



HYDRAULIC MODELING OF PIPELINE RUPTURES

Planning Ahead to Save the Waters
of North Dakota



HYDRAULIC MODELING OF PIPELINE RUPTURES

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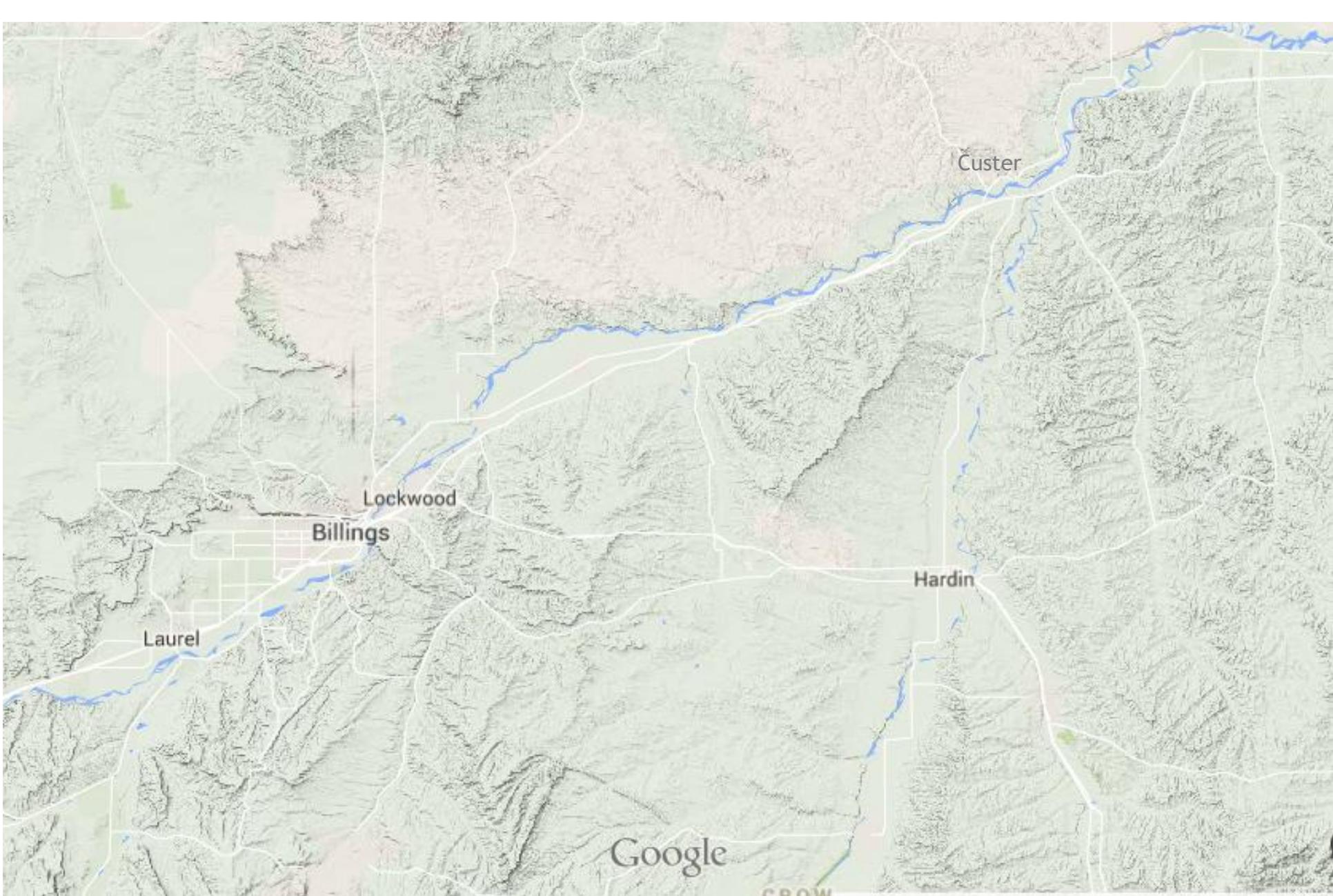
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HYDRAULIC MODELING OF PIPELINE RUPTURES

◇ Text

Pipeline Ruptures -Case Study 1

- ◇ July 1, 2011
- ◇ An estimated 1,500 barrels, or 63,000 gallons of crude spilled into the fast-moving, flood-stage Yellowstone River when ExxonMobil's Silvertip Pipeline broke near Laurel. At the time of the discharge, the Yellowstone river was at the peak of a 30-year flood and the river was flowing out of its banks.



