SIERRA CLUB
JOHN MUIR CHAPTER

Electric Power Plants, Oil and Natural Gas

Threats to Water Quality in Wisconsin

A report by the Sierra Club-John Muir Chapter

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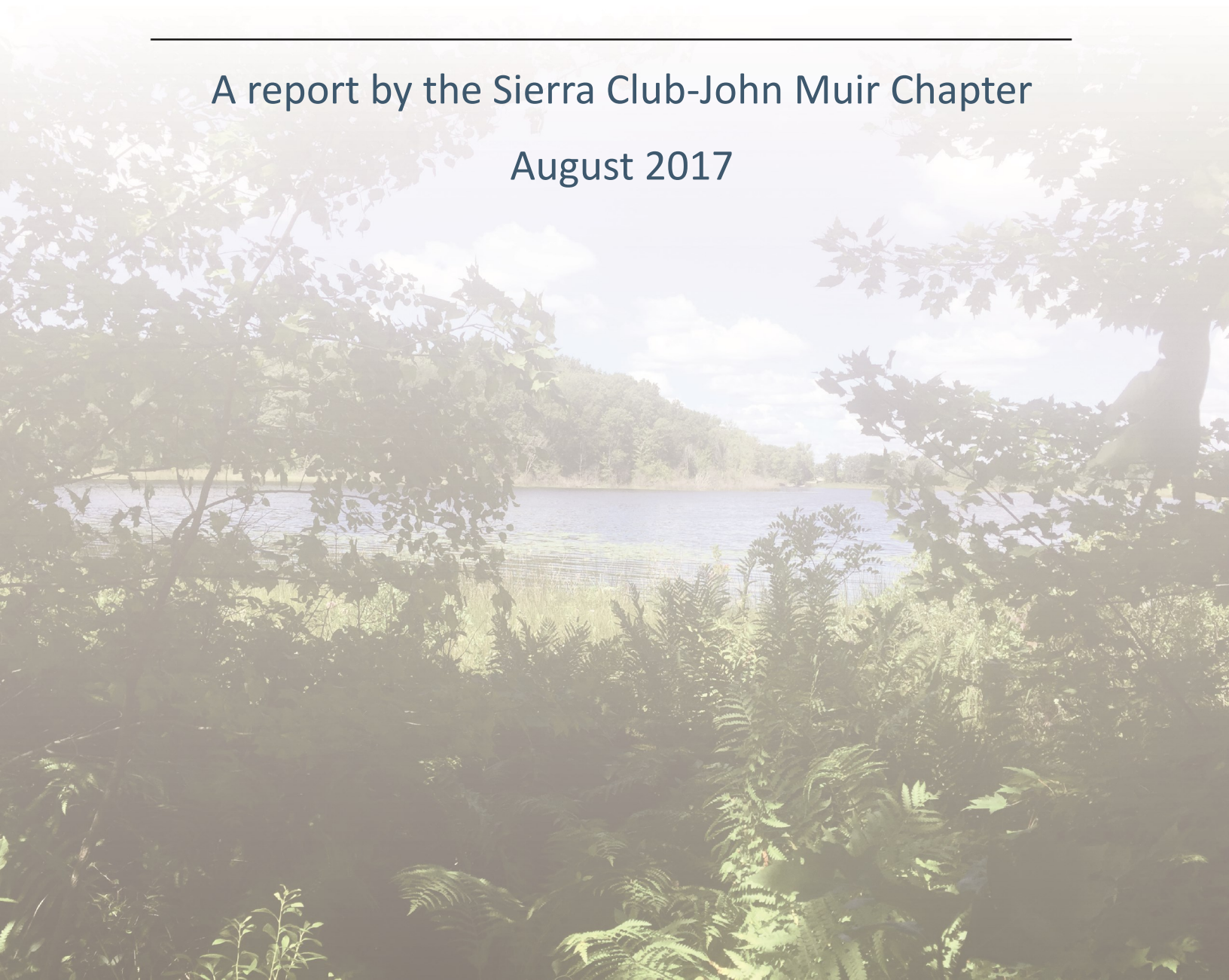

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Introduction

Water and the energy systems in Wisconsin are inextricably connected. Approximately 70 percent of all water used in Wisconsin is used to generate electricity. Because of the large quantity of water needed, most generating facilities are on or near water bodies. In addition, about 30 percent of all energy in the state is used to move water. This connection between the transportation, use and disposal of waste from fuels and water pose significant risks.

