, physical differences between the two types of oil mean they present different transportation issues and challenges.

Table 1: Characteristics of Bakken crude oil and Alberta oil sands crude oil

	Bakken shale crude oil	**Alberta oil sands crude**
Also called	Light tight oil, light sweet oil	Heavy crude oil, heavy sour crude oil, tar sands, bitumen (raw form of oil sands crude)
Origin	Bakken formation (mostly North Dakota but also Montana, Manitoba and Saskatchewan)	Northern Alberta (Athabasca/Fort McMurray, Peace River, Cold Lake)
Density	Low	High
Main extraction method	Fracking	Surface mining or in-situ recovery
Main transportation method in the Great Lakes	Train	Pipeline
Transportation challenges	Volatility, flammability, capacity	Density, viscosity, capacity

The acceleration in crude oil production has challenged both industry and government to address the growing need to transport crude oil efficiently, safely and economically from the oil fields to refineries and points of export in both countries. Crude oil transportation modes include pipelines (the traditional preferred mode of transporting petroleum products by the oil industry) and tankers, but increasingly producers are turning to rail and other methods to transport crude oil as a result of capacity bottlenecks in the pipeline network.

Oil and oil products have played an important role in the development of the U.S. and Canada and oil still play a predominate role in the energy mix of the two countries. Together with natural gas, oil benefits our lives in countless ways every day. They supply more than 60 percent of the energy needs in the U.S. for multiple purposes: fueling cars, heating homes or cooking food. Crude oil also supplies the building blocks for countless everyday products, including dent-resistant car fenders, soft drink bottles and camping equipment. The benefits of oil are far reaching in many ways that we would rarely think of. For instance, oil is used in the development of products such as synthetic fabrics, pharmaceuticals, fertilizers, sporting goods and toys.

The oil and natural gas industry is one of the world's largest industries and oil plays a vital role in supporting the North American economy. Annual revenues are large as are the costs of providing consumers with the energy they need. Among those costs are finding and producing oil and natural gas; and refining, distributing and marketing those refined products.

While the economies and societies of Canada and the U.S. partake of the many benefits of oil, many areas in the two countries are challenged with significant emerging issues and recent problems surrounding the transportation of domestic crude oil. The Great Lakes-St. Lawrence River region is one of those areas. The binational Great Lakes-St. Lawrence River region, home to eight U.S. states, two Canadian provinces, and a number of tribal governments, has become a hub of oil transportation and refining activity within the two nations. The region is a leading center of business and manufacturing for the two countries. The lakes and the river provide an efficient means of transporting manufactured goods and raw materials for the region and the rest of the world.

Oil production provides billions of dollars of annual revenue for the U.S. and Canadian federal, provincial, state, and tribal governments in the form of royalties, rents, bonuses, income taxes and other payments. In terms of employment, from 2009 to 2013, job growth in the oil and gas industry far exceeded average employment increases for all industries in the U.S. and in some sectors in Canada. These employment increases tend to be focused in production-heavy areas, and in much the same way, predicted growth in production and transportation needs may benefit some parts of the region more than others. However, increasing domestic production and expansion of transportation capacity also contribute to oil price stability, with transport access boosting profit margins for industry, which can increase revenues to government and help stabilize consumer costs. Producer profit per gallon of crude oil – the "netback" sales revenue minus transportation costs – can be much higher when oil reaches better markets. Higher demand at these markets allows producers to sell their crude oil for more money than it costs them to transport it there. This is a key driver of demand for growing crude oil transportation capacity and options.

The petroleum industry in the region is a coordinated network of refineries, pipelines, terminals, barges and vessels. This network operates 24 hours per day, 365 days per year to meet the energy needs and demands of the region's residential, industrial and commercial customers. For instance, Ontario's Chemical Valley located south of Sarnia is one of the world's leading production centers for petrochemicals. One of the largest refineries in the U.S. is located on the shores of Lake Michigan in Whiting, Indiana.

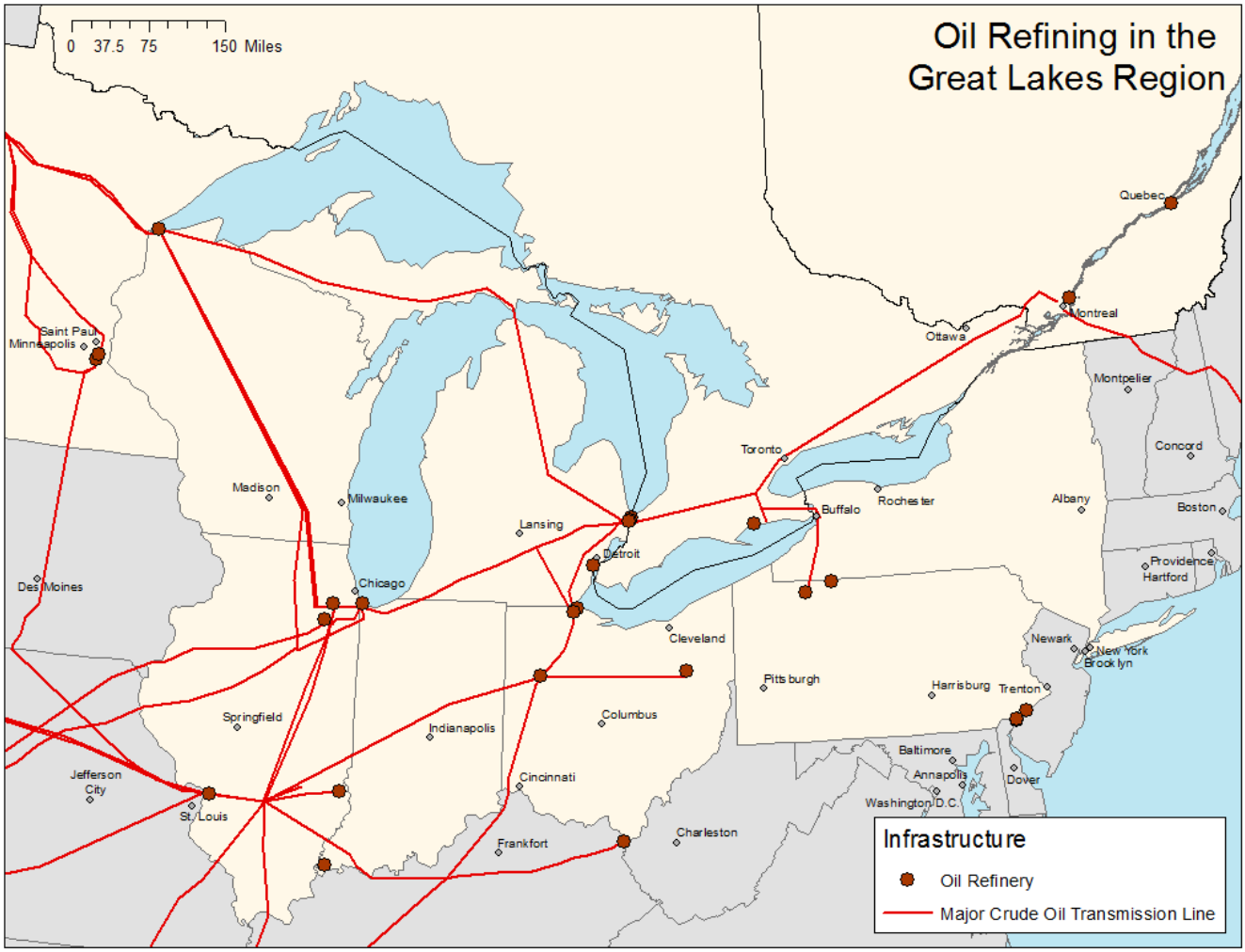

Figure 3: Transmission pipelines and refineries in the Great Lakes-St. Lawrence River states and provinces.

Large quantities of crude oil from Alberta and North Dakota move into or through the Great Lakes and St. Lawrence River basin every day, making the region an important link in the oil transportation and refinement process. Six American and six Canadian refineries operate in the Great Lakes drainage basin and there are 25 refineries operating in the eight-state, two-province region. These facilities combined refine nearly five million bbl/d of crude oil[5]. While these refineries represent destination points within the region, the region is also experiencing challenges due to the large amount of domestic crude oil being transported through the region (primarily via rail tankers and pipelines) to refineries and other destination points outside of the region. Crude oil from the Alberta oil sands may pass through the region to other refineries or may be processed at refineries along the lakes, while most Bakken crude passes directly through the region on its way to refineries elsewhere.

Local governments incur costs associated with infrastructure development, training and capacity building for first response duties for oil spills. For some municipalities, this means that local taxpayers are shouldering economic impacts of increasing response resources for potential emergencies without necessarily receiving substantial gains from oil production, extraction, or refining activities and associated royalties or tax income from industry. In particular, much of the Bakken crude oil transiting via rail through the Great Lakes region is destined for East Coast refineries. Thus, in these cases, communities absorb first responder costs without receiving economic benefits or associated jobs. Transport can also adversely impact other industries via land use, shared infrastructure and traffic congestion.

The potential impacts of a spill in the Great Lakes-St. Lawrence River region are particularly important and need to be better understood. These impacts might be economic, societal, environmental or human health-related or a combination of these. The human health concerns might include impacts to drinking water, air contamination, and explosion as the result of a spill, leak, a derailment or a collision. The economy of the region might be detrimentally affected by spills causing impacts to commercial and sport fishing, tourism and recreation and disruption of business and normal day-to-day activities. The cost of a spill cleanup can also be high and the liability insurance limits might not always be sufficient to cover these costs. Finally, a spill can have a negative impact on the environment. In open water, for example, there is no proven way to recover sunken heavy oil. It can detrimentally impact aquatic flora and fauna. An inland spill might also result in toxic contamination of soils and groundwater aquifers.

The importance of issues surrounding the safety of oil transportation through the region was tragically brought to attention on July 6, 2013 when a train carrying numerous tank cars of crude oil from the Bakken formation in North Dakota derailed in the town of Lac-Mégantic, Québec. The derailment resulted in a devastating fire and explosions causing the loss of 47 lives, billions of dollars of damage to the town and an oil spill in the Chaudière River, the main source of drinking water for thousands of downstream citizens. This calamitous accident served to underscore deep concerns that many officials and decisionmakers in both the U.S. and Canada were beginning to have about the potential negative impacts of increased oil transportation both in the Great Lakes-St. Lawrence River region and throughout the two countries.

Nearly 25 years earlier the two countries received a serious wakeup call regarding the devastation that can occur from transporting oil via vessel. In March 1989, the *Exxon-Valdez* was grounded on a reef and began leaking millions of gallons of oil into the pristine waters of Prince William Sound, Alaska. This incident, which received worldwide attention, precipitated the development and passage of several key pieces of environmental protection legislation in both the U.S. and Canada, most notably the Oil Pollution Act (OPA) of 1990.

In July 2010 another headline-making oil spill occurred in the Great Lakes-St. Lawrence River region when a pipeline carrying diluted bitumen, a heavy crude oil from the Alberta oil sands, spilled into Talmadge Creek, a tributary of the Kalamazoo River near Marshall, Mich. Approximately one million gallons of oil was spilled, resulting in one of the largest inland spills and cleanups in U.S. history. This spill generated regional and binational interest regarding issues surrounding transportation of oil via pipeline, the age of the infrastructure and the need to review and evaluate the programmatic and regulatory framework to ensure that the transportation of oil via this mode is safe and efficient.