Custer

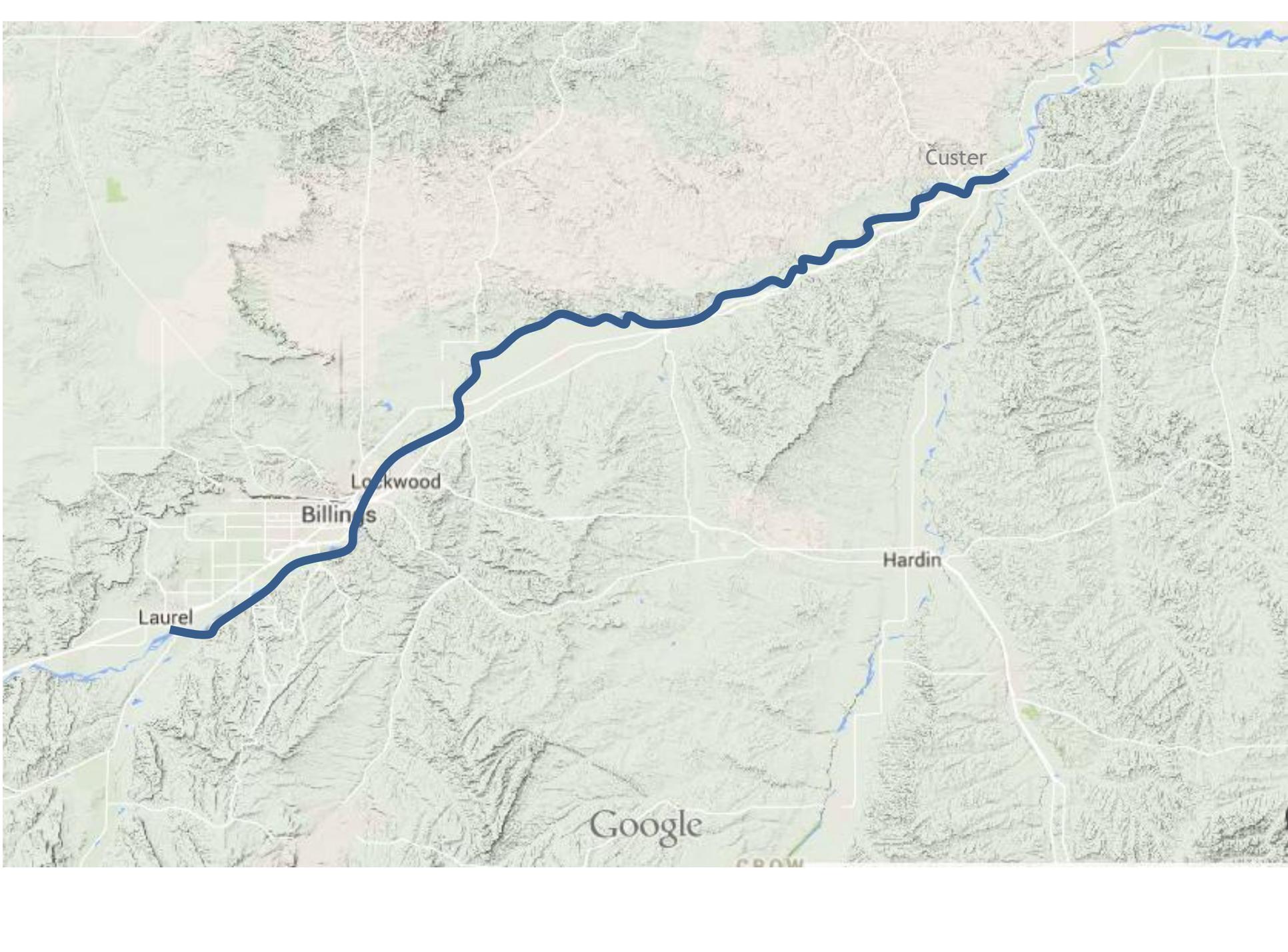
Lockwood

Billings

Hardin

Laurel

Google



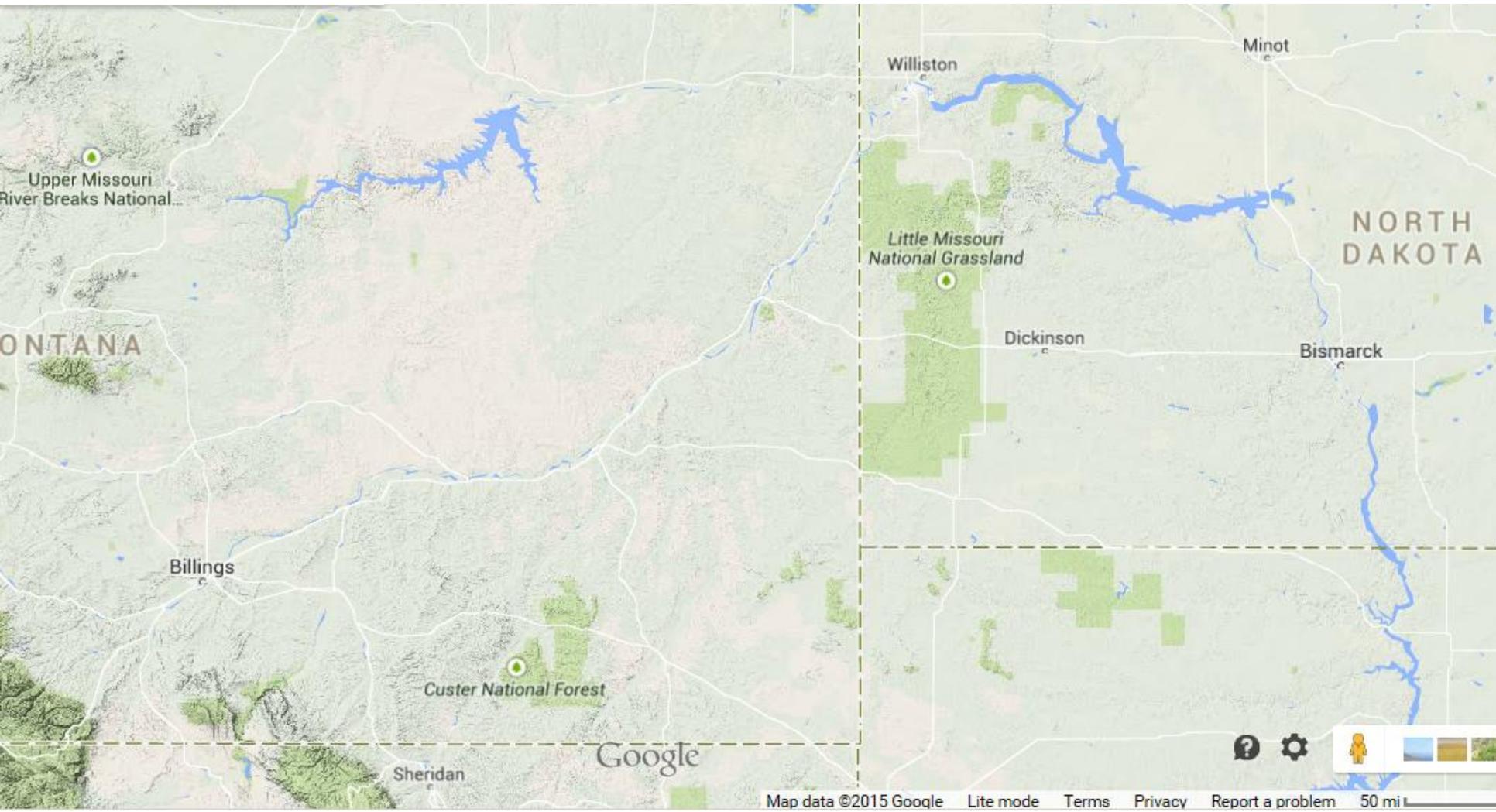
Custer

Lockwood
Billings

Laurel

Hardin

Google



Upper Missouri
River Breaks National...