Wisconsin has over 84,000 miles of streams and rivers, more than a million acres of inland lakes, 1,000 miles of Great Lakes shoreline, and more than five million acres of wetlands that provide opportunities for recreational and commercial activities. Approximately two-thirds of people living in the state get their drinking water from groundwater, and water underpins major sectors of the Wisconsin's economy including agriculture and tourism. However, the transportation of fuels, generation of energy and disposal of waste from energy generation all pose a threat to the quality of Wisconsin's surface and groundwater resources.

Transportation of Fuels

Wisconsin has no fossil fuel deposits. This means all fuels used to generate energy must be transported into the state. In addition, due to the state's location, there are huge amounts of fuels, many of which aren't even consumed in Wisconsin, transported through the state by rail and pipeline and that cross hundreds of waterways.

Natural Gas Transport

Transporting natural gas from the wellhead to the final customer involves multiple physical transfers and processing steps. There are no natural gas production activities, underground natural gas storage fields, nor market centers in Wisconsin. Natural gas is delivered through several interstate pipelines from natural gas fields in Oklahoma, Texas, Louisiana, Kansas, and Alberta, Canada. A large portion of natural gas is transported from western Canada through U.S. refineries in other Midwestern states. Most natural gas enters the state from Illinois and Minnesota and the natural gas not consumed continues on to Michigan. There are 4,800 miles of interstate natural gas pipelines and 19 natural gas local distribution companies in Wisconsin.

The transportation of this fuel threatens water resources. Natural gas transmission and distribution pipelines are a significant source of methane leaks. When methane pollutes water resources, it impacts water chemistry, and bacteria in the water can metabolize methane, creating dangerous byproducts like hydrogen sulfide (Cahill, 2017).

Additionally, transporting this highly flammable gas is dangerous. Between 2008 and 2015, there were 5,065 significant safety incidents with 108 fatalities and 531 injuries related to natural gas pipeline transmission and distribution. In Wisconsin, the U.S. Department of Energy identified a significant external event affecting natural gas transmission and distribution pipelines once every 5.2 and 1.3 years, respectively (OE, DOE), (The Hidden Cost of Fossil Fuels, Union of Concerned Scientists).

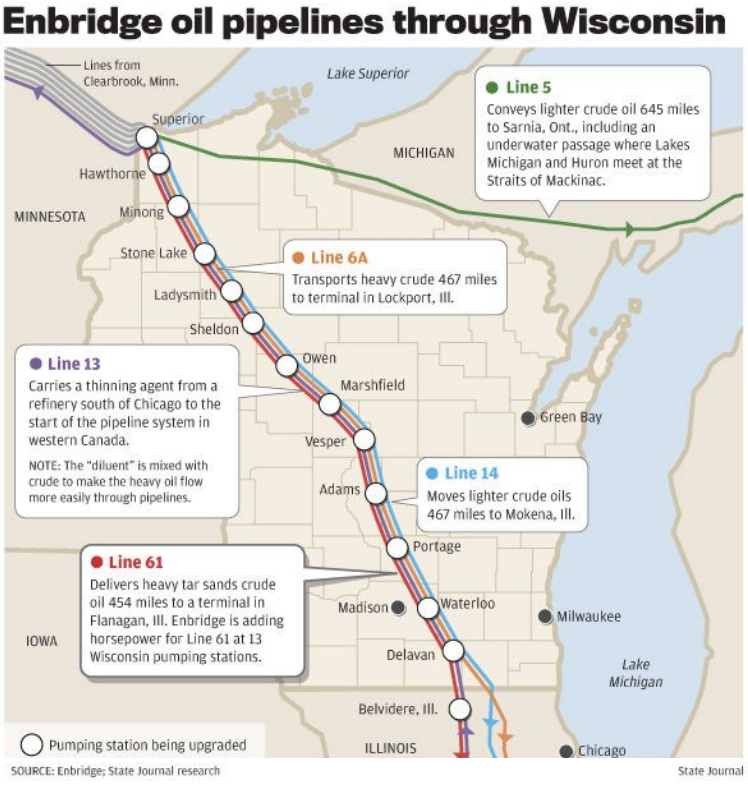
2014 natural gas pipeline rupture in Copano Bay, Texas. Photograph from sott.net.