These alarming incidents have caused both U.S. and Canadian officials to analyze their regulatory regime for oil transport and to enact stronger laws and policies. Both countries are enacting changes to amend or strengthen existing programs to ensure that the current regulations meet the challenges and risks generated by increased oil production and transportation. In order to strengthen existing policies, they have ordered emergency regulatory measures be undertaken and implemented response policies for both companies involved in oil transport and the federal agencies that regulate them. Similar scrutiny is occurring in the Great Lakes-St. Lawrence River region.

Since the Lac-Mégantic incident at least 23 other transportation-related crude oil spills have been reported in the news from both the U.S. and Canada involving all modes of transportation, including rail (eight incidents), pipeline (eight incidents), vessel/barge (two incidents) and truck (at least one incident). At least four of these spills occurred in a Great Lakes state or province.[6]

Table 2: Accidents resulting in oil spills since the Lac-Mégantic accident on July 6, 2013# (spills in Great Lakes states are shaded)

Date	Mode of transportation	Location	Amount spilled (gallons)*
8/13/2013	Pipeline	Erie, IL	772,800
9/29/2013	Pipeline	North Dakota	865,200
10/19/2013	Rail	Gainford, AB	unknown
11/7/2013	Rail	Aliceville, AL	2,730,000
12/30/2013	Rail	Casselton, ND	475,000
1/7/2014	Rail	Plaster Rock, NB	unknown
1/18/2014	Pipeline	Rowatt (Regina), SK	5,250
2/3/2014	Rail	between Red Wing and Winona, MN	12,000
2/13/2014	Rail	Vandergrift, PA	10,000
2/24/2014	Barge/Tanker	Vacherie, LA	31,500
3/19/2014	Pipeline	Colerain Township, OH	10,000
3/22/2014	Barge/Tanker	Galveston Bay, TX	168,000
4/30/2014	Rail	Lynchburg, VA	30,000
5/10/2014	Rail	Lasalle, CO	7,930
5/14/2014	Pipeline	Bakersfield, CA	190,000
5/28/2014	Pipeline	Delta National Wildlife Refuge, LA	2,100
5/28/2014	Pipeline	Powder River, WY	25,000
6/7/2014	Pipeline	New Town, ND	29,000
6/11/2014	Truck	St. George, UT	4,000
6/29/2014	rail	Port of Albany, NY	4,200
10/13/2014	pipeline	Lake Caddo, LA	168,000
12/1/2014	pipeline	Red Heart Creek, AB	15,850
12/16/2014	pipeline	Regina, MB	56,700

*Amount of initial spill. Amount recovered not considered

Only accidents with spills of more than 1,000 gallons were compiled. Accidents in storage and processing facilities are not included

With the recognition of the important role that oil plays in providing the energy and industry needs of the two countries, the recent increase in crude oil shipments needs to be properly understood with regard to risks and impacts. The different modes of transportation pose environmental and safety risks from accidents. The risks can be further complicated based on the properties of oil being transported. Because of the diverse nature of oil and the different ways that spills can occur, it is difficult to predict the extent and duration of their impacts on the ecosystem, human health and the economy.

Purpose of the Report

Concerns over these recent spills, coupled with the need for information regarding the dramatic increase in domestic oil production and the commensurate increase in oil transportation (especially by rail) to and through the Great Lakes-St. Lawrence River region prompted the Great Lakes Commission, at its 2013 Annual Meeting, to instruct its staff to prepare an issue brief on oil transportation. Because of the scope of the issue, staff has prepared a series of four background briefing papers to report on the potential benefits, risks and options for mitigating risks surrounding

the transportation of crude oil in the Great Lakes-St. Lawrence River region, including an assessment of the regulatory structure in the two countries and the states and provinces. At the 2013 annual meeting, the Commissioners expressed their interest in better understanding both the positive benefits of oil production and transportation but also the risks and impacts to the region's citizens and environment, and to consider ways these risks and impacts can be reduced and minimized to protect the Great Lakes and St. Lawrence River ecosystem.

This summary is accompanied by the four supporting issue briefs:

- Developments in Crude Oil Extraction and Movement;
- Advantages, Disadvantages, and Economic Benefits Associated with Crude Oil Transportation;
- Risks and Impacts Associated with Crude Oil Transportation; and
- Policies, Programs and Regulations Governing the Movement of Crude Oil.

During the fall of 2014, these discussion drafts were available for review and comment to the Great Lakes Commissioners, the states and provinces, federal, state/provincial and local governmental agencies from the U.S. and Canada, business and industry, and non-governmental stakeholders involved in or concerned about the transportation of crude oil in the Great Lakes and St. Lawrence River region. A summary of the comments is available in Appendix 1: Summary of Comments Received. The final report was presented to the Great Lakes Commission at its 2015 semiannual meeting in late February and includes observations, key findings and potential next steps to guide the work of the Commission on this important issue.

The Great Lakes Commission is an interstate compact agency that promotes the orderly, integrated and comprehensive development, use and conservation of the water and related natural resources of the Great Lakes basin and St. Lawrence River. Its members include the eight Great Lakes states, with associate member status for the Canadian provinces of Ontario and Québec. The Commission was established by joint legislative action of the Great Lakes states in 1955 (the Great Lakes Basin Compact) and granted congressional consent in 1968. A Declaration of Partnership established associate membership for the provinces in 1999.

The Commission's mission is to help its member jurisdictions speak with a unified voice and collectively fulfill their vision for a healthy, vibrant Great Lakes-St. Lawrence River region. Commission products and services focus on communication and education, information integration and reporting, facilitation and consensus building, and policy coordination and advocacy.

The Commission has a longstanding interest in emergency preparedness and response and oil transportation issues, dating back to the mid-1980s. The Commission formed an emergency preparedness task force in 1989 to help develop policy recommendations for the region in the aftermath of the *Exxon Valdez* incident. The work of the Commission and its task force (which remained in place until 1996) contributed to the passage of two important pieces of environmental legislation in 1990; the Oil Pollution Act and the Great Lakes Critical Programs Act, which strengthened both regional and national preparedness and response frameworks related to oil spills. For the past 25 years the Commission has worked with the U.S. Environmental Protection Agency and its Region 5 Regional Response Team to advance area contingency planning efforts through the creation of inland area maps and other tools that support spill planning and response in the field. In the 1990s, the Commission and the Council of Great Lakes Governors (with support from the Great Lakes Protection Fund) created the *Great Lakes Spill Protection Initiative*, a partnership between state and federal agencies and the region's major oil companies that helped build and strengthen government-industry collaboration and coordination mandated under OPA. And in 2010, the Commission established a second emergency preparedness task force in the wake of the Enbridge pipeline spill that occurred outside of Marshall, Mich. in July of that year. The task force report,[7] presented to the Great Lakes Commissioners in September 2012, detailed nearly two dozen policy recommendations to help strengthen federal, state and provincial preparedness and response programs in areas related to cold-weather response, vessel-based spills, shoreline facility-based spills and pipeline spills.

The 2013 action item is a continuation of the Commission's interest in preparedness and response activities related to oil and is an acknowledgement that there is a need for managers and decisionmakers in both the public and private

sectors to better understand the complex nature of oil extraction, transportation and refinement from economic, societal, environmental and public health perspectives.

Developments and Responses from Regional Partners to Recent Oil Spills

Government agencies, nongovernmental environmental and citizens groups as well as the oil industry itself have shown a strong interest in raising awareness to help policymakers better understand the challenges and constraints faced by the industry to move crude oil from the point of extraction to final destination points.

Within the Great Lakes-St. Lawrence River region, recent studies and reports completed by state, provincial and federal agencies and citizen environmental groups address the risks associated with transporting crude oil. For instance, in April 2014, a multi-agency report was issued by the State of New York on transporting crude oil with a series of recommendations to reduce risks and improve response capacity directed toward the state, the federal government and industry.

Updating programs and policies in the Great Lakes-St. Lawrence River region is also rapidly progressing with state/provincial elected officials and agencies implementing more rules, regulations and policy briefs at regular intervals. A few examples from the region include: the Michigan Attorney General and Department of Environmental Quality Director are convening a taskforce to study petroleum pipeline safety throughout the state as well as the state's preparedness for spills; the Governor of New York State issued an Executive Order in January 2014 to various state agencies directing them to petition U.S. DOT to strengthen rail car standards, and to assess federal agencies' needs and risks associated with the transport of crude oil. As of December 2014, several recommendations in the assessment have been adopted by federal agencies, and the State of New York has deployed a new, targeted rail inspection and training campaign specific to crude oil transport. Minnesota has been exploring ways to enhance its emergency response system, highlighting the importance of lessening the volatility of Bakken crude oil transported by rail. In September 2014, the Governor of Minnesota wrote a letter to the Governor of North Dakota advocating that the North Dakota Industrial Commission establish conditioning standards to reduce volatility of Bakken crude oil. In December 2014, North Dakota regulators ordered that such crude oil be treated to reduce volatility in advance of transport.

These recently published reports (and new initiatives) were prompted to a large extent by recent spills or by concerns related to proposals to transport more oil through the region. A brief summary of these issues by transport mode is included below.

Pipelines

Pipelines are the traditional preferred mode of transportation for oil. A pipeline transports oil by a series of pumping stations situated at various intervals along each route, generally using remotely controlled valves. More oil is transported through the Great Lakes-St. Lawrence River basin by pipeline than by any other mode. With pipelines, different types of crude oil from different origins and with different characteristics can be transported in the same line. To ensure safety of transport, pipeline companies operate control centers. These centers, staffed 24 hours per day, monitor data from information points located along the pipeline system to check for leaks and spills. Leak detection is provided by volume in/volume out readings of product flow through a given length of pipeline. These volumes are regularly compared and if they are not within prescribed limits, the pipeline is shut down and inspected by the company. In addition to these pipeline monitoring practices, pipeline routes are visually inspected on a regular basis. Requests have been made both to build new pipelines and to increase the capacity of the existing pipeline network by, for example, allowing higher pressures within the lines or changing their direction of flow.

There has been renewed awareness of the issue of pipeline safety and the need to better understand the issues surrounding the transport of oil through pipelines as a result of two spills that occurred in the Great Lakes region in the summer of 2010: the one mentioned above that occurred near Marshall, Mich. and another that occurred in September of that year in Romeoville, Ill. These pipeline incidents have drawn attention to the vulnerability of the Great Lakes basin from pipeline spills. These spills have also prompted preparedness and response agencies to evaluate the state of preparedness within their agency/jurisdiction and to begin the process of identifying areas where these programs can be improved.

In the U.S., pipelines are regulated by the Department of Transportation (DOT) through its Pipeline and Hazardous Material Safety Administration (PHMSA). States have some authority under the Pipeline Safety Act to enact stricter standards, but most states have not done so. In Canada, interprovincial and international pipeline transportation is governed by the National Energy Board (NEB). NEB defines safety and security, environmental protection, and economic efficiency outcomes and requires regulated companies to determine the best means to achieve the outcomes to effectively manage risk. .

In 2012 the National Wildlife Federation completed a legal analysis of pipelines and issued a report titled *After the Marshall Spill: Oil Pipelines in the Great Lakes*.[8] The report examined whether laws and regulations governing pipelines adequately protect the Great Lakes Basin from oil pollution. The report concluded that federal laws are inadequate in many respects related to planning, inspection, maintenance, enforcement, risk management and communications, among others. The report also notes that the states themselves have not passed their own laws to fill regulatory gaps. For instance, within the Great Lakes region, only a few states have chosen to regulate the safety and environmental impacts of oil pipelines. Michigan, Minnesota and Illinois require operators to obtain a routing permit for new oil pipelines. Currently, just three Great Lakes states—Indiana, Minnesota and New York—are certified to regulate intrastate pipelines. For more information regarding legislation, see Issue Brief 4.