ONTANA

Billings

Custer National Forest

Sheridan

Google

Williston

Minot

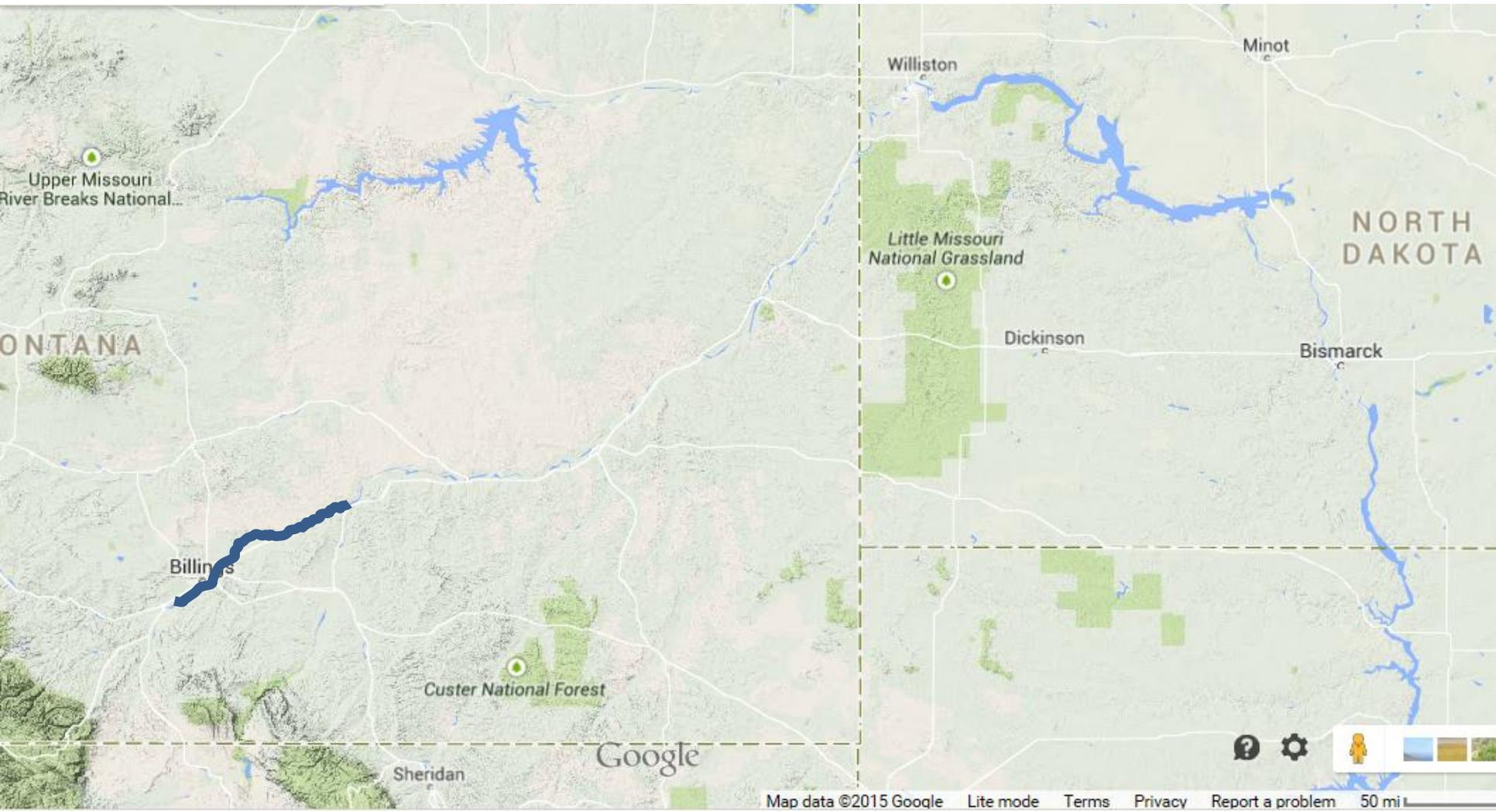
Little Missouri
National Grassland

Dickinson

Bismarck

NORTH
DAKOTA

Map controls including a location pin icon, a gear icon for settings, a person icon for street view, and a color palette for map styles.



Upper Missouri
River Breaks National...

ONTANA

Billings

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Google

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Little Missouri
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NORTH
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Minot





River And Division Segments
Divisions A, B And C
As of 28 Aug 2011

Custer
→

Billings
→

Laurel
↓

A

B

C

Point of Release
←







Pipeline Ruptures -Case Study 2

- ◇ March 27, 2013
- ◇ 14 cars on a 94-car Canadian Pacific Railway train derailed in Parkers Prairie, Minn., on Wednesday, spilling as much as 714 barrels of crude oil from the Bakken shale fields.





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Pipeline Ruptures -Case Study 3

- ◇ January 17, 2015
- ◇ A breach along the Poplar Pipeline near Glendive, MT caused a spill of up to 40,000 gallons of oil produced in the Bakken shale fields of Montana and North Dakota, Wyoming-based Bridger Pipeline



Aerial picture of the site of the Yellowstone oil pipeline spill. On Jan. 17, 2015



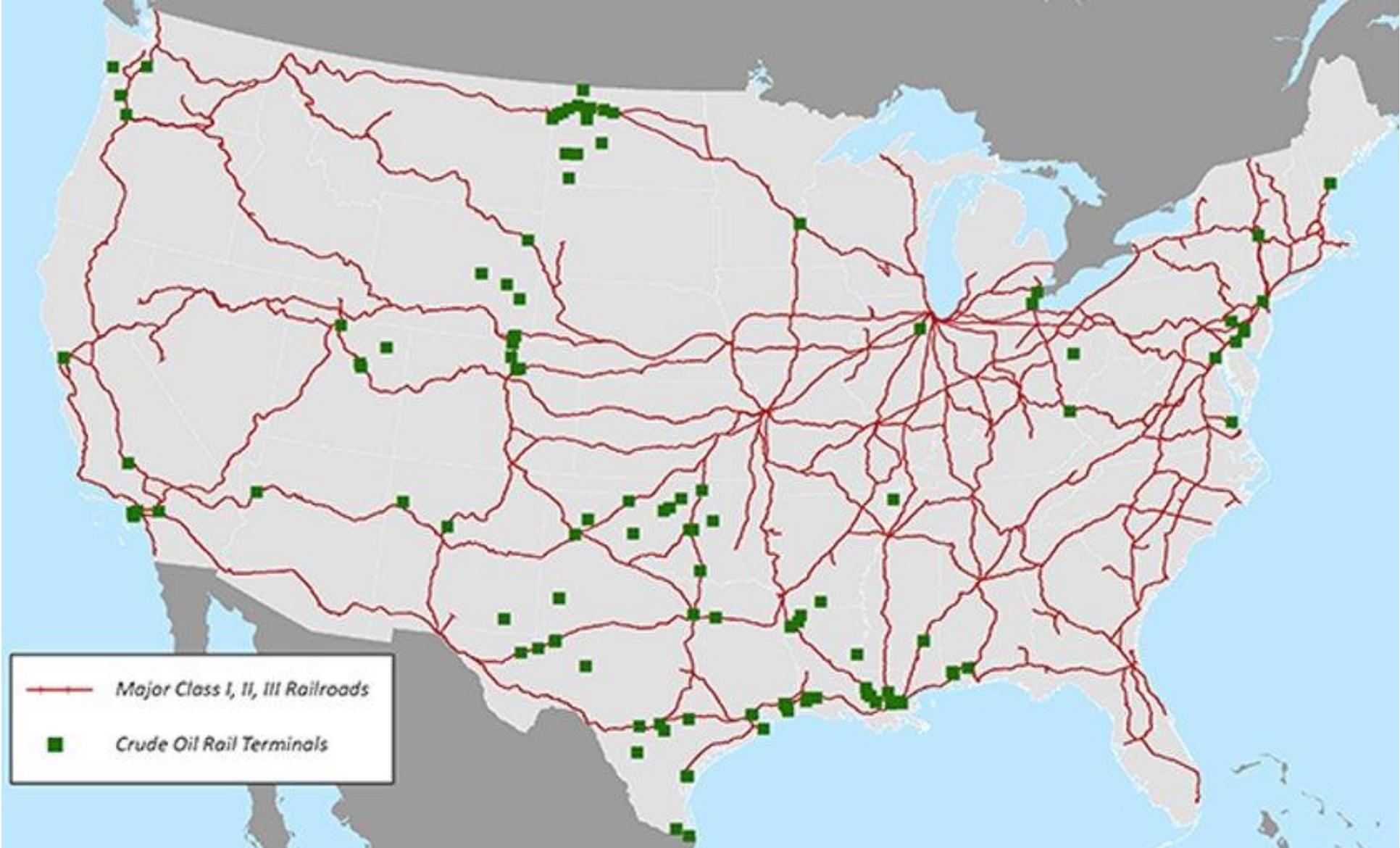
Photo Credit: Environmental Protection Agency