Oil Transport: Pipelines and Vessels

The primary methods for transporting oil and oil products are pipelines, vessels, vehicles, and railroads. Each poses a threat to environment, water quality, health and/or safety. Oil spills and leaks can result in the toxic contamination of soil and groundwater aquifers. Spills adversely affect water-related tourism and other commercial and industrial businesses. Spill cleanup costs are often high, and not fully covered by insurance, leaving taxpayers with the bill. Open water spills can kill aquatic flora and fauna. Moreover, such spills can have long-term effects. For example, there is no proven way to recover sunken heavy oil.

While Wisconsin has no crude oil production or reserves, the Calumet Oil Refinery in Superior processes about 45,000 barrels of crude oil per day. Crude oil is transported from Canada and North Dakota to Wisconsin through a pipeline system owned by the pipeline company Enbridge. Enbridge's holding tanks in Superior can hold up to 13 million barrels of oil, which is worrisome considering the tank is about two hundred feet from the Nemadji River that flows into Lake Superior.

From Superior, the mainline of the Enbridge Lakehead System consists of three pipelines that run down the middle of Wisconsin in an 80-foot corridor to the Illinois border, through Chicago, into Michigan and on to refineries. These pipelines can carry up to 2 million of barrels of oil a day and extend through over 12 counties and run under hundreds of streams, wetlands and rivers including the headwaters to the nationally -protected St. Croix River (Eagan, 2017).



As if that was not concerning enough, the other part of the system runs through northern Wisconsin and Michigan, under the Straits of Mackinac, through Michigan to a refinery in Ontario (Great Lakes Commission). The Straits have been called one of the worst places in the world for an oil pipeline, due to its vital role in the Great Lakes System and because it would contaminate the drinking water of tens of thousands of people in Wisconsin, Michigan and Canada (Great Lakes Commission).

2010 Kalamazoo Tar Sands Pipeline Spill. Photograph from circleofblue.org.

Additionally, many of these pipelines are operating beyond their planned lifelines. Fifty-five percent of pipelines in the Great Lakes region were installed before 1970 (Cristopherson, 2014). Unfortunately, many communities are familiar with just how large the impact of a spill from these aging pipelines can be. In July 2010, an Enbridge oil pipeline ruptured near Marshall, Michigan and spilled almost 1 million gallons of crude oil into Talmadge Creek, a tributary of the Kalamazoo River. Enbridge has already spent a billion dollars on the clean up, and much of the oil pollution remains in the river (Eagan, 2017). Members of the community say they are still facing negative health and economic impacts.

Spills have not only occurred in Michigan, but in Wisconsin as well. In 2016 the Wisconsin Department of Natural Resources issued a report that showed that Enbridge had 85 spills in Wisconsin during the prior decade. Many were less than 2,100 gallons; six were up to 21,000 gallons, and five were up to 210,000 gallons. During those years Enbridge spills totaled over 3.5 million gallons of crude oil and other liquid industrial products (Great Lakes Commission) (Egan).