Another pipeline-related concern that has received public attention relates to the location and operation of the Enbridge oil pipeline (Line 5) that runs under the Straits of Mackinac, the narrow waterway separating the Michigan's upper and lower peninsulas. The Straits of Mackinac connect two of the Great Lakes, Lake Michigan and Lake Huron, and are five miles (8.0 km) wide and 120 ft (37 m) deep on average. The Straits connect lakes Michigan and Huron so that hydrologically the two are considered one lake.

Line 5 is part of the Enbridge Lakehead system, a network of pipelines that run from Superior, Wisconsin to Sarnia, Ontario. This system carries crude oil from Alberta and North Dakota. Part of the system runs from Superior to Chicago and then through southern Michigan. The other part of the system runs through northern Wisconsin, under the Straits of Mackinac and through Michigan, ending in Sarnia, Ontario after crossing the St. Clair River at Port Huron, Mich.

The Enbridge Line 5 pipeline has a diameter of 30 inches and was built in 1953. Under the Straits, it splits into two 20-inch wide pipelines built with thicker pipe walls and an additional external coating to minimize corrosion. It can carry up to 540 thousand bbl/d of natural gas liquids (NGL) and crude oil.[9] According to the most recent information provided by Enbridge, there is no heavy crude oil from oil sands currently transported in this line.

Since the Straits of Mackinac are so important to the region economically, ecologically, historically and culturally, there are many concerns about the Line 5 pipeline that go above and beyond concerns expressed over pipelines in general. Some of these concerns include:

- The pipeline is more than 60 years old and has never been replaced; there could be corrosion issues that increase the risk of a spill.
- If Alberta oil sands crude were to be transported in this line, the operating pressure will have to be increased, which will increase the temperature in the pipeline and might have an impact on the integrity of the pipeline along with unanticipated ecological impacts.

- There are extreme conditions in the Straits—ice cover, challenging lake currents and the depth of the Straits—all of which would make an oil spill response extremely challenging.
- The unpredictable currents in the Straits may create specific problems for responders trying to contain an oil spill. New modeling studies[10] suggest that oil spilled in lakes Michigan and Huron would disperse rapidly and the recovery would be very challenging, especially if the material is oil sands crude.

The safe operation of this pipeline was addressed by the State of Michigan in a July 2014 letter to Enbridge from Michigan's attorney general requesting that it address one particular issue pursuant to the 1953 "Straits of Mackinac Pipe Line Easement" granted by the State of Michigan. The easement requires that the pipeline be supported at intervals not to exceed 75 feet. Currently, the average distance between supports is 54 feet, but there are some unsupported spaces (acknowledged by Enbridge) that are more than 75 feet apart. The letter triggered a 90-day period during which Enbridge is required to "correct that specified non-compliance with the Easement or at a minimum, have commenced and diligently pursued remedial action as soon as it is reasonably possible."Work has begun in August 2014.

In Canada, Trans Canada's Energy East pipeline project has received a lot of public attention. The project involves converting an existing gas pipeline that runs from Saskatchewan to Ontario in a crude oil pipeline then constructing new pipelines in Alberta, Ontario, Québec and New-Brunswick. This project would allow transportation of crude oil from Alberta to eastern Canada refineries (through the Great Lakes-St. Lawrence River basin), and also to ports for exportation. There are concerns from the public about the integrity of the existing pipeline and the impact of changing the type of product on its safety. The Energy East pipeline is planned to cross several rivers, including the Ottawa River and the St. Lawrence River. The location of a new terminal for transportation on the St. Lawrence, in Cacouna, has been in the center of public and legal disputes. In Québec, the government listed seven conditions to agree to the project, including social acceptance, a thorough environmental and economic analysis, financial and technical guarantees in case of a spill, and respect to the First Nations. In Ontario, public consultations on the project are plan for January 2015. For more detail on this project, see Issue Brief 1.

Approximately 70 percent of oil sands produced in Alberta is shipped to refineries in the U.S. via pipeline.[11] A major reason for producers favoring pipeline transportation is the cost. Transportation of crude oil via pipeline is, on average, $5 to $10 per barrel cheaper than via rail, presenting producers with an optimally cost effective shipping option when available.[12] An important implication of this cost differential is that increasing production of oil sands crude in Alberta is likely to continue to drive industry movement toward new pipeline construction to support future transportation into the U.S. Midwest for refining. Pipeline transport is cost effective and can provide easement revenue to landowners in the U.S. However, new construction can interfere with agriculture and other land uses, and inconsistencies in state laws combined with a lack of federal permitting can make easement land restoration and payment enforcement difficult. The main risks associated with pipelines are infrastructure concerns (e.g., quality of the material and welds), natural hazards and extreme weather conditions, adequate monitoring, an outdated regulatory regime and geography (i.e., challenges presented by the physical environment). In the Great Lakes states, 55 percent of the pipelines traversing the region were installed prior to 1970 and nationally in Canada, approximately 48 percent were installed more than 30 years ago.

Vessels

In 2011, more than 19 million metric tonnes of refined petroleum products were transported on the Great Lakes and through the St. Lawrence River Seaway. Although there is refined petroleum transported on the Great Lakes, no crude oil is transported on the Great Lakes at the current time. In September 2014, the first tankers transporting crude oil for export were seen on the St. Lawrence River. These transport oil sands crude that has been shipped by rail from Alberta to Sorel-Tracy, Québec, and stored near the port. According to environmental groups, there could be up to 50 shipments each year in coming years.

Vessel-based transit would capitalize on existing coastal refinery infrastructure and the efficiencies inherent in transporting any/all heavy bulk goods by water. Although crude oil is not transported by vessel on the Great Lakes themselves, as the production of domestic crude oil continues to grow, there is an overall increase of crude oil transportation on the broader Great Lakes basin waterway system, which includes the inland waterways, rivers, and canals adjacent to the Great Lakes. The U.S. Coast Guard notes that even without factoring in cargos, the large foreign, Canadian and U.S. vessels traversing the Great lakes and the St. Lawrence River can carry thousands of gallons of diesel or bunker C oil as fuel. The majority of the fuel oil is carried on U.S. and Canadian Lakers is located in internal tanks away from the skin or outer hull of the vessel, but the vessels themselves do bring a certain level of risk with them on their own.

The increase in domestic production, affordable prices for oil sands crude and the refining capacity in the U.S. Midwest for oil sands crude have combined to create the demand to transport crude oil to refineries located in or near the Great Lakes basin. There are six refineries in the Great Lakes basin in the U.S. and six located on or near the Great Lakes and St. Lawrence Seaway in Canada.[13]

Table 3: Refineries and refining capacity in the Great Lakes states and provinces[14]

State / Province	# of refineries in state or province	Total refining capacity (thousand bbl/d)	# of refineries in Great Lakes basin	Refining capacity in Great Lakes basin (thousand bbl/d)
Illinois	4	989,000	0	0
Indiana	2	427,000	1	400,000
Michigan	1	123,000	1	123,000
Minnesota	2	413,000	0	0
Ohio	4	940,000	3	860,000
Pennsylvania	5	769,000	0	0
Wisconsin	1	45,000	1	45,000
Ontario	4	390,000	4	390,000
Québec	2	402,000	2	402,000
Total	25	4,498,000	12	2,220,000

The need to move domestic crude oil quickly and efficiently has created incentive for industry to explore vessel transport of crude oil on the Great Lakes, not only to refineries in the eight-state, two-province region capable of refining the specific types of crude oil being transported, but also to refineries located outside the basin. This would also include shipment of oil through Chicago to barges that would traverse the Mississippi River to reach additional refineries in the U.S. Gulf Coast and through the St. Lawrence Seaway to refineries on the east coast of Canada, the U.S. and Europe.

Most of the attention and interest shown in waterborne transportation of crude oil on the Great Lakes relates to the concern that a crude oil spill from a vessel could be catastrophic for the Great Lakes. The Great Lakes waters are pristine in many parts of the system, providing fish and wildlife habitat for hundreds of species. However, because of the region's geographic location (the Great Lakes are located approximately between the 41st and 49th parallels north), water bodies in the region (including the Great Lakes themselves) have the potential to be covered in ice for several months out of the year. Poor weather and seasonal ice cover can also impede shipping functionality.

While oil spill response in water is always difficult, cold weather response operations—particularly those involving ice—are extremely challenging and fundamentally different from operations in open water and milder temperatures. Oil spill responders must understand the properties of oil in cold weather to inform the response strategy in conditions of freeze up, full ice and ice break up. While studies have been conducted by researchers in government, academia and the private sector, much of this research has focused on cold weather response in the maritime waters

of Alaska and the Arctic region. While this information is relevant for the Great Lakes-St. Lawrence River, many of the tools and spill response techniques have yet to be tested in the freshwater environment of the Great Lakes.

In the U.S. the transport of oil is governed by a complex set of regulations varying by mode. Ships transporting oil are governed by OPA with the U.S. Coast Guard having the regulatory lead for oceans and the Great Lakes and U.S. EPA having the lead for inland areas. Canada has enacted similar laws governing oil transportation by vessel, the primary law being the Canada Shipping Act. The Act led to the creation of the National Spill Response Plan developed by the Canadian Coast Guard to address marine emergencies for the Great Lakes, connecting channels and the St. Lawrence River. The plan addresses spills that impact Canadian waters from vessels in transit and during loading and unloading operations. Great Lakes binational agreements prompted by the Great Lakes Water Quality Agreement, such as CANUSLAK (the joint marine pollution contingency plan) and CANUSCENT (the joint inland pollution contingency plan), provide the framework for well-coordinated emergency preparedness and response between the two countries. More information on legislation is provided in Issue Brief 4.

It is important to note that vessel transportation of commodities has several advantages over other transportation modes such as rail and truck. Although economic and logistical factors are important (and often pivotal) in mode choice decisions, environmental and safety issues and benefits are becoming increasingly important in the decisionmaking process. In this regard, vessel transportation generally fares very favorably when compared with other modes of transportation. For instance, vessel transportation generally is safer, uses less fuel and produces fewer emissions than rail or truck transport when compared with equivalent commodity hauls. Also, marine transportation is the preferred mode and performs the best related to impacts associated with congestion and noise. Vessels operating on the Great Lakes and St. Lawrence River are quieter than rail and trucks and the noise they produce is generally away from population centers. Finally, due to the good track record of the marine transportation industry and the advances in spill preparedness and response programs under the U.S. Oil Pollution Act and similar laws in Canada, waterborne transportation of oil and petroleum products is generally considered to be safe in comparison with other modes. On the other side, there are risks associated with water-borne transportation: collision between two or more ships and between a ship and infrastructure, grounding, severe weather conditions and human error associated with piloting the vessel on the water and in ports. Even though water transportation of crude oil can be considered safer, the volume of oil being transported means the consequences in case of an accident resulting in a spill could be greater than with other modes of transportation.

In late 2013 the Alliance for the Great Lakes issued a report titled *Oil and Water: Tar Sands and Crude Shipping Meets the Great Lakes?*[15] It presents the potential impacts of the production and movement of oil sands on the Great Lakes and describes the state of preparedness in the region, the regulatory framework and the federal and state response programs, and the need to strengthen these programs. While this report acknowledges that waterborne transportation of crude oil is not occurring on the Great Lakes proper and currently represents only a small percentage of the crude oil being transported to and through the region, it warns about the possibility of this mode playing a more prominent role in the future and the need for the region to be adequately prepared to respond to a spill if one were to occur.