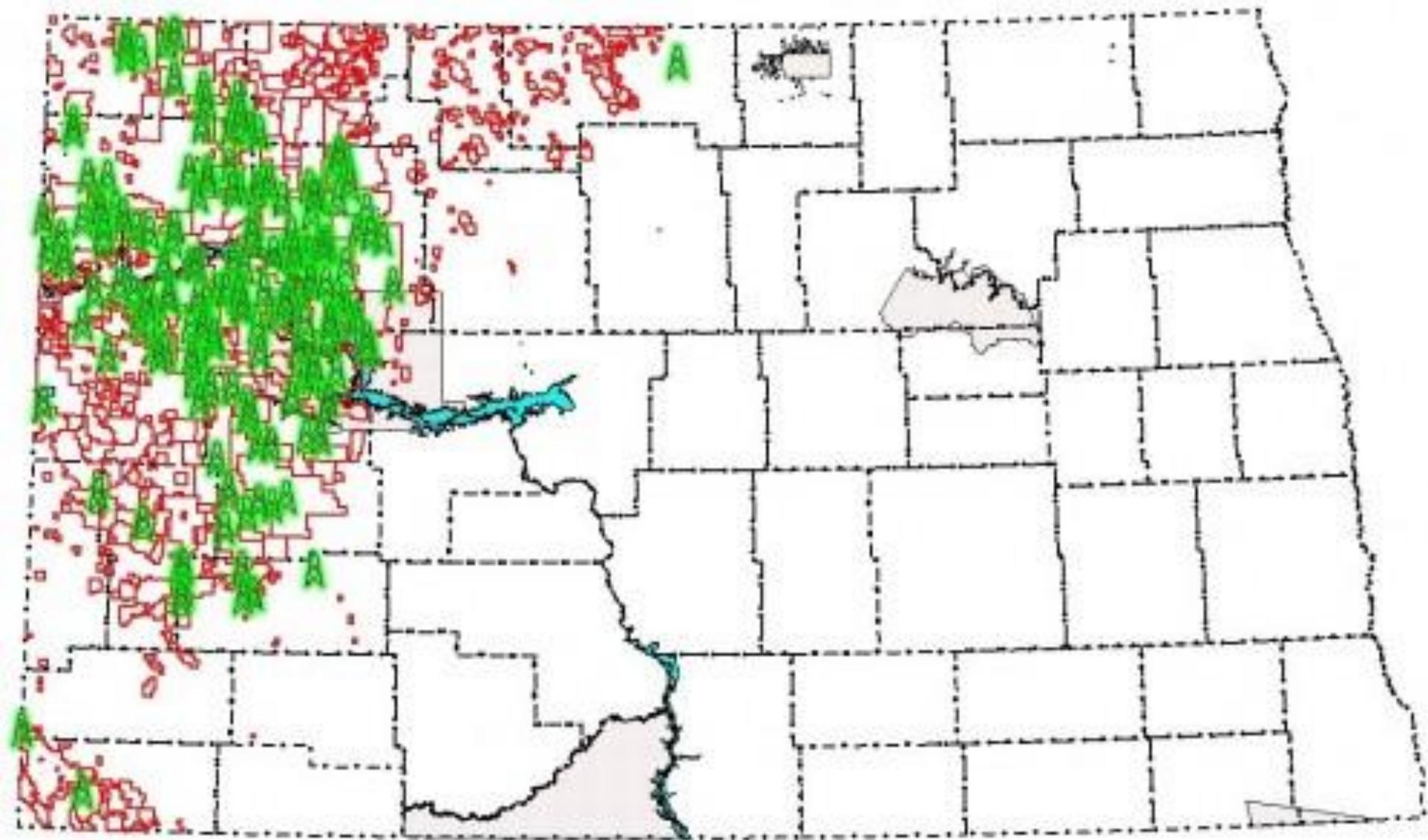
Oil Recovery on Jan. 28, 2015



Photo Credit: Environmental Protection Agency







Recent North Dakota Oil Spills

- ◇ January 7, 2015
- ◇ Nearly 3 million gallons of saltwater leaked from a saltwater collection line owned by Summit Midstream Partners LP into a creek that feeds into the Missouri River.

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- ◇ Nearly 3 million gallons of saltwater leaked from a saltwater collection line owned by Summit Midstream Partners LP into a creek that feeds into the Missouri River.
- ◇ Officials have called the leak the largest of its kind in state history.



Recent North Dakota Oil Spills

Four “significant” oil-related spills, including two that impacted wetlands, were reported by North Dakota state officials in February 2015.

Recent North Dakota Oil Spills

The first was a double-incident reported by Hess Corp., which said that approximately 42,000 gallons of oil industry wastewater was released from two of its well sites in Williams County, located about three miles apart.

Both spills occurred because of opened valves.

Both of the waste spills were said to have impacted wetlands, though the extent of the damage has not been reported.

Recent North Dakota Oil Spills

The next spill, reported on Tuesday February 17, 2015, was a 1,260-gallon oil spill in McKenzie County. In that incident, the oil overflowed from a truck and spilled into an oxbow of Charbonneau Creek, which is a tributary of the Yellowstone River.

Recent North Dakota Oil Spills

The fourth incident saw 400 gallons of diesel fuel spill from an open valve of a truck and into an unnamed tributary of Lonesome Creek.

Protection of natural resources & minimize ecological impacts

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 - water supplies & waterways
 - drains
 - sewage systems
 - pipe and cable ducts

Protection of natural resources & minimize ecological impacts

- Oil spills should be trapped in ditches and gullies by earth dams when possible.





Overland Aerial Photography © 2013

Protection of natural resources & minimize ecological impacts

- › Sorbent Sweep/Booms should be employed













Quiz

Quiz

- › What the best means for locating and predicting spill response locations?

Best means for locating spills





U.S. Environmental Protection Agency (EPA)

- ◇ **TITLE 40** - Reorganization Plan 3 of 1970, Establishes the U.S. Environmental Protection Agency (EPA) in the Executive branch as an independent Agency, effective December 2, 1970.



U.S. Environmental Protection Agency (EPA)

- ◇ **TITLE 40** → PROTECTION of ENVIRONMENT
 - ◇ **CHAPTER I** → ENVIRONMENTAL PROTECTION AGENCY
 - ◇ **SUBCHAPTER D** → WATER PROGRAMS
 - ◇ PART 112—OIL POLLUTION PREVENTION
 - ◇ Appendix C - Substantial Harm Criteria

Pipeline and Hazardous Materials Safety Administration

- The Oil Pollution Act of 1990 (OPA) amended the Federal Water Pollution Control Act, (FWPCA) to require all oil handling and transportation facilities to file a PHMSA Response Plans.

Pipeline and Hazardous Materials

Safety Administration

- ◇ is a [United States Department of Transportation](#) agency created in 2004, responsible for developing and enforcing regulations for the safe, reliable, and environmentally sound operation of the US 2.6 million mile pipeline transportation. It is responsible for nearly 1 million daily shipments of hazardous materials by land, sea, and air. It oversees the nation's pipeline infrastructure, which accounts for 64 percent of the energy commodities consumed in the United States. Made up of the Office of Pipeline Safety and the Office of Hazardous Materials Safety.

