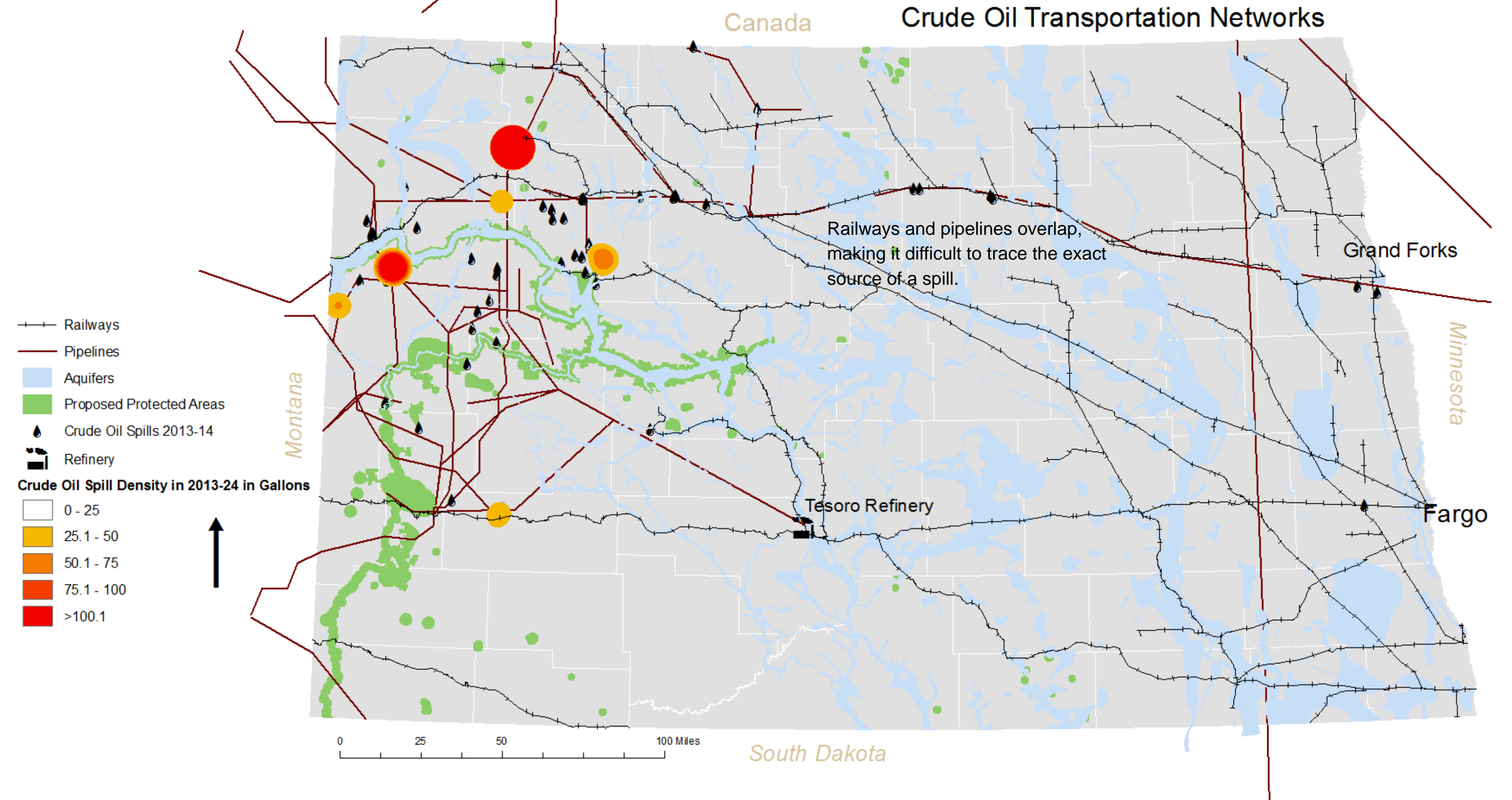
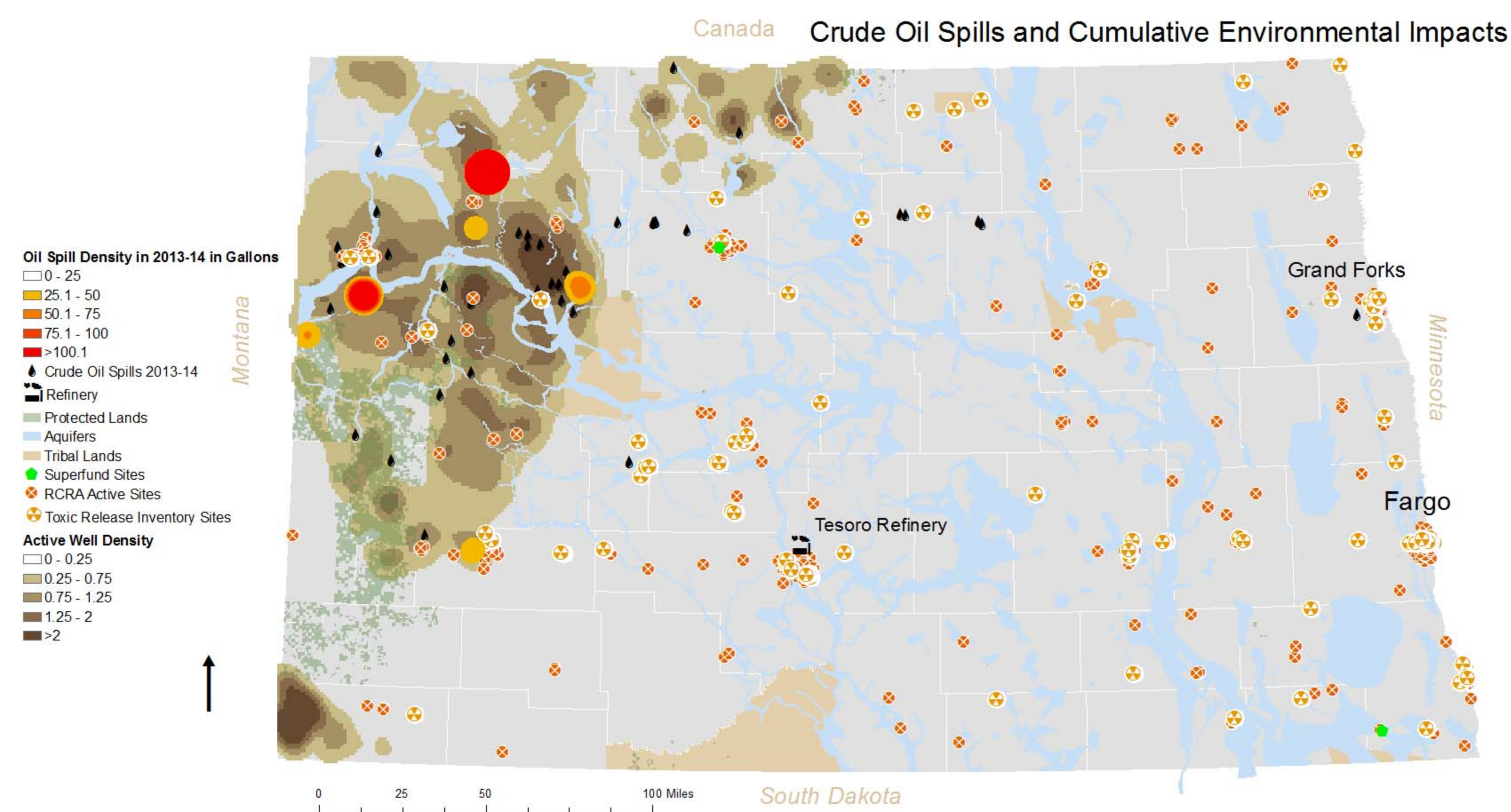