Rail

Crude oil transported by rail is most often carried in Class 111 tank cars, either in unit trains consisting strictly of tank cars carrying crude oil to a single destination, or as mixed trains hauling a variety of cargos to various destinations. Limitations facing pipeline transport (such as capacity and the fixed location of pipelines) combined with attractive cost factors have spurred demand for crude oil transportation via rail. Although it is more expensive than pipeline transport, oil transport by rail allows producers to respond to changing market conditions by being more geographically flexible, providing much shorter transit contract term periods and offering far faster delivery times to coastal markets. The Association of American Railroads reports that for the first half of 2014 (compared to the same period in 2013) there was a seven percent carloads increase in the United States and a 7.7 percent increase in Canada–totaling 380,961 carloads and 188,423 carloads carrying petroleum and petroleum products in each nation

by mid-year, respectively.[16] However, the increase over the last six years is far more striking: In the United States, 9,500 carloads of crude oil were carried by train in 2008, while 650,000 carloads were forecasted to be carried in 2014, a more than 68-fold increase. In Canada, 500 carloads were carried in 2009 and an estimated 140,000 carloads will be carried in 2014, a 28-fold increase.[17]

The increase in transportation of crude oil via rail has garnered much attention in the Great Lakes-St. Lawrence River region since the Lac-Mégantic train derailment and explosion in July of 2013. Since that time, at least eight other rail-related spills/accidents have occurred in the U.S. and Canada (see Table 1), creating a public debate about the safety of transporting crude oil by rail and the adequacy of the regulatory regime to keep pace with the rapid increase in transportation by this mode.

In the United States, rail transport is governed under DOT's Federal Railroad Administration (FRA). A potential strength of individual regulatory bodies is the opportunity to create strong policy that focuses on just one mode of transportation. Conversely, focusing on just one aspect of transportation can lead to a lack of coordination and harmonization among regulations and regulatory and response agencies. Canadian governance of rail transport is similar to the U.S. and safety standards developed by the rail industry apply in both countries. Transport Canada sets regulatory standards under the Railway Safety Act as well as the Transportation of Dangerous Goods Act. Recently, both countries have noted gaps in their regulatory regimes for rail and are taking steps, such as strengthening classification and labeling requirements, to fill those gaps. As these standards become stricter and agencies continue to promulgate rules, the hope is that the number of accidents will decrease while the effectiveness and timeliness of response actions will increase.

At least 12 governmental studies have been released since mid-2013 (after the Lac-Mégantic incident) examining issues surrounding the transportation of oil. These reports are listed in the bibliography that accompanies this report. Several of the reports examine multi-modal transportation (i.e., a combination of pipeline, vessel and rail) but at least six are focused exclusively on issues surrounding the increase in transportation of crude oil by rail. All of these reports reference the Lac-Mégantic tragedy and underscore how this event needs to serve as a wakeup call to both countries to ensure that oil transportation is done safely and efficiently in order to protect the environment, improve public safety and safeguard communities in both countries. These reports were written in the face of uncertainty about the ability of the U.S. and Canada pipeline network to respond to the increase in demand for oil transportation and the trend—noted above—of oil producers turning to rail transportation as a quick and flexible alternative to pipeline transport.

Legislation has been introduced in both Congress and Parliament following the Lac-Mégantic incident that would address issues related to minimum crew complements, crew training, changes in tank car designs, route selections for trains carrying crude oil, communications with states, provinces and communities regarding when and where oil is being transported and other issues. Regulatory agencies are also investigating ways that rail transport of crude oil can be made safer. While the response from government has been prompt, it has still been a struggle for the legislative and regulatory regime to keep pace with the market-driven increase in rail transportation. Legislative and regulatory actions and changes are described more fully in Issue Brief 4.

Rail transportation has some key advantages over other modes of transportation. Rail is much more flexible than pipelines or shipping crude oil by vessel or barge. This flexibility relates to the vast network of rail lines already in place and the relative ease of adding a "spur line" to allow for transport of oil directly from an oil field to a main rail line. Statistics show that railroads consistently spill less crude oil per ton mile than other modes of land transportation. Also, with existing infrastructure that supports greater access to new production areas and more refining locations, rail provides a wider range of geographic options. Rail transport allows producers to make more rapid changes in delivery location as market demand shifts, and with the added advantage of transporting oil much faster.[18] For example, a trip from the Bakken oil field to the U.S. Gulf Coast can take up to 40 days via pipeline versus five to seven days by rail.[19]

An immature crude-by-rail regulatory framework – especially single category classification of different crude types and the lack of crude oil cargo reporting requirements – constrains local government ability to appropriately prepare for possible incidents. Another issue related to this mode is that increased crude-by-rail traffic can crowd out rail access by other sectors, including agriculture and passenger transit. The main rail-related risks are the state of infrastructure, tank car design and safety, railroad crossings, lack of information on mixed trains' cargo, high volume of crude oil transported in unit trains, an immature regulatory regime and lack of human capital planning. For more details on these risks, please see Issue Brief 3.

Other areas of concern

Trucks do not play a major role in the transportation for crude oil in the Great Lakes-St. Lawrence River region. Individual tanker trucks hold less oil than rail cars, vessels and pipelines and are predominantly used for local transportation of crude oil, usually from the extraction site to pipeline or rail loading stations. In locations where the extraction site and the refineries are in close proximity, such as in Texas, trucks are used more often.

Tank trucks do play an important role in moving crude oil from production areas to pipeline and rail transport or between different modes, but on the whole, relatively little is moved via truck in the region.If it were to occur, increased tank truck traffic would likely cause localized congestion and greater wear and tear on roads. In terms of spill risks and consequences, the increase in truck oil shipments brings its own causes for concern. The risks are mainly related to in-route collision, inadequate infrastructure, inadequate truck safety design, and an immature regulatory regime. In addition, trucks can be driven by a wider variety of routes that take them close to sensitive resources, increasing the possibility of damage from a cargo if it does spill.

Finally, transshipments sites, where oil is moved from one mode of transportation to another mode or to a storage facility, can also be a source of risk. Some Great Lakes transshipment sites are becoming more important because of their geographic location. The risks at these sites can come from equipment failure, human error, inadequate storage and maintenance, inadequate inspection and regulatory regimes and unmonitored docked cargos.

Key Findings and Observations

General Findings

- **The Great Lakes and St. Lawrence River region is particularly dependent on petroleum and related products**

  Oil and oil products have played an important role in the development of the U.S. and Canada and oil still plays a predominate role in the energy mix of the two countries. The Great Lakes-St. Lawrence River region is particularly dependent on petroleum products because of the makeup of the regional economy; including power generation, manufacturing and chemical industries, among others.

- **There has been a significant increase in North American crude oil production over the past six years**

  In recent years domestic production of crude oil in the United States (primarily from the Bakken formation, the Alberta oil sands and the Permian and Eagle Ford fields in Texas) has increased at a tremendous rate. This increased production is predicted to continue into the future, creating significant challenges in transporting crude oil to refineries and destination points. The rapid expansion of crude oil production since 2009 has been striking: total production reached 7.4 million barrels per day (bbl/d) in 2013, up from 5.35 million bbl/d five years prior in 2009 – an increase of 38.5 percent. The forecasted output for 2015 represents what will be the highest level of domestic production in the U.S. since 1972: 9.3 million bbl/d, a 75 percent increase over 2009 levels. The yearly

Bakken shale oil production was a little over one million barrels in 2005 and increased to almost 300 million barrels in 2013. The Alberta oil sands yearly crude production has also been increasing in the last few years, with production increasing from 352,000 barrels in 2005 to 708,000 barrels in 2013.

- **Pipeline transport of oil is the traditional preferred mode of oil transportation in North America due primarily to reliability and cost advantages**

  Pipeline transport of oil is the main and preferred mode by which oil is transported into and throughout the Central and Prairie Provinces and the U.S. Midwest. Approximately 70 percent of oil sands produced in Alberta is shipped to refineries in the U.S. via pipeline. A major reason producers favor pipeline transportation is cost. Transportation of crude oil via pipeline is, on average, $5 to $10 dollars per barrel cheaper than via rail, presenting producers with an optimally cost effective shipping option when available. An important implication of this cost differential is that the increasing production of oil sands crude in Alberta is likely to continue to drive industry movement toward new pipeline construction to support future transportation to U.S. and Canadian refineries.

- **There has been a tremendous increase in the transportation of crude oil by rail, with Canada experiencing a 28-fold increase since 2008 and the U.S. experiencing a single-year increase of 423 percent from 2011-2012**

  The Association of American Railroads reports that for the first half of 2014 (compared to the same period in 2013), there was a seven percent carloads increase in the U.S. and a 7.7 percent increase in Canada. However, the increase over the last six years is far more striking. In the U.S., 9,500 carloads of crude oil were carried by train in 2008, with 650,000 carloads forecasted by the end of 2014, a more than 68 fold increase. In Canada, 500 carloads were carried in 2009 and an estimated 140,000 carloads will be carried by the end of 2014, a 28-fold increase.

- **There is currently no crude oil being shipped by vessel on the Great Lakes. However this could be a possibility in the future as there is already crude oil shipped on the St. Lawrence River.**

  Although there is refined petroleum transported on the Great Lakes, no crude oil is transported on the Great Lakes at the current time. In September 2014, the first tankers transporting crude oil for export were seen on the St. Lawrence River. These transport oil sands crude that has been shipped by rail from Alberta to Sorel-Tracy, Québec and stored near the port. According to environmental groups, there could be up to 50 shipments each year in coming years.

Oil Extraction and Movement

- **There are conflicting reports about the characteristics of Bakken crude oil that can have an impact on the transportation process by rail**

  Some recent train accidents involving Bakken crude oil resulted in major explosions. There is a common perception that Bakken crude oil is more volatile and explosive than other types of crude oil. However, industry reports have concluded that the physical properties of Bakken crude oil do not make it more dangerous than other similar products transported by rail.

- **The characteristics of Alberta oil sands present particular challenges in the transportation of the product**

  Oil sands crude is made up of 75-80 percent inorganic material, 3-5 percent water and 10-12 percent bitumen, a viscous form of petroleum. Due to its high viscosity and density, raw bitumen must be processed to make transportation easier and more efficient. The most commonly used techniques for pipeline transportation are upgrading (creating synthetic crude oil) and diluting (with gas condensate or synthetic crude oil). Other methods

include emulsion and core annular flow (surrounding the crude oil with a film of water or solvent near the pipe wall). For rail transportation, tank cars have to be heated to reduce the viscosity, which can be costly and possibly increase the potential for internal corrosion.

- **The Great Lakes and St. Lawrence River region are both an impediment (a geographic "roadblock") as well as an important link in the oil transportation and refinement process**

  Pipelines and railroads must – for the most part – go around the Great Lakes (with the notable exception of pipeline crossings under the Straits of Mackinaw, Port Huron-Sarnia, the Niagara River and the St. Lawrence River). Six American and six Canadian refineries operate within the Great Lakes drainage basin and there are 25 refineries total operating in the eight-state, two-province region. These facilities combined refine nearly five million bbl/d of crude oil. While these refineries represent destination points within the region, the region is also experiencing challenges due to the large amounts of domestic crude oil that are being transported through the region (primarily via rail tankers and pipelines) to refineries and other destination points outside of the region.

- **Bakken crude oil passes directly through the region to refineries located elsewhere**

  In the Great Lakes region, much of the Bakken crude oil traveling by rail is being transited through to refineries in other areas, including the East Coast and the Gulf Coast. This create situations where oil trains are passing through some states and provinces regularly with the associated risks but without producing economic benefits through refining activities or transmodal transfer points.