Spill Response Locations

- ◇ How do we predict spill response locations?

Spill Response Locations

- › Pipeline and Hazardous Materials Safety Administration (PHMSA) Response Plans

PHMSA Response Plans

- ◇ The plan is intended to prepare the owner/operator of the facility to respond to an oil or hazardous substance discharge. The Response Plan (RP) includes:
 - ◇ 1. Implements Company Policy.
 - ◇ 2. Provides responsibilities and guidelines for personnel responding to a discharge from an oil handling or pipeline facility.
 - ◇ 3. Helps on-scene personnel prepare for a discharge.
 - ◇ 4. Reduces chances of injury or damage to responders, the public, and the environment.
 - ◇ 5. Ensures an effective, comprehensive response.
 - ◇ 6. Defines spill detection and notification procedures to be followed once a discharge occurs.
 - ◇ 7. Outlines response and mitigation procedures for addressing a crude oil discharge.
 - ◇ 8. Identifies training and drill procedures for responders.

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How do we predict spill response locations

- ◇ [Title 40](#) → [Chapter I](#) → [Subchapter D](#) → [Part 112](#) → [Subpart D](#) → Appendix C - Substantial Harm Criteria
- ◇ **Attachment C-III—Calculation of the Planning Distance**

How do we predict spill response locations

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◇ Chezy-Manning's equation

How do we predict spill response locations

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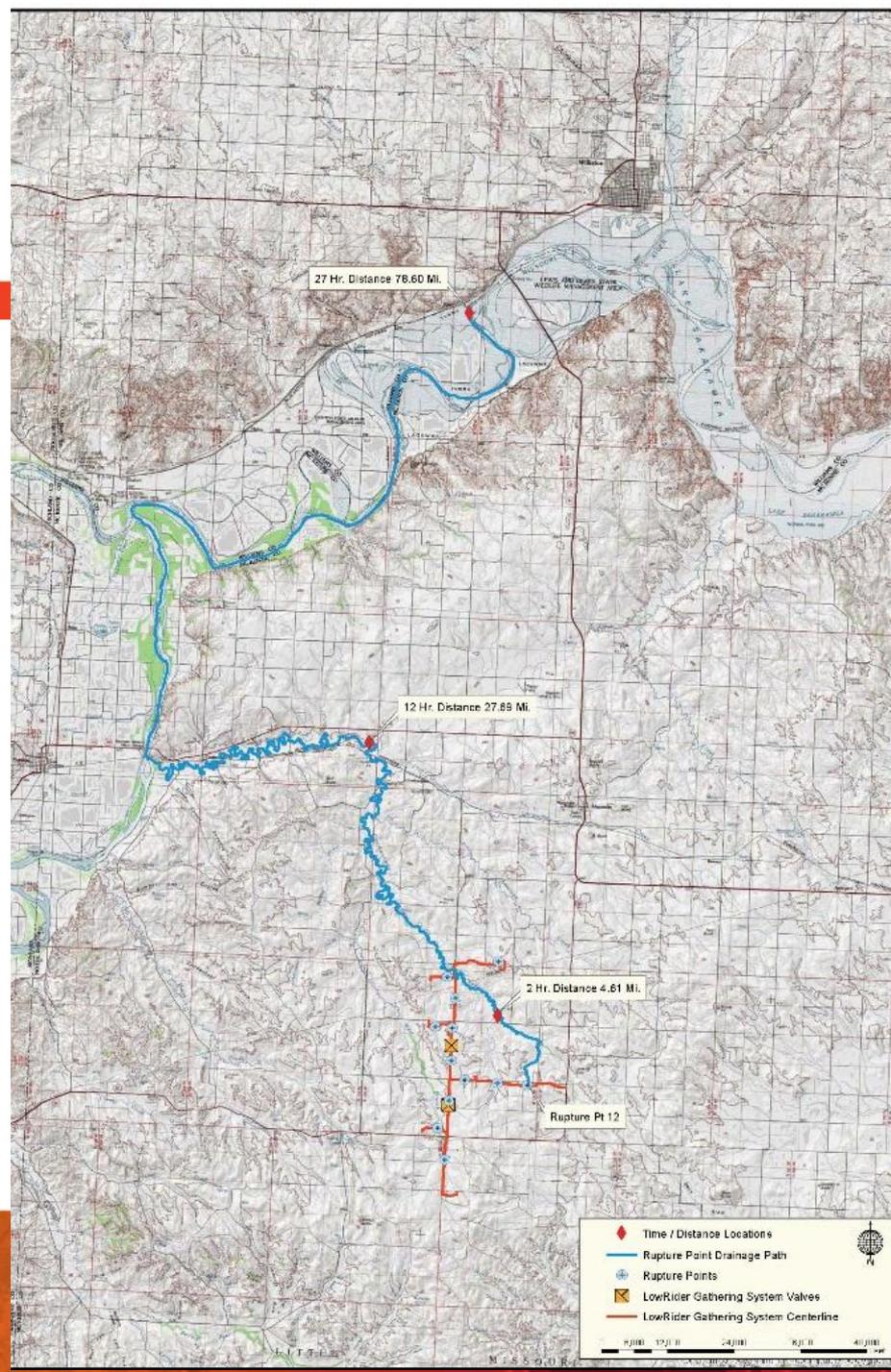
$$◇ v = 1.5/n \times r^{2/3} \times s^{1/2}$$