Crude Oil Spill Density in North Dakota's Bakken Shale



Project Description

This project explores cumulative environmental pollution. I use non-oilfield (i.e., outside a well facility) crude oil spills as a measurement of pollution and I use data from March 2013 through March 2014. While the majority of oil spills are small and do not have a significant effect on the environment, multiple small oil spills can contribute to cumulative environmental damages, especially when considered in the context of other pollution sources. Furthermore, certain modes of crude oil transportation may pose greater risks for oil spill pollution. For this study, I map the density of oil spill hot spots related to the position of crude oil pipelines, railway networks, aquifers, and active drilling sites in North Dakota. In practice, companies are typically responsible for the environmental assessment of the specific lease area for which they are seeking to obtain a permit. The cumulative effect of their activity is more difficult to take into account when assessing the risk to the environment from onshore or offshore drilling. By mapping out frequently affected areas, this information can be incorporated into oil spill response planning to establish better locations for response equipment availability and deployment.

Research Questions

A. Where are crude oil spills occurring in North Dakota and are certain areas hot spots of cumulative oil pollution?

B. Where are oil spills located in relation to other environmentally impacted sites, such as Superfund sites, RCRA sites, and Toxic Release Inventory facilities designated by the EPA?

Methodology

Crude oil spill data is reported to and released by the North Dakota Department of Health. For this project, I used General Environmental Incidents, meaning that the data recorded represents spills (in gallons) that occurred outside of a well field facility. While active well data and railway data is easily accessible, pipeline data is difficult to obtain due to national security concerns. I used an incomplete dataset from the Energy Information Agency (EIA) and supplemented it by tracing and digitizing an existing comprehensive North Dakota pipeline map. I performed a Kernel Density analysis to find density patterns of oil spills as well as of active well sites in order to compare where oil was being spilt relative to the intensity of drilling. I also mapped the locations of other environmentally sensitive sites such as aquifers, protected lands, and tribal lands. The maps include environmentally damaged sites, such as Superfund sites, Resource Conservation and Recovery Act (RCRA) sites, and Toxic Release Inventory facilities, as classified by the Environmental Protection Agency (EPA).

Findings

The largest spill during the period of the collected data was the Tesoro Pipeline spill (648,900 gallons) in October 2013. The second largest spill density is found near pipeline network intersections. The most frequent spills are small spills, up to 100 gallons in volume. There are many other smaller spills that cumulatively build up to significant environmental impacts, especially around the transportation networks serving the Bakken shale. All drilling (and much of the pipeline infrastructure) is located in eastern North Dakota and much of it is concentrated around the Missouri River and its groundwater system. Crude oil spill hot spots are typically outside of the North Dakota Industrial Commission's Proposed Protected Areas. Nevertheless, the latter are still at risk from smaller scale spill pollution.

Data Sources:

North Dakota Department of Health, General Environmental Incidents dataset (2013-2014); North Dakota Department of Transportation (2013); U.S. Energy Information Administration (2013); North Dakota State Water Commission (2014); North Dakota Pipeline Authority (2013); North Dakota Industrial Commission (2014); Environmental Protection Agency (2012-2013); North Dakota Department of Transportation (2012); North Dakota Forest Service (2012); U.S. Fish and Wildlife Service (2009, 2011).

Map Projection: NAD 1983 State Plane North Dakota North FIPS 3301 Feet