Oil Transportation Advantages, Disadvantages and Economic Benefits

- **Job growth in the oil and gas industry has exceeded average growth for all industries in the U.S. and in some sectors in Canada**

  In the binational Great Lakes region, oil and gas industry employment impacts are mixed and widely varying. For example, the provinces of Ontario and Québec, as well as New York State, saw net losses in oil and gas industry jobs between 2009 and 2013, while some states, such as Pennsylvania, Indiana, and Minnesota, each saw increases of over 100 percent in industry employment numbers. Increases in employment have been largely focused in production-heavy regions and should not be considered equally distributed throughout both nations or across all states and provinces. The U.S. Department of Labor predicts that strong employment growth in oil and gas extraction and support will persist, but this growth may likely continue to benefit some parts of the region more than others.

- **The oil industry provides government revenue from oil production via income taxes and royalties**

  Oil production is a critical source of revenue for the U.S. and Canadian federal, provincial, state and tribal governments. In fiscal year 2013, revenue from the oil and gas industry paid to the U.S. government, including royalties, rents, bonuses, and other payments, totaled $12.64 billion – with oil industry payments being one of the largest sources of non-tax federal revenue. In Canada, the province of Alberta received $3.56 billion in royalties related to oil sands production in 2013 alone, while Canadian oil and gas extraction and supporting activities accounted for $2.42 billion in income taxes to the national government in tax year 2012.

- **Pipeline construction generates income to landowners and costs to industry, such as agriculture and forestry**

  Pipeline siting procedures typically involve easement or "right-of-way" agreements where private or public owners retain a legal title to their land, but give up certain rights to specific usage of the land to pipeline

operators. Pipeline operators pay landowners in exchange for limited rights to construct, operate, and maintain pipelines on their land. Such agreements can provide an additional source of income for private landowners, in addition to a source of funds to governments for those pipelines constructed on government land. The construction of pipelines can present disadvantages to agricultural landowners holding productive farmland whose field crops, livestock, drainage tiles, etc., may be adversely impacted in the process of installing lines. Pipeline construction can also interfere with timber operations and that of other industries, depending on the siting location.

- **Rail provides greater flexibility than transporting oil by pipelines or vessel and is often faster than transporting oil by pipeline**

  The greater flexibility of rail transportation relates to the vast network of rail lines already in place and the relative ease of adding a "spur line" to transport oil directly from the oil field to a main rail line. Also, with an existing infrastructure that supports greater access to new production areas and more refining locations, rail provides a wider range of geographic options. Rail transport allows producers to make rapid changes with regard to delivery locations as market demand shifts with the added advantage of transporting the oil much faster. For example, a trip from the Bakken oil field to the U.S. Gulf Coast can take up to 40 days via pipeline versus five to seven days by rail.

- **Vessel transportation of bulk commodities is generally safer, uses less fuel and produces fewer emissions than rail or truck transport when compared with equivalent commodity hauls**

  Various modal shift studies have been undertaken going back as early as 1970. In a 1993 Modal Shift study conducted by the Great Lakes Commission for numerous U.S. and Canadian transportation entities, it was found that rail fuel use was 44 percent higher than the marine counterpart and emissions from rail were 47 percent higher than for vessels for the same quantity of material transported. A 2005 update of the 1993 study showed that while rail transport had improved significantly in the area of emissions, marine transportation was still much more fuel efficient and still produced fewer emissions, especially in scenarios where truck transport and rail transport were considered together.

Risks and Impacts of Oil Transportation

- **The recent increases in crude oil shipments to and through the Great Lakes-St. Lawrence River region poses environmental and safety risks from accidents that may occur from pipelines, rail lines, waterways and at transshipment sites**

  Since 2010 the use of land and water transport networks to connect energy extraction sites in the Western U.S. and Canada with refineries and ports on the East, West, and Gulf Coasts has grown exponentially. Transport of two types of crude oil has dramatically increased across the Great Lakes states and provinces and through the region's waterways: light crude shale oil, particularly from North Dakota's Bakken shale and heavy oil sands crude from Northern Alberta region. As oil production and transportation volumes continue to increase, all the modes of crude oil transport - pipelines, rail, vessel, barge and trucks – as well as the transshipment locations where oil is moved from one mode of transport to another, pose potential risks to the environment, public health, and safety.

- **There is a need to better understand the relative risks of oil spills associated with increased transportation of crude oil**

  It is difficult to predict the extent and costs of impacts from oil spills to the ecosystem, human health and the regional economy. As such, a better understanding of relative risks associated with oil spills becomes extremely important. There is a need for a complete study of relative risks and impacts that systematically considers all the

factors for each mode of transport—economic consequences, incident rates, fatality rates, long-term environmental damages, etc.— in order to develop a more comprehensive regional approach to reduce the risks of spills. Risk assessments including scenario-based research and focusing on the distinctive risks and impacts for each mode of transport are needed. All the modes of crude oil transport through the Great Lakes-St. Lawrence River region pose certain risks that depend on a number of factors – the type of crude oil being transported, the route and destination of transport, population density of areas where oil is being transported to and through, environmental protection concerns, ecological variability and vulnerability, state of emergency preparedness and response capabilities in the region, climate and weather conditions, among others.

- **The risks and costs of increased oil transportation to government agencies need to be studied and better understood**

  A better understanding of governance risk can affect the way that risks are managed and impacts are mitigated. For instance, costs of emergency preparedness and response may be disproportionately borne by state, provincial and local governments, especially when oil is passing through a region to markets and refineries on the West, East or Gulf Coasts. Another concern is the issue of oil spill liability, which is not always fully addressed by the market or by existing regulatory programs. In the case of rail transport, shipping companies are often under-insured and the costs of accident remediation may exceed the insurance coverage available in the commercial market. Although shared liabilities is a possible solution (where the government bears the costs over and above the cap limit provided by insurance companies) the use of public money to support oil spill remediation has attracted public scrutiny. The issue of liability when the oil is in transit is another complicating factor. Existing regulatory regimes (e.g., airline safety regulations) may provide models that can be used to evaluate the safety and response mechanisms for the various modes of transport that ship crude oil.

- **The age and quality of infrastructure is a concern for most modes of oil transportation, which poses an increased risk for a spill or accident**

  Numerous studies have identified the age and quality of infrastructure as a factor increasing risks for spills, especially for pipelines, trains and rail lines, and transshipment sites. The age and quality of pipeline infrastructure may be important contributors to increased oil spill risk in the Great Lakes region. According to the Office of Pipeline Safety, much of the pipeline infrastructure has been in place for decades. In the Great Lakes States, 55 percent of the pipelines were built prior to 1970. While it is difficult to deduce the age of pipeline infrastructure in the Canadian provinces, the National Energy Board's statistics from July 2011 show that approximately 48 percent of Canadian pipelines carrying hazardous liquids were installed more than 30 years ago. Additionally, incident data collected by the Pipeline and Hazardous Material Safety Administration (PHMSA) show that the most common cause of spill incidents is pipeline infrastructure failure. Studies of Federal Railroad Administration (FRA) data show that 60 percent of freight-train accidents are caused by derailments. The major causes of derailments are broken rails or welds, buckled track, obstructions and main-line brake malfunctions. Some derailment incidents, such as that in Aliceville, Alabama, in November 2013, point to failure of trestles, which are sometimes antiquated and not always adequately maintained. The most common risk associated with shore-side transshipment facilities relate to technical failure and defects of equipment such as an oil loader that can cause oil to spill.

- **Communications between oil companies, oil transporters, regulatory and response agencies is important but is often lacking and can be better coordinated to help improve preparedness and reduce the risk from spills**

  Emergency preparedness and response efforts are often complicated by the lack of communication between oil producers, shippers, carriers, regulatory agencies and state/provincial and local emergency responders. For pipelines, communication between pipeline companies, the pipeline regulatory agencies (U.S. DOT's PHMSA and Canada's National Energy Board, NEB) and response agencies (federal, state and provincial) needs to be improved. For railroads, similar coordinated efforts to improve communication need to occur between the FRA

and Transport Canada and response agencies at the federal, state and provincial level. Opportunities for improved communication may include cross-agency/industry participation in exercises, broader participation with the Regional Response Teams (RRTs) on the U.S. and greater use of Memoranda of Understanding between agencies and jurisdictions in Canada to improve communications. Communities located along a pipeline route need to be included in communications and coordination to help improve preparedness and reduce the risk from spills. The NTSB has identified the lack of public and community awareness as a common problem which exacerbates the adverse impacts caused by pipeline incidents

Oil Transportation Programs, Policies and Regulations

- **The increase in oil production and transportation, particularly rail transportation of oil, is outpacing the development and implementation of regulatory, enforcement and inspection programs**

  The rapid increase in the volume of crude oil transported by rail has created challenges to strengthen existing or develop new federal regulatory, inspection and enforcement programs in the U.S. and Canada. Rulemaking and staff training processes can take years to complete. This is important because the lack of a mature regulatory regime places an initial and disproportionate burden on states, provinces, and local governments regarding emergency preparedness and response in the event of a spill.

- **A review of the funding and adequacy of inspection and enforcement protocols and the timeliness of spill reporting across all modes will help identify gaps in regulatory, prevention and response programs**

  Weaknesses in governmental and industry programs (inspection, enforcement, preparedness and response) related to oil transportation is a common theme among numerous governmental and nongovernmental reports issued since the summer of 2013. A thorough review of these programs will be helpful to the Great Lakes and St. Lawrence River Region in determining regulatory and programmatic gaps that need to be addressed to provide for greater safety and reducing the risk associated with transporting oil into and through the region. In its 2012 report to the Great Lakes Commission, the Great Lakes-St. Lawrence River Emergency Preparedness Task Force called for a review of funding of programs for emergency preparedness and response in order to ensure that the region is well-protected in the event of a spill. Data collection and reporting for oil transportation in the region was also indentified by the Task Force as a priority to help preparedness and response agencies better understand the movement of oil in and trough the region.

- **The Great Lakes States and Provinces are not taking full advantage of opportunities to assume oversight of pipeline safety, inspection and enforcement**

  U.S. DOT's PHMSA implements pipeline design, construction, operation, maintenance, and spill response planning provisions. PHMSA is the only agency authorized to prescribe safety standards for interstate pipelines. While the states have the ability to assume some aspects of pipeline siting, regulation, inspection and enforcement within the Great Lakes region, only a few states have chosen to regulate the safety and environmental impacts of oil pipelines. States may assume oversight of pipeline regulatory, inspection and enforcement responsibilities for intrastate pipelines through an annual certification based on state adoption of the minimum federal regulations established by PHMSA. Three Great Lakes States – Indiana, Minnesota, and New York – have certified programs. Illinois, Michigan and Minnesota are the only Great Lakes states that require permits for new oil pipeline construction.

  In Canada, cooperation between regulators and governments allows cross-jurisdictional energy transportation projects to be regulated… A Memorandum of Understanding (MOU) is one tool to identify opportunities to coordinate responsibilities when possible and share information. Each party to an MOU remains independent and sovereign to its decision-making. The National Energy Board (NEB) has various MOUs in place to deal with adjacent jurisdictions, including a multi-party agreement between the NEB and the Ontario Ministry of

Energy and Environment, the Ministère des Ressources Naturelles du Québec and various other provincial governments.