How do we predict spill response locations

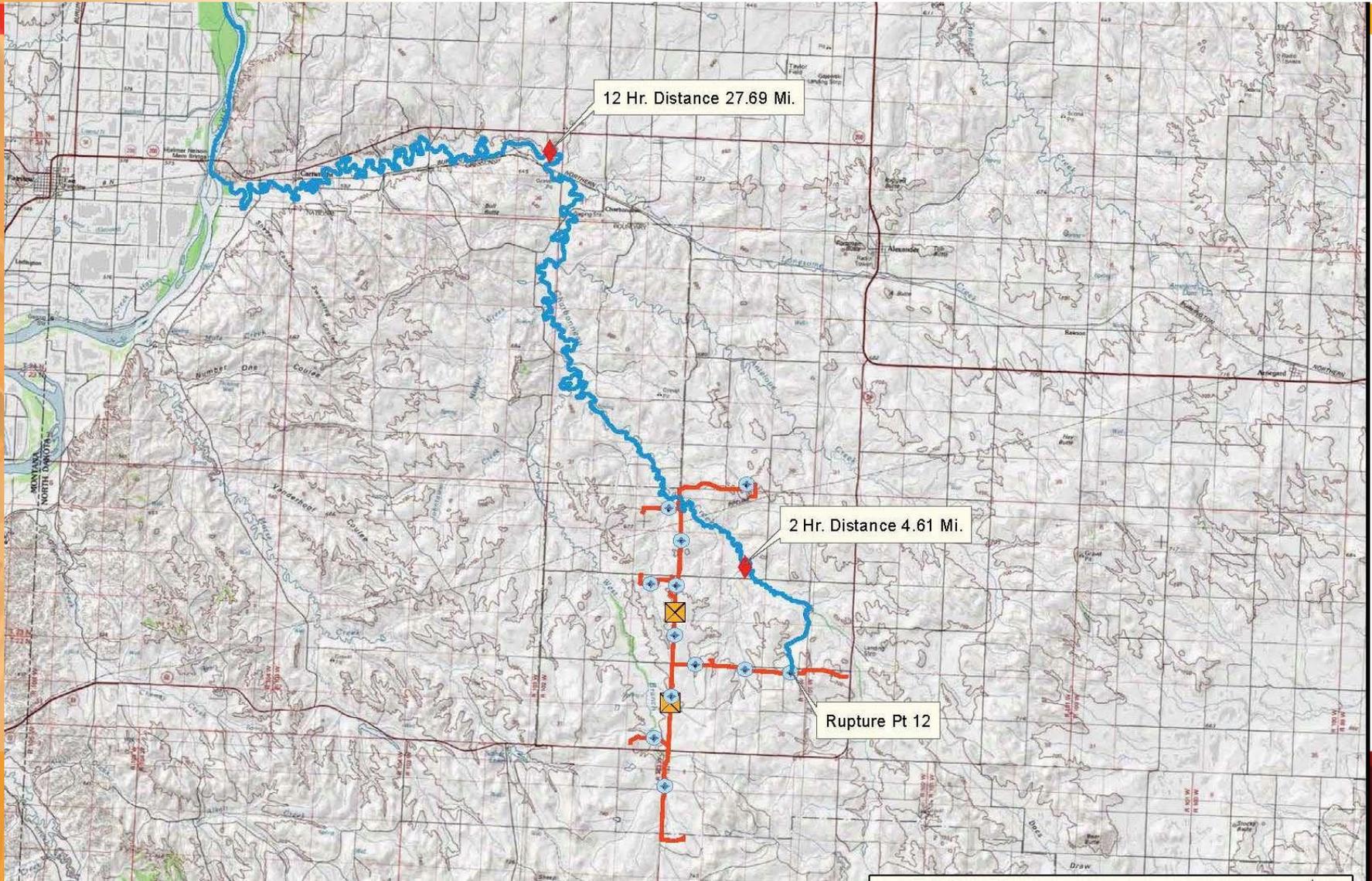
- With velocity (v) solved it is now just a time distance problem.