Pipelines are not the only risky mode of transporting oil. Refined petroleum products are transported by vessel on the Great Lakes (19 million metric tons in 2011). While crude oil has not been transported by vessel on the Great Lakes, it is transported on inland waterways, rivers, and canals. Increased crude oil production has created an incentive to explore vessel transportation on the Lakes. The risks associated with waterborne transportation include spills from boat collisions, grounding, severe weather, and human error. Five of the ten largest oil spills in U.S. history were from boats. A crude oil spill from a vessel would quickly contaminate a large area of fresh water and habitat that could be further complicated by ice and cold weather, which a common in the winter months (Great Lakes Commission).

Rail Transport of Frac Sand and Crude Oil

Frac sand and crude oil are both transported by rail through Wisconsin. The risk this poses is similar to that of pipelines and vessels: spills, fires and explosions are all possible when transporting oil and frac sand by rail. In Wisconsin, this poses a particular risk due to the increased tonnage of material crossing aging infrastructure, particularly rail bridges (Wisconsin Center for Investigative Journalism) (Chase, 2014) Rail bridges that are in poor repair increase the possibility of accidents, which is especially concerning if the bridge crosses a waterway.

The rail transport of frac sand from Wisconsin to hydraulic fracturing sites in North Dakota, Texas, and Pennsylvania, and the rail transport of crude oil through the state to refineries in the east have caused a substantial increase in freight rail traffic in the state. Wisconsin is the largest producer of frac sand in the United States, with an estimated output of about 26 million tons annually (Chase, 2014). Frac sand is typically hauled in unit trains consisting of 100 to 125 cars, with a total payload of 10,000 to 12,500 tons per train (WI DOT, 2013). If an accident occurs, the train cars and the frac sand they haul can pollute land and waterways.

In addition to increased frac sand rail traffic, the transport of crude oil by rail has increased substantially. Crude oil by rail increased from nearly zero in 2010 to just under 1.0 million barrels per day in August 2015 (WI DOT, 2016). Oil tank cars follow one route along the Mississippi River, and another across the state through Milwaukee. Much of this crude oil is from the Bakken oil fields in North Dakota and Montana. Bakken oil is very volatile and more prone to fires (Bergquist, 2015). The increase in crude oil rail transport has contributed to capacity constraints on some rail corridors (WI DOT, 2016).

According to the National Transportation Safety Board, between March, 2013, and April, 2014, there were eight major accidents in the United States and Canada, including the derailment of a Burlington Northern Santa Fe Railroad train in Galena, Illinois. The train was carrying more than three million gallons of crude oil. (Muivany, 2014) (Bergquist, 2015) (DOT, 2016). The fire from these spills can cause severe injury or death, and the spilled oil from the railcars pollutes nearby waterways. The DOT report states that "one possible factor in the rise of incidents in Wisconsin is attributed in the increased train traffic, which can be attributed to recent booms in sand mining in Wisconsin and crude oil from shale in North Dakota" (WI DOT, 2016)

Coal

Generation and Processing

The air emissions from coal fired power plants are well documented. They not only include carbon dioxide, but also heavy metals such as mercury. According to the Natural Resource Defense Council, “about half of the reactive mercury emitted into the air is deposited within 300 miles of the source of emissions” into soil, rivers and lakes. Because most coal fired power plants are located on bodies of water, mercury contamination in lakes and streams has led to fish consumption advisories being issued for all major water bodies in the state.