- **Plans to retrofit and/or eliminate DOT-111 tank cars and replace them with newer, safer models will significantly improve the safety of oil transportation by rail**

  A notable weakness in the rail regulatory framework is the need to upgrade Class 111 (commonly called DOT-111) tank cars, which use a flawed design that was involved with at least 40 serious accidents between 2000 and 2012. PHMSA and the FRA have undertaken a number of actions to improve rail car standards and are moving forward with a rulemaking to enhance tank car standards. PHMSA is seeking to impose additional safety standards on the DOT-111 tank cars. The proposed rule, published July 23, 2014, was one of four amendments recommended by the National Transportation Safety Board. The notice of proposed Rulemaking proposed enhanced tank car standards, classification testing and new operations requirements that include braking controls and speed restrictions. Specifically, the rule proposes phasing out DOT-111 tank cars for the shipment of packing group I flammable liquids, including most Bakken crude oil, unless the tank cars are retrofitted to comply with new tank car design standards

- **Pursuing additional improvements to rail transportation safety, including adopting new technologies and dual person crew requirements may help lessen the number of rail accidents**

  Recent reports from both the U.S. and Canada on the safety of rail transportation have identified weaknesses and improvements that will help lessen the number of rail accidents. These improvements include installing positive train control (PTC) in all trains, designed to override human error in controlling train speed, and enforcing adequate inspection and labeling procedures of cargo. In addition, the U.S. Congress is pursuing legislation that would require two-person crews on all trains.

- **Proper classification of all types of oil transported by train is necessary**
  Misclassification of train car contents due to mislabeling by shippers and carriers has caused difficulties for emergency responders. In March 2014 the U.S. DOT issued an Emergency Restriction/Prohibition Order requiring all shippers and carriers to classify all bulk petroleum as the most hazardous packing group. The DOT said, "Misclassification is one of the most dangerous mistakes to be made when dealing with hazardous material because proper classification is a critical first step in determining how to … safely transport hazardous material." Mislabeling is just as large a problem in Canada. Following the Lac-Mégantic accident, in October 2013, Transport Canada, under Section 32 of the Transport of Dangerous Goods Act, issued a Protective Direction requiring that all persons importing or offering for transport crude oil immediately test the classification. Both countries have found that mislabeling material to be a factor in the magnitude of accidents.

- **Federal, state and provincial response agencies may not be adequately funded and equipped to efficiently respond to spills from different modes and in all locations**

  A 2012 report from the Emergency Preparedness Task Force to the Great Lakes Commission identified the need for reliable, consistent and adequate long-term funding for federal, state and provincial agencies to implement and maintain preparedness and response programs. Review of reports released since 2012 suggests that this is still an issue. The 2012 report identified specific priorities including support for training and exercising; inspection and enforcement; research; data collection and reporting; and, conducting risk assessments.

- **The Great Lakes-St. Lawrence States and Provinces, as well as jurisdictions outside the region, are investigating approaches and developing new policies and programs to address the risks associated with oil transportation.**

Government agencies, nongovernmental environmental and citizens groups as well as the oil industry have shown a strong interest in raising awareness to help policymakers better understand the challenges and constraints of moving crude oil from the point of extraction to final destination points. The states and provinces themselves have also been active in considering ways to reduce the risks associated with oil transportation.

At least 10 governmental studies investigating the risks associated with oil transportation have been released since mid-2013 (after the Lac-Mégantic incident in Québec) and two of these were major reports issued by state government (California and New York).

The Great Lakes-St. Lawrence States and Provinces can also learn from different approaches being developed by other jurisdictions. Washington State utilizes an innovative strategy to respond to spills under the Vessel of Opportunity (VOO) Program. Alaska has dedicated additional agency resources toward protecting the public and mitigating the effects of oil and hazardous substance releases. Hawaii has designed their own fully equipped training program to respond to oil releases.

- **Some mechanisms for communication, coordination and notification between jurisdictions regarding oil transportation and spills currently exist and may be expanded to further enhance preparedness and response in the region.**

  Communication, including spill notification and coordination of response activities between jurisdictions and different levels of government is extremely important to ensure a timely response in the event of a spill. In its 2012 report to the Great Lakes Commission, the Emergency Preparedness Task Force identified the need to improve communications between jurisdictions and levels of government especially focusing on (and involving) the federal agencies responsible for pipeline permitting and regulations.

  Both the U.S. and Canada communicate and coordinate across state, provincial and federal jurisdictions through multiagency teams and through contingency planning efforts that occur across geographic regions and different levels of government including binationally. Regional annexes have been developed under the Great Lakes Water Quality Agreement (GLWQA) to enhance binational communication and coordination. The CANUSLAK Annex deals with the Great Lakes and St. Lawrence River and specifically covers the contiguous waters as defined in the GLWQA.

  Article 6 of GLWQA is an important communication tool because it requires notification of planned activities (between the parties) that could lead to a pollution incident or could have a significant cumulative impact on the waters of the Great Lakes. This Article lists oil and gas pipelines and oil and gas drilling as examples of activities that could trigger notification. Moreover, the Agreement leaves open the last clause of actions which trigger notification, saying simply, "other categories of activities identified by parties." Transport of crude oil by rail or ship could be included under this section if the parties deem appropriate. The states and provinces will benefit by an expanded interpretation of Article 6 and by being included in the notification process.

- **Vessel Response Plans (VRPs) required under the Oil Pollution Act (OPA) represents one important component of the U.S. regulatory regime that ensures safe transportation of crude oil by vessel. At present, it is unlikely that VRP requirements could be met for transport of heavy crude oil on the Great Lakes.**

  Vessel Response Plans are required for all vessels operating in U.S. waters transporting oil as a cargo. These plans, approved by the U.S. Coast Guard under OPA, must meet requirements for the specific geography through which the vessel travels and must include information regarding the resources, methods and techniques that will be used by the shipper for response and recovery in the event of a spill in that setting. According to the

Coast Guard, adequate response methods and techniques do not currently exist for marine related incidents, e.g. spills of heavy oils to open bodies of freshwater such as the Great Lakes. Until adequate methods and techniques can be developed, current VRP requirements would likely preclude the shipping of heavy crude oil by tanker vessel on the Great Lakes.

[1] U.S. Energy Information Administration. United States Overview Data. 2014. http://www.eia.gov/countries/country-data.cfm?fips=US&trk=m#pet

[2] U.S. Energy Information Administration. Short Term Energy Outlook. July, 2014. http://www.eia.gov/forecasts/steo/pdf/steo_full.pdf

[3] Based on data from U.S. Energy Information Administration (EIA) and Canadian Association of Petroleum Producers (CAPP).

[4] Based on data from the North Dakota Department of Mineral Resources and Canadian Association of Petroleum Producers (CAPP).

[5] Based on data from U.S. Energy Information Administration (EIA) and Canadian Association of Petroleum Producers (CAPP), and each refinery website.

[6] Based on information from the National Transportation Safety Board (U.S.), Transportation Safety Board (Canada) and a review of news articles.

[7] Emergency Preparedness Task Force. *Emergency Preparedness and Response Programs for Oil and Hazardous Materials Spills – Challenges and Priorities for the Great Lakes-St. Lawrence River*. (Great Lakes Commission, 2012)

[8] Sara Grosman, Lesley MacGregor. After the Marshall Spill: Oil Pipelines in the Great Lakes Region. (National Wildlife Federation, 2012)

[9] Enbridge. "Line 5". http://www.enbridge.com/InYourCommunity/PipelinesInYourCommunity/Enbridge-in-Michigan/Line-5.aspx (accessed July 31, 2014)

[10] David Schwab. *Straits of Mackinac Contaminant Release Scenarios: Flow Visualization and Tracer Simulations*. (University of Michigan Water Center, 2014)

[11] U.S. Energy Information Administration. Canada Overview Data. 2014. http://www.eia.gov/countries/country-data.cfm?fips=CA&trk=m#pet

[12] John Frittelli *et al*. *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress*.

[13] Based on data from U.S. Energy Information Administration (EIA) and Canadian Association of Petroleum Producers (CAPP)

[14] For the number of refineries, the information is based on data from U.S. Energy Information Administration (EIA) and Canadian Association of Petroleum Producers (CAPP); for the capacity, the information is based on each refinery website.

[15] Lyman C. Welch, Alec Mullee, Abhilasha Shrestha and Dan Wade. *Oil and Water: Tar Sands Crude Shipping Meets the Great Lakes.* (Alliance for the Great Lakes, 2013).

[16] Association of American Railroads. Rail Freight Traffic. July 07, 2014. https://www.aar.org/newsandevents/Freight-Rail-Traffic/Documents/2014-07-03-railtraffic.pdf

[17] John Frittelli, Paul W. Parformak, Jonathan L. Ramseur, Anthony Andrews, Robert Pirog and Michael Ratner. *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress*. (Congressional Research Service, 2014).

[18] John Frittelli *et al*. *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress*.

[19] John Frittelli *et al*. *U.S. Rail Transportation of Crude Oil: Background and Issues for Congress*.

Appendices

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Appendix 1: Oil Transportation Draft Report Comments

The report titled *Summary of Issues and Trends Surrounding the Movement of Crude Oil Transportation in the Great Lakes-St. Lawrence River Region* and accompanying issue briefs were presented as drafts to the Great Lakes Commission at its Annual Meeting in Buffalo on Sept. 30, 2014. The Commission received the report and briefs as "review drafts" and instructed staff to initiate a formal 60-day review and comment period in order to solicit input from the variety of regional stakeholders interested in the issue of crude oil transportation.

The formal comment period began Oct. 1 and continued through Dec. 2, 2014. A website was created containing the four briefs and summary report to help facilitate the review process. Dozens of agencies and organizations and thousands of individuals were contacted either directly or through a variety of email lists and memberships rosters available to the staff. Those contacted included the Great Lakes Commissioners, Alternates and Associates and the official Observers to the Great Lakes Commission, which includes more than 30 individuals representing government, business, industry and the nongovernmental sectors.

In addition, comments were solicited from U.S. and Canadian federal agencies involved with transportation, environmental protection, resource management and emergency preparedness and response, state and provincial agencies representing the same interests, members of industry and industry associations involved in oil production and transport, members of the Great Lake-St. Lawrence maritime transportation community, and numerous citizen and nongovernmental environmental groups.

The outreach effort involved several Great Lakes Commission staff and was ongoing during the October-December period. The process was conducted formally but had informal elements that included one-on-one communication and group discussions with interested parties. Outreach efforts occurred in different ways: email, conference calls, individual phone conversations and presentations at workshops, meetings and conferences. Prior to the close of the comment period, staff received inquiries from a few groups and agencies asking for a brief extension. The project website remained open through Dec. 8 and a few comments were submitted after the Dec. 1 deadline. Comments sent by email even after Dec. 8 were also considered in the completion of the final report. More than 30 sets of written comments from federal, state, and provincial governments, NGOs, and the public were received. Most of these comments were directed specifically to the summary report and/or the issue briefs, but some comments were made related to issues outside the scope of the report. The summary below describes how staff addressed the comments, when they were addressed, and explains why some of these comments weren't or couldn't be addressed.

Comments addressed

While numerous comments were received from individuals and members of the public, the lengthier and more detailed comments were mainly from agencies, associations and organizations. During the review of the comments, staff noticed that there were several common (and repeating) themes or categories of the

comments. These are summarized below. Individual comments, especially those correcting facts or more editorial in nature, were incorporated into the final report and briefs and are not presented here.

Cumulative infrastructure impact

Commenters identified the need to discuss possible cumulative impacts on secondary transportation markets. Expansion of infrastructure development in one mode has potential side effects on demand for others. The final draft report notes that allowing shipping via vessels on the Great Lakes may incentivize additional crude oil transport infrastructure development by land in surrounding jurisdictions, and current approvals of pipeline expansions and changes may decrease the demand for vessel transport as an alternative mechanism.

Tribal sovereignty and involvement in decisionmaking

Commenters noted that the draft report failed to mention treaty rights/tribal sovereignty and respective engagement or consultation in the decisionmaking processes by First Nations and Native American governments. The final report now mentions tribal considerations and consultation as it relates to a particular legislative mechanism, for environmental evaluation, for example.