Appendix C of the PHMSA Response Plan



Response Time Location Map

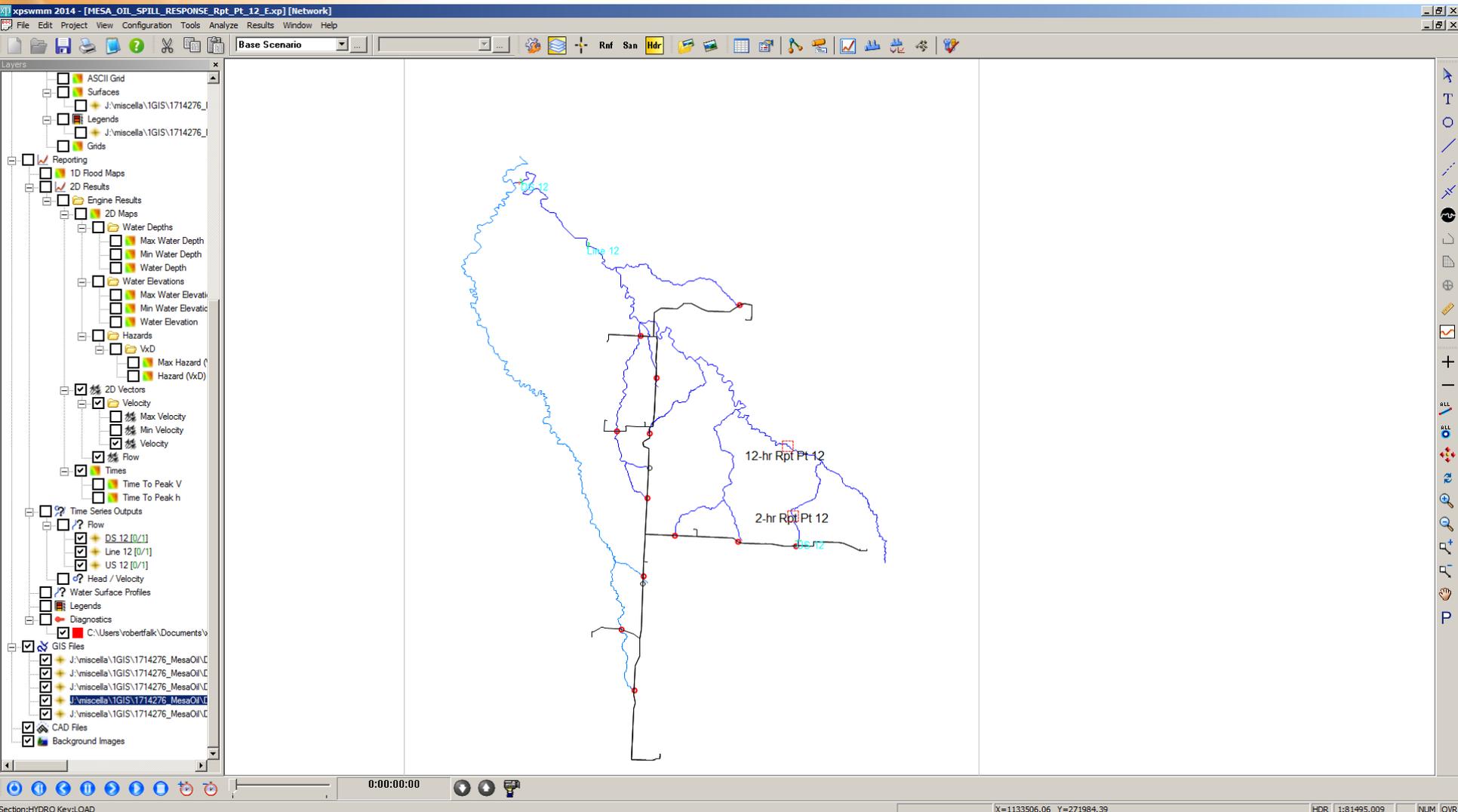


12 Hr. Distance 27.69 Mi.

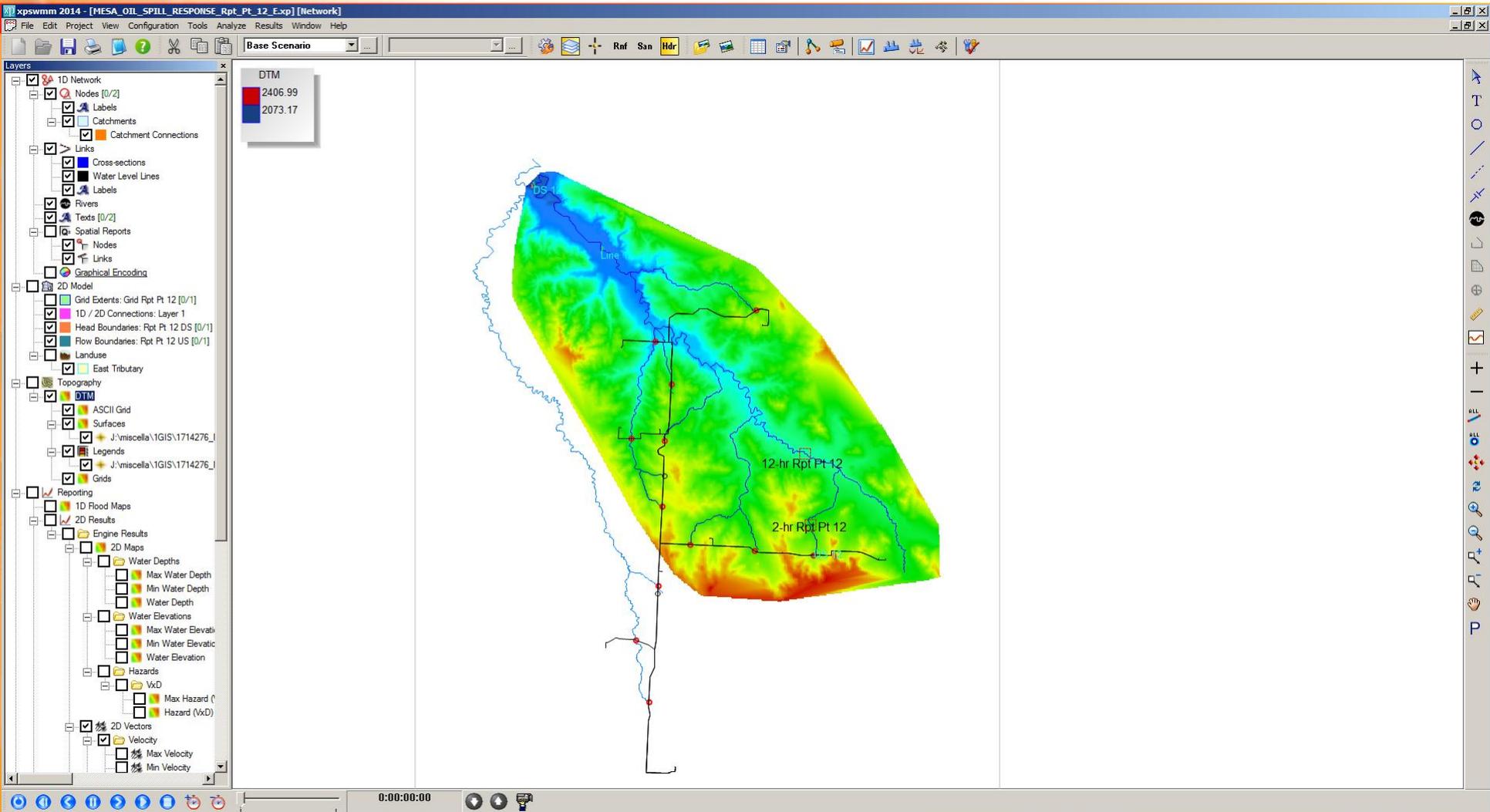
2 Hr. Distance 4.61 Mi.

Rupture Pt 12

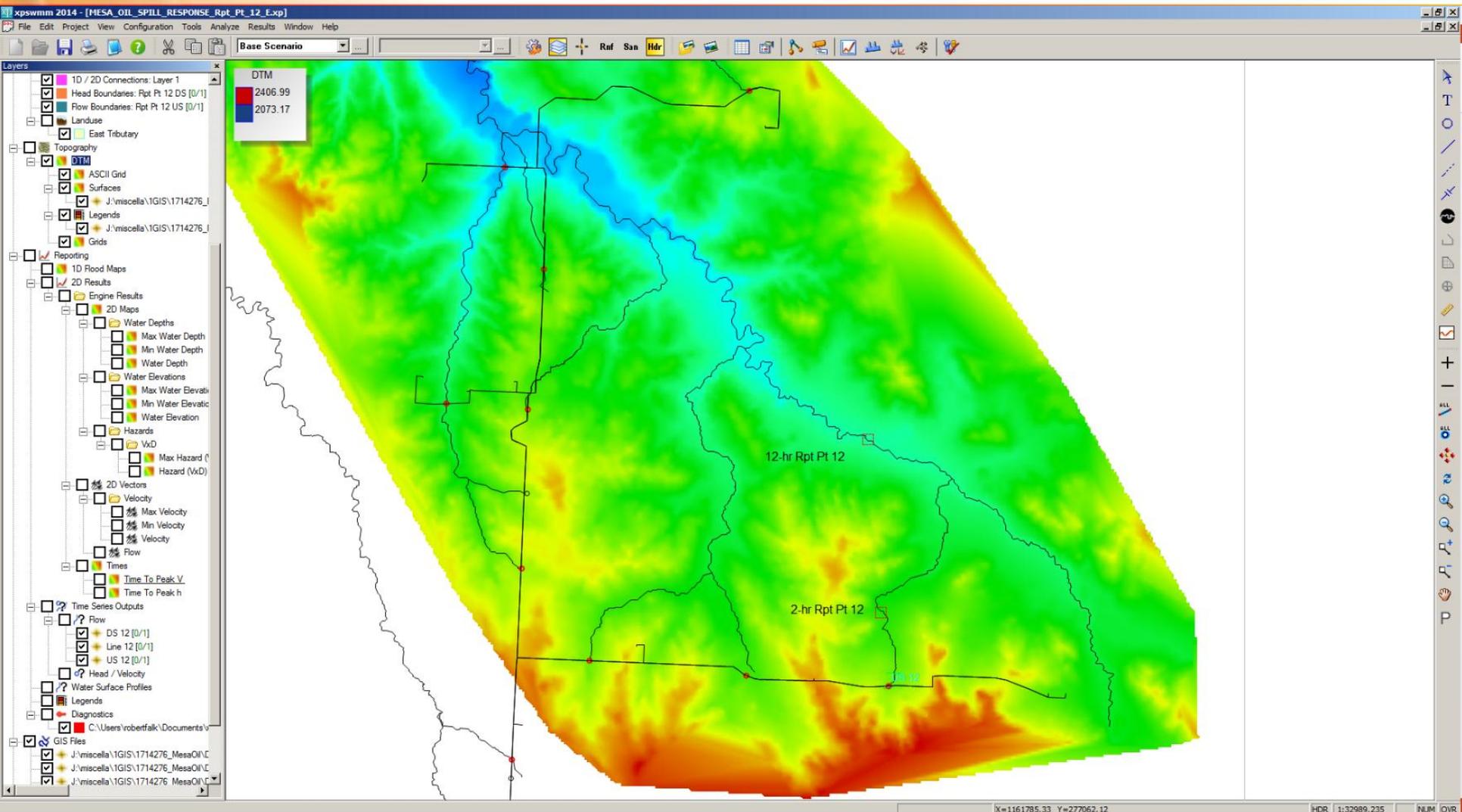
XPSWMM 2014



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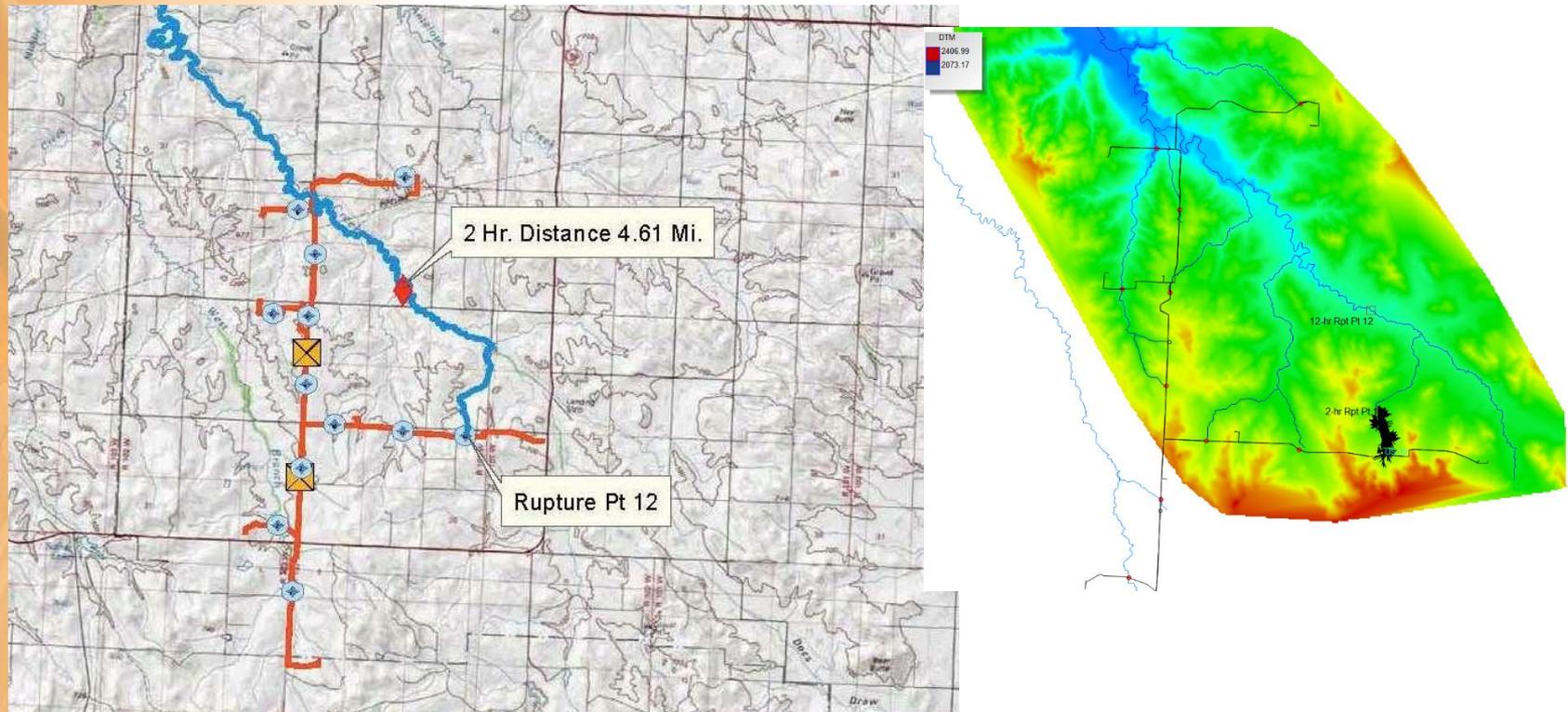


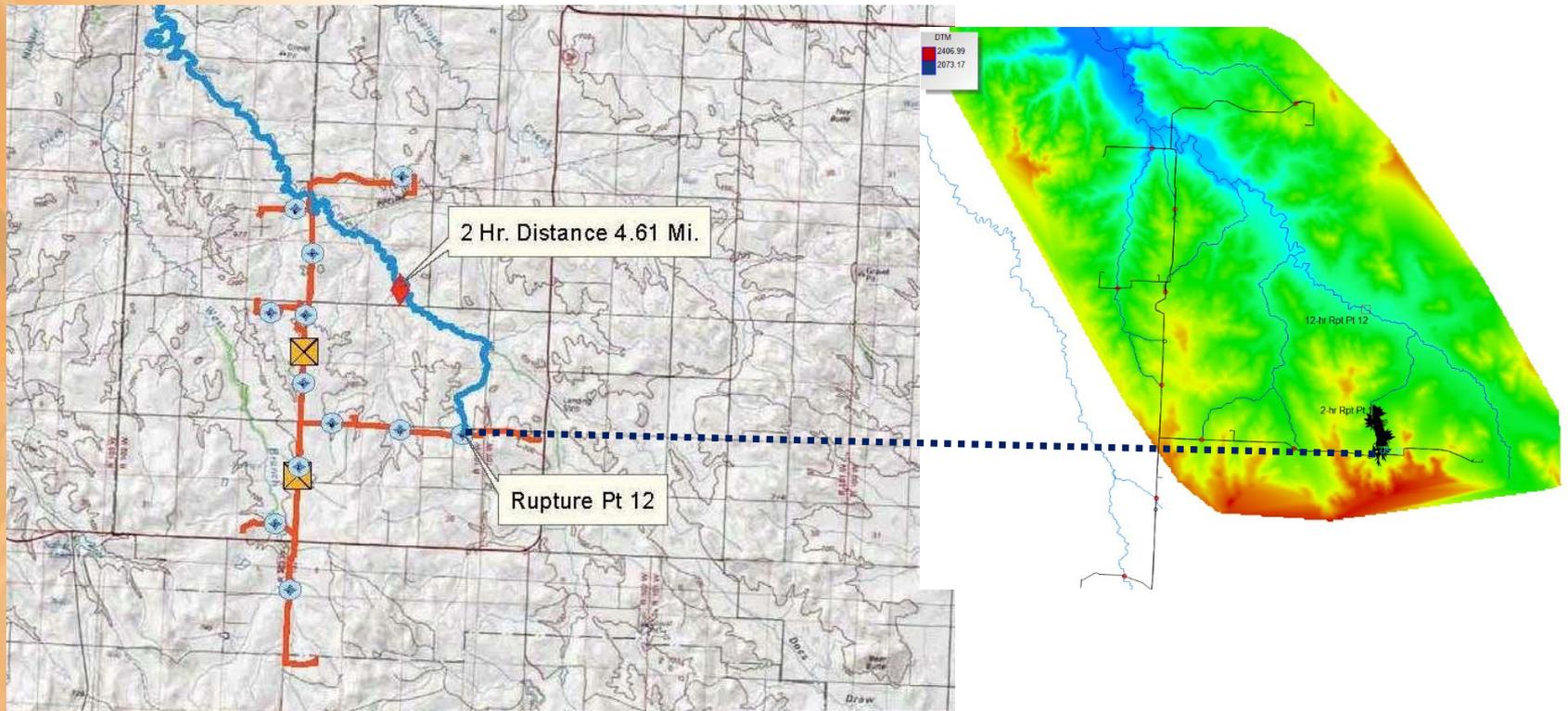
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