Coal Ash

Not only does energy generation take a toll on Wisconsin waterways, the waste from coal plants has significant environmental and health impacts. Coal ash is the waste material that is left after coal is burned, and depending on where in the coal burning furnace it comes from, it can take different forms: fine, powdery fly ash; large bottom ash; boiler slag; and flue gas desulfurization (FGD) sludge. Depending on where the coal was mined, coal ash can contain heavy metals that are dangerous to humans and the environment including arsenic, lead, mercury, chromium, boron, and more. If these toxicants are ingested or inhaled, they can cause a host of health problems including cancer, cognitive and behavioral problems, heart damage, lung disease, and birth defects. The Environmental Protection Agency (EPA) has determined that living next to a coal ash disposal site can increase the risk of cancer or other diseases (Physicians for Social Responsibility, Fact Sheet). Because of the health risks posed by coal ash, it is imperative that the ash be disposed of in a way that assures it will be isolated from people and the environment.

Unfortunately, the proper disposal of coal ash is not consistently happening in Wisconsin. Under Wisconsin regulations, beneficial use of coal ash is exempt from waste disposal standards. Reuse of coal ash includes disposal under buildings, roadways, or highway berms, as well as spreading it on roadways, paths, fields, and parks (NR 538, Wis. Adm. Code). There are no requirements for coal-burning utilities to disclose where and how they beneficially use much of their waste. While about half of coal ash nationwide is “reused,” 85 percent of coal ash in Wisconsin goes to reuse projects, making it the highest in the U.S. (Cook, Mathewson and Nekola, 2014).

In 2014, Clean Wisconsin conducted a research project to assess the impact of beneficial reuse of coal ash in southeastern Wisconsin (Waukesha, Milwaukee, Racine and Kenosha Counties). Clean Wisconsin found that the area has at least 1 million tons of coal ash in beneficial reuse projects throughout the area. Based on extensive groundwater monitoring data collected by the DNR, the study found a correlation between the location of the coal ash and molybdenum contamination in drinking water wells. The closer drinking water wells were to large coal ash reuse sites, the higher the levels of molybdenum contamination were likely to be. Also, wells downflow of such sites tended to have much higher levels of molybdenum.

Another way coal ash can pollute air and water is through dumping. Between 1969 and 1978 about 600,000 tons of coal ash was dumped by We Energies in the unlined Highway 59 Landfill in Waukesha. The EPA identified it as a proven damage case for contaminating nearby private drinking wells with arsenic, boron, chloride, iron, manganese, molybdenum and sulfate. Subsequently, We Energies paid residents to abandon their wells while municipal water was supplied and the landfill was cleaned up. After showing improvement, more recent testing still showed some well contamination. In 2009, We Energies began buying up properties and plugging contaminated wells in Caledonia, near landfills used by the Oak Creek power plant. In 2013 the EPA determined that the landfills were a source of molybdenum contamination.

In October 2011 a bluff in Oak Creek collapsed into Lake Michigan resulting in 25,000 tons of coal ash dumped in the lake. The bluff was found to be composed of coal ash that was used to fill the ravine during the 1950's. In early 2013, DNR released information showing widespread molybdenum contamination that extended into the Yorkville area of Racine County. Although it is an essential nutrient at low levels, high levels of molybdenum can cause reproductive and developmental problems in animals including fetal mortality and degenerative changes in the brain and nervous system. It can also cause a gout-like disease in humans, hand and leg joint pains, enlargement of the liver, and gastrointestinal, liver, and kidney disorders. After testing its well, Yorkville Elementary School found the water had extremely high levels of molybdenum. Since then the school district has provided bottled water to students and staff (Cook et. Al., 2014). New sampling of the Yorkville Elementary School neighborhood wells found molybdenum concentrations above the DNR enforcement level, and all boron levels and 90 percent of arsenic levels were above state preventive action limits.

Nuclear

Currently, there are three nuclear power plants in Wisconsin: Point Beach, Kewanee, and the La Crosse Boiling Water Reactor (BWR), of which only the Point Beach nuclear power plant is currently operational. Approximately 14 percent of the state's electricity is produced by nuclear power. (Wisconsin Public Service Commission)

Nuclear power plants heat water with a nuclear reaction to generate steam, turn a turbine and create electricity. Water is also used to cool both nuclear power plants and spent nuclear fuel. These water withdrawals can significantly disrupt water flow and aquatic systems. Nuclear power plants with once-through cooling systems withdraw vast amounts of water from aquatic ecosystems and typically return that water to those ecosystems at a much higher temperature, which often creates hot spots that kill or harm aquatic animals and plants. Plants with cooling towers withdraw less water, but produce much more steam (Kerth, Kim, Garren and Abrams, 2012). These water supplies are also a frequent destination for spilled or dumped radioactive liquid.