Vessel transport

A few commenters pointed out that the report seemed to be advocating for vessel transportation as the safest method. The total comments received, however, indicated that there are differing opinions regarding the desirability of each mode. It is recognized that vessel transport of bulk commodities does have some advantages but there is not definitive information available to dictate a response that one mode is favored over another under all circumstances. While discussing the advantages and disadvantages of each mode, the final draft has been modified to avoid the perception of preferment for a particular mode.

Financial liability for spills

A number of commenters requested more detail on financial liability for spills. While a detailed and comprehensive review of the liability process is outside of the scale of this report, the final content includes additional detail in the following areas: vessel owners and facility owners; funding availability relative to cleanup cost; the potential for jurisdictions to compel higher funding levels.

Response/regulatory framework

There were specific comments related to response and regulatory framework. Attempts were made to address all these comments, keeping in mind that the issue is in constant evolution. The general regulatory framework is described either in the report or in Issue Brief 4, but with limited depth of detail, as the issue is complex and a full discussion extends beyond the scope of the report. A summary table with recent developments from federal, state and provincial authorities was developed and included in the report executive summary. As of the publication date, the final report is as accurate as possible on the regulatory and programmatic issues regarding crude oil transportation in the region.

Format and terminology

There were some comments regarding terminology used in the summary report and issue briefs. These comments were addressed and unclear concepts have been clarified. Because the report is addressed to people who might not be familiar with the issue or lack technical expertise, the report has been kept simple with the general approach of avoiding going into too much detail on certain technical topics.

The format of the summary report was discussed in several comments. The final draft has been modified to avoid repetition by removing the summary of each issue brief and integrating this information in the report itself.

Comments not addressed

Several commenters noted the absence of climate change considerations in the report. It is acknowledged that climate change impacts related to the extraction, transformation and use of fossil fuels is an important issue for the region. However, this issue is beyond the scope of this report, the purpose of which is strictly focused on the transportation of crude oil in the Great Lakes-St. Lawrence River basin. The reviewers also felt that the issue of climate change should be addressed in a discussion over the choices regarding the source of energy for the region, and the necessity to aim for cleaner energies. It was suggested that a comparative analysis of greenhouse gas emissions for each mode of transportation be performed. Again, while important, this exercise is beyond the scope of this report. There are certain aspects of surrounding crude oil transportation that were not evaluated in the report, but that were raised by commenters and should be considered in the future.

There were two main topics that were requested in several comments and that were not addressed because of time and resource constraints. The first one is a complete in depth economic analysis of the costs and benefits of crude oil transportation. The report presents some data for revenue for the governments (mostly federal governments), mainly related to oil and gas extraction, but not a lot on specific local economic benefits. There should be a comparison between the petroleum industry and "green" energy industries. Furthermore, the report does not attempt to quantify the indirect economic benefits. A thorough economic analysis should also include economic impacts of crude oil transportation on local industries like commercial and recreational fishing, tourism, agriculture and others. This impact analysis should also include the impacts of a spill on local, state/provincial and regional economies, as well as non-market valuation accounting for public health and natural resources impacts.

A complete economic analysis would also inform and benefit from a thorough risk analysis for each mode. Risks related to transportation of crude oil in the Great Lakes basin are function of location, materials in use during loading/shopping, availability of containment and cleanup methods, route transit times, physical conditions, and time periods of unique vulnerability. A comprehensive risk analysis should also take into consideration the particular climatological and geographical attributes of the Great Lakes basin and consider the risks for each mode in relation to seasonality. It should also include an analysis of any anticipated increased risks related to climate change. Finally, the risk analysis should also present an inventory of environmentally sensitive areas and evaluate the risks particular for these areas.

There are some other comments that could not be addressed by the staff when reviewing the report, again because of time or resource constraints. It was suggested that a good analysis of each mode of transportation should also include a summary of accidents for each mode. Due to the different sources of data that would need to be reconciled, in addition to the lack of public data in some cases, this would have been difficult to accomplish in the timeframe available to complete the report. Other aspects to consider in a comparative analysis are the difference in scale of each mode, varying regulations concerning the information that has to be provided by carriers and shippers, different measurements of impact of an accident, and the considerations of data regarding oil spilled versus recovered. Such an analysis is possible, but would require more time and resources to complete.

Finally, several reviewers suggested that the Public Trust Doctrine/Public Trust Law be discussed in depth. This is considered lightly in legal aspects, but a thorough analysis of this issue is also beyond the scope of the report.

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Appendix 2: Action Item from September 9, 2013, GLC Annual Meeting

Adopted Sept. 9, 2013

Preparation of an issue brief on the transportation of crude oil in the Great Lakes-St. Lawrence River region

Background: The development of domestic crude oil in both the United States and Canada has become an important part of energy policy in the two countries. Designed to reduce the dependence on imported oil, these developments create economic opportunities for oil companies, transportation interests, local communities where oil is extracted and/or shipped for refinement and export, as well as consumers. Development of the Bakken Oil formation, covering parts of two provinces and two states in the Great Plains and the Athabasca Oil Sands formation in Alberta represent two of the biggest oil formations in North America and have created an economic boom reducing unemployment and creating budget surpluses for local communities and even entire states. However, the rapid development of the Bakken oil reserves and the Alberta tar sands have created some challenges in areas related to protection of water supplies, the need to maintain and upgrade infrastructure and sewage systems, stresses on government services and especially impacts related to the transportation of crude oil and tar sands from the western fields to the eastern part of the continent.

In the Great Lakes-St. Lawrence River region increased transportation of crude oil has created new challenges and some problems. The Montreal, Maine and Atlantic Railway (MMAR) train of 72 tank cars of crude oil that derailed and burned on July 6 in Lac-Mégantic, Québec, was carrying shale crude oil from the Bakken oil reserves for refinement in New Brunswick. The MMAR derailment killed 47 people and released an estimated 5.7 million liters of oil into the environment. This tragic event, along with the July 2010 oil pipeline rupture in Marshall, Mich., and other less-publicized incidents, has created a need for the Great Lakes-St. Lawrence River region to better understand the extent and nature of safety issues surrounding the transportation of crude oil from the west by all modes including rail, vessel and pipeline. In order to transport oil from the production fields in Alberta and the western United States, many pipeline expansion plans have been proposed. However, due to recent concerns about pipeline safety, many of these have been slow to clear the many levels of approval and permitting. One consequence of this has been the phenomenal growth in rail shipments of oil in the last four years.

The Lac-Mégantic event could be a wake-up call for the region regarding the potential for accidents to occur in transporting crude oil by rail, pipeline and vessels. In December 2012, an oil tanker containing more than 12 million gallons of crude oil ran aground and ruptured its outer hull on the Hudson River in Albany, N.Y. Fortunately, it was a double hull tanker and no oil was spilled in the event. Additional movements of crude oil, as well as planned increases, are occurring throughout the region. A Houston

oil company is seeking permission from the State of New York to more than double its shipments of North Dakota shale crude oil through the Port of Albany. Calumet Specialty Products Partners (a pipeline company) is seeking permission from the State of Wisconsin to build a crude oil loading station on Lake Superior in Superior, Wis. The region is in need of more information regarding the extent and nature of the potential risks associated with the increased movement of crude oil and tar sands products.

In addition to recent tragic events, the issue of crude oil transportation is especially relevant for the Great Lakes-St. Lawrence region in light of the upcoming consultations by the Canadian National Energy Board on the inversion (reversal) of the Sarnia-Montréal pipeline. That project, as well as other projects related to the transportation of crude oil from Western Canada and North Dakota to Québec and New Brunswick, will be the subject of public debate in the coming weeks and months.

Although interprovincial, interstate and international crude oil transportation falls under federal jurisdiction in Canada and the United States, tragedies such as Lac-Mégantic remind us that state and provincial governments will be greatly solicited by their population whenever such an accident occurs, and that the prevention of these accidents involve state and provincial jurisdictions.

Action: The Great Lakes Commission staff is directed to prepare an issue brief evaluating the potential benefits, risks and options for mitigating risks surrounding the transportation of crude oil in the Great Lakes-St. Lawrence River region, including an assessment of the regulatory structure in the two countries and states and provinces. The staff is instructed to consult with the Emergency Preparedness Task Force and the Economic Committee in preparing the issue brief. Consultations for the issue brief should also include interested stakeholders and relevant government agencies in the areas of environmental assessment, water policy, decontamination policy, hazardous materials, economic development and commercial interests.

Appendix 3
Summary of Issue Brief 1:
Developments in Crude Oil Extraction and Movement in the U.S. and Canada

States, provinces and tribal governments across the Great Lakes-St. Lawrence River region experience the benefits from but also assume many of the risks of crude oil transportation. The risks and benefits vary greatly depending on several factors, such as the type and amount of oil transported, where the oil is refined and the mode of transportation used to get the oil to its destination. In North America, oil sands reserves are found primarily in Alberta, Canada. Oil sands crude is a nonconventional type of oil that, when initially extracted, is made up of inorganic material, water and bitumen, a viscous form of petroleum. Approximately 70 percent of oil sands products from Canada are sent to refineries in the Midwest. As of 2009, 26 refineries were equipped to process this type of crude oil, 12 of them located in Great Lakes states.

Shale oil, also called light tight oil, is another type of nonconventional crude oil and is found in low permeability sedimentary formations. It is much more volatile than other types of crude oil and has a flash point that resembles that of gasoline, making it very flammable and potentially explosive. A large amount of the shale oil extracted in the U.S. comes from the Bakken formation in North Dakota. In the Great Lakes region there are also several small oil reserves in Ohio, Pennsylvania and New York, as well as some shale oil production in northern Michigan.

Table 3: Characteristics of Bakken crude oil and Alberta oil sands crude oil

	Bakken shale crude oil	**Alberta oil sands crude**
Also called	Light tight oil, light sweet oil	Heavy crude oil, heavy sour crude oil, tar sands, bitumen (raw form of oil sands crude)
Origin	Bakken formation (mostly North Dakota but also Montana, Manitoba and Saskatchewan)	Northern Alberta (Athabasca/Fort McMurray, Peace River, Cold Lake)
Density	Low	High
Main extraction method	Fracking	Surface mining or in-situ recovery
Main transportation method in the Great Lakes	Train	Pipeline
Transportation challenges	Volatility, flammability, capacity	Density, viscosity, capacity

Large quantities of crude oil from Alberta and North Dakota move into or through the Great Lakes and St. Lawrence River basin every day, making the region an important link in the oil transportation and refinement process. Crude oil from the Alberta oil sands may pass through the region to other refineries or may be processed at refineries along the lakes. Most Bakken crude, on the other hand, passes directly through the region on its way to refineries elsewhere. Even though the physical characteristics of oil sands crude and shale oil differ markedly, both have the same United Nations (UN) classification. This single classification gives very broad criteria and restrictions for transportation. However, physical differences between the two types of oil mean they present different transportation issues and challenges.

Pipelines are the traditional preferred mode of transportation for petroleum products. With pipelines, different types of crude oil from different origins and with different characteristics can be transported in the same line. Requests have been made both to build new pipelines and to increase the capacity of the existing pipeline network by, for example, allowing higher pressures within the lines or changing their direction of flow. However, the increased production of Bakken shale oil and of Canadian oil sands products has exceeded the transportation capacity of the existing pipeline network. As a result, rail has recently become the alternate transport mode relied upon most frequently.

Rail now accounts for more than 50 percent of the oil sands and shale oil products transported, either in unit trains consisting strictly of tank cars carrying crude oil to a single destination, or as mixed trains hauling a variety of cargos to various destinations. Regardless of the type of train, crude oil transported by rail is most often carried in Class 111 tank cars that have been criticized as being out of date and insufficient for transportation of light tight oil.

Trucks play a limited role in the transportation for crude oil in the Great Lakes-St. Lawrence River region. Individual tanker trucks hold less oil than other modes of transportation and are predominantly used for local transportation of crude oil, usually from the extraction site to pipeline or rail loading stations. In locations where the extraction site and the refineries are in close proximity, such as in Texas, trucks are used more often.

Appendix 4
Summary of Issue Brief 2:
Advantages, Disadvantages and Economic Benefits Associated with Crude Oil Transportation

Accelerating unconventional crude oil production in the U.S. and Canada has generated increasing demand for transportation capacity between emerging areas of extraction and refinery locations. The binational Great Lakes-St. Lawrence River region is a hub of both transportation and refining activity.

Oil and petroleum products provide societal and economic benefits to the U.S. and Canada. Oil is an important part of the energy portfolio of both countries, including the Great Lakes-St. Lawrence River region. Oil supports the energy needs of the region's residential, institutional and commercial/industrial customers and the regional and local economies by contributing to the tax base of states, provinces and communities. Oil production provides billions of dollars of annual revenue for the U.S. and Canadian federal, provincial, state, and tribal governments in the form of royalties, rents, bonuses, income taxes and other payments. In terms of employment, from 2009 to 2013, job growth in the oil and gas industry far exceeded average employment increases for all industries in the U.S. and in some sectors in Canada. These employment increases tend to be focused in production-heavy areas, and predicted growth may continue to benefit some parts of the region more than others. Increasing domestic production and expansion of transportation capacity also contribute to oil price stability, with transport access boosting profit margins for industry, which can also increase revenues to government. Producer profit per gallon of crude oil – the "netback" sales revenue minus transportation costs – can be much higher when oil reaches better markets. Higher demand at these markets allows producers to sell their crude oil for more money than it costs them to transport it there. This is a key driver of demand for growing crude oil transportation capacity and options.

Local governments incur costs associated with infrastructure development, training and capacity building for first response duties for oil spills. For some municipalities, this means that local taxpayers are shouldering economic impacts of resource development for potential emergencies without necessarily receiving substantial gains from oil production, extracting, or refining activities and associated royalties or taxation from industry. In particular, much of the Bakken crude oil transiting via rail through the Great Lakes region is destined for East Coast refineries. Thus, in these cases, communities absorb first responder costs without receiving economic benefits or associated jobs. Transport can also adversely impact other industries via land use, shared infrastructure and traffic congestion.

There are also advantages, disadvantages and varying degrees of risk associated with the different modes of oil transportation. Despite being more expensive than pipeline transport, oil transport by rail allows producers to respond to changing market conditions by being more geographically flexible, providing much shorter transit contract term periods, and offering far faster delivery times to coastal markets. However, tank car shortages and adverse weather can negatively impact the use of rail. Limited pipeline capacity has created an increase in rail usage: in the U.S., 9,500 carloads of crude oil were carried by train in 2008, with 650,000 carloads forecasted by the end of 2014. An immature crude-by-rail regulatory framework – especially single category classification of different crude types and the lack of crude oil cargo reporting requirements – constrains local government ability to appropriately prepare for possible incidents. Increased crude-by-rail traffic can also crowd out rail access by other sectors, including agriculture and passenger transit.

Liquid pipeline is the favored mode of transport by the oil industry and approximately 70 percent of Alberta oil sands crude is shipped to Midwest refineries via pipeline. Pipeline transport is cost effective

and can provide easement revenue to landowners in the U.S. However, new construction can interfere with agriculture and other land uses, and inconsistencies in state laws combined with a lack of federal permitting can make easement land restoration and payment enforcement difficult.

There is not currently ship or barge transit of crude oil on the Great Lakes, but there has been a dramatic increase in crude oil transported on inland waterways connected to the lakes. Vessel-based transit would capitalize on existing coastal refinery infrastructure and the efficiencies inherent in transporting any/all heavy bulk goods by water. But the ecological, economic, and human health impacts and risks of day-to-day transit of crude oil on the Great Lakes are unknown but certainly warrant close scrutiny given the sensitivity of the Great Lakes freshwater environment. Crude oil has been imported on the St, Lawrence River for years. In the fall of 2014, the first shipments for export left the port of Sorel-Tracy, Québec. Tank trucks play a role in moving crude oil from production areas to pipeline and rail transport or between different modes, but on the whole, relatively little is moved via truck in the region. Increased tank truck traffic would likely cause localized congestion and greater wear and tear on roads.

Appendix 5
Summary of Issue Brief 3:
Risks and Impacts Associated with Crude Oil Transportation

More than 43 million people rely on the Great Lakes for drinking water, jobs and to support their way of life. This represents roughly 8 percent of the U.S. population and 50 percent of Canada's. As the world's greatest system of freshwater resources, the Great Lakes and the St. Lawrence River have shaped the economic, social and cultural heritage of the region for hundreds of years and continue to have a profound influence on the regional and national economies of the U.S. and Canada.

With the recognition of the important role that oil plays in providing the energy needs of the two countries, the recent increase in crude oil shipments needs to be properly understood with regard to risks and impacts. The different modes of transportation pose environmental and safety risks from accidents that may occur from pipelines, rail lines, waterways and at transshipment sites. The risks can be further complicated based on the properties of oil being transported. Because of the diverse nature of oil and the different ways that spills can occur, it is difficult to predict the extent and duration of their impacts on the ecosystem, human health and the economy.

In the Great Lakes states 55 percent of the pipelines traversing the region were installed prior to 1970 and nationally in Canada, approximately 48 percent were installed more than 30 years ago. The main risks associated with pipelines are concerns about the infrastructure (e.g., quality of the material and welds), natural hazards and extreme weather conditions, adequate monitoring, and geography (i.e., challenges presented by the physical environment and remote location).

Regarding vessel transportation, that there is currently no crude oil being transported by ships and barges on the Great Lakes, but some on the St, Lawrence River.. The risks associated with water-borne transportation are collision between two or more ships and between a ship and infrastructure, grounding, severe weather conditions and human error associated with piloting the vessel on the water and in ports.

For rail transportation, the recent growth in volume of oil transported by this mode, coupled with numerous accidents, have elevated the importance of understanding the safety and environmental risks associated with the transport of crude oil by rail. The main rail-related risks are the state of infrastructure (rails, welds), tank car design and safety (i.e., Class 111—DOT-111—tank cars) railroad crossings, lack of information on mixed trains' cargo, high volume of crude oil transported in unit trains, an immature regulatory regime and lack of human capital planning.

Although trucks transport only a small percentage of the total oil being moved in the U.S. and Canada, and an even smaller percentage in the Great Lakes region, the increase in truck oil shipments can be a cause of concern. The risks are mainly related to in-route collision, inadequate infrastructure, inadequate truck safety design, and an immature regulatory regime.

Transshipments sites are becoming more important because of their geographic location. The risks at these sites can come from equipment failure, human error, inadequate storage and maintenance, regulatory regime and unmonitored docked cargos.

The potential impacts of a spill in the Great Lakes-St. Lawrence River region are particularly important and need to be better understood. These impacts might be related to human health, the environment or the economy. A spill, might have impacts on drinking water, might cause air contamination, and result in life-threatening explosion and fire. If spilled in open water, sunken oil can be hard to recover. Oil spill on land

can also contaminate groundwater aquifers. Aquatic and semi-aquatic fauna and flora can be affected by an oil spill, directly (ingestion, air contamination) and indirectly (physical contact reducing capacities, reproductive and developmental problems, destruction of habitat). The economy of a region might be detrimentally affected by spills causing impacts to commercial and sport fishing, tourism and recreation and disruption of business and normal day-to-day activities. The cost of a spill cleanup can also be high and the liability insurance limits might not always be sufficient to cover these costs.

Appendix 6
Summary of Issue Brief 4:
Programs, Policies and Regulations Governing the Movement of Crude Oil

Heightened societal awareness of issues and problems triggered by significant events (such as a large oil spill) often leads to changes in governmental policies and programs. The *Exxon Valdez* oil spill that occurred off the coast of Alaska in March 1989 spurred the U. S. into action, with the enactment of the Oil Pollution Act (OPA) in 1990. More recently, the U.S. and Canada have begun examining their oil-related programmatic and regulatory regimes due to the attention created by numerous spills from different transportation modes and oil production practices. Both countries are enacting changes to amend or strengthen existing programs to ensure that the current regulations meet the challenges and risks generated by increased oil production and transportation. Similar scrutiny is occurring in the Great Lakes-St. Lawrence River region.

There are two major factors driving regulatory and programmatic changes in both countries and in the region. First is the increased frequency and severity of oil-related accidents in recent years. In 2010, an oil pipeline ruptured near Marshall, Mich. spilling nearly one million gallons of crude oil into nearby Tallmadge Creek (a tributary to the Kalamazoo River) triggering one of the largest inland area spill cleanups in U.S. history. In 2013 the region was reminded again of the dangers of oil transportation when a train transporting crude oil derailed and exploded in Lac-Mégantic, Québec killing 47 people and causing billions of dollars in damages to the town. While the Lac-Mégantic accident captured the attention of the public and demanded a response from government officials it was soon followed by other oil transportation-related accidents, four of which occurred in the Great Lakes states. These alarming incidents have caused both U.S. and Canadian officials to analyze their regulatory regime for oil transport and to enact stronger laws and policies. Both countries, in order to strengthen existing policies, have ordered emergency regulatory measures be undertaken, assessed the inspection of rail cars, and implemented response policies for both companies involved in oil transport and the federal agencies that regulate them.

In the U.S. the transport of oil by is governed by a complex set of regulations varying by mode. Ships transporting oil are governed by OPA with the U.S. Coast Guard having the regulatory lead for oceans and the Great Lakes and U.S. EPA having the lead for inland areas. Canada has enacted similar laws governing oil transportation by vessel, the primary law being the Canada Shipping Act. The Act led to the creation of the National Spill Response Plan developed by the Canadian Coast Guard to address marine emergencies for the Great Lakes, connecting channels and the St. Lawrence River. The plan addresses spills that impact Canadian waters from vessels in transit and during loading and unloading operations. Great Lakes binational agreements such as CANUSLAK (the joint marine pollution contingency plan) and CANUSCENT (the joint inland pollution contingency plan) prompted by the Great Lakes Water Quality Agreement (1987 Protocol) provide the framework for well-coordinated emergency preparedness and response between the two countries.

In the U.S., pipelines are regulated by the Department of Transportation (DOT) through its Pipeline and Hazardous Material Safety Administration (PHMSA). States have some authority under the Pipeline Safety Act to enact stricter standards, but most states have not done so. Rail transport is governed under DOT's Federal Railroad Administration (FRA). A potential strength of these individual regulatory bodies is the opportunity to create strong policy that focuses on just one mode of transportation. Conversely, focusing on just one aspect of transportation can lead to a lack of coordination and harmonization among regulations, regulatory and response agencies.

In Canada, pipeline transportation is governed by the National Energy Board (NEB). Canadian pipeline regulations set standards that industry must meet while allowing companies the flexibility to determine how to best meet them. Specifically, the NEB oversees oil transport for both interprovincial and international pipelines. Canadian governance of rail transport is similar to the U.S. and safety standards developed by the rail industry apply in both countries. Transport Canada sets regulatory standards under the Railway Safety Act as well as the Transportation of Dangerous Goods Act.

Recently, both countries have noted gaps in their regulatory regimes for rail and are taking steps, such as strengthening classification and labeling requirements, to fill those gaps. As these standards become stricter and agencies continue to promulgate rules, the hope is that the number of accidents will decrease while the effectiveness and timeliness of response actions will increase.