In an operating nuclear plant, the improper operation of piping systems can cause a loss of water from the spent fuel pool. Water can also be lost through the fuel transfer canal to the reactor refueling cavity. In a closed plant, pipes can freeze and break if heating is not maintained. If pipes break at an elevation below the pool water level, the volume of water in the pool could be reduced and spent fuel could be exposed.

Point Beach Nuclear Power Plant.

Nuclear Waste

While nuclear power plants pose risks during the generation process nuclear waste disposal poses an even greater threat. Reactor fuel contains uranium and other radioactive isotopes, some of which can be exposed to people through food and drinking water if released in large quantities. All radiation can damage cells and DNA, and long-term exposure increases the risk of various forms of cancer and other illnesses such as anemia and cataracts.

Leakage of radioactive material, particularly tritium, into groundwater is a common occurrence at nuclear power plants in the U.S. Plants that are prone to leak are older and have miles of underground piping. Some piping is encased in concrete and difficult to access, so they can corrode over time and begin to leak contaminated water.

Because of the toxicity of nuclear fuel and the long half-life of radioactive wastes the storage and management of spent fuel is a major safety concern. Nuclear fuel is used until it can no longer generate enough heat to produce electricity. Fuel removed from production is stored in a spent fuel pool at the power plant for five to seven years until the spent fuel is cool enough for dry storage. The U.S. Department of Energy (DOE) is ultimately responsible for disposal or storage of spent fuel, but has yet to license a long-term repository. Until DOE accepts spent fuel, each utility that operates a nuclear plant is responsible for the spent fuel it produces. The utility must store the fuel in a spent fuel pool and/or Nuclear Regulatory Commission (NRC) approved dry casks, meaning there is a present and ongoing threat to waterways.

Nuclear Waste Dry Casks

Conclusion and Solutions

Wisconsin is needlessly putting water at risk from the transportation and use of the fuels used to generate energy. The transportation of natural gas, oil, and frac sands through Wisconsin by rail, pipeline and shipper pose a significant threat to environmental and public health due to aging infrastructure and frequent spills and accidents. Furthermore, energy production by coal has resulted in water and air contaminated by mercury and coal ash, while nuclear power plants disrupt water flow and aquatic ecosystems.

Energy production and transportation methods must be altered drastically in order to safeguard Wisconsin's environment and people. Already, coal plants across the nation are shutting down in large numbers, many of them years earlier than planned because they are no longer economical. At the same time, renewables such as wind and solar are rapidly replacing dirty energy in the power sector. Wisconsin should protect its waters and economy by accelerating this trend, thereby reducing the numerous threats to the state's waters posed by the production and transportation of natural gas, frac sand, crude oil, coal and nuclear power. In order to do so, a strategy is needed that includes:

- Preventing the construction of any further fossil fuel pipelines and nuclear or coal power plants.
- Planning for the retirement and removal of existing pipelines and nuclear or coal power plants.
- Re-evaluating the regulation of coal ash to ensure it is does not continue to contaminate Wisconsin's air and waterways.
- Investing in renewable energy that produces jobs and protects the state's valuable air and waterways that support the health of residents and thousands of jobs in tourism and agriculture.
- Imposing better safety standards for the transportation of oil.
- Developing and implementing strict standards that hold polluters and spillers accountable for cleaning up waterways.

With energy safeguards in place and with an investment in the clean energy economy, Wisconsin's waterways and the health of its citizens will be better protected.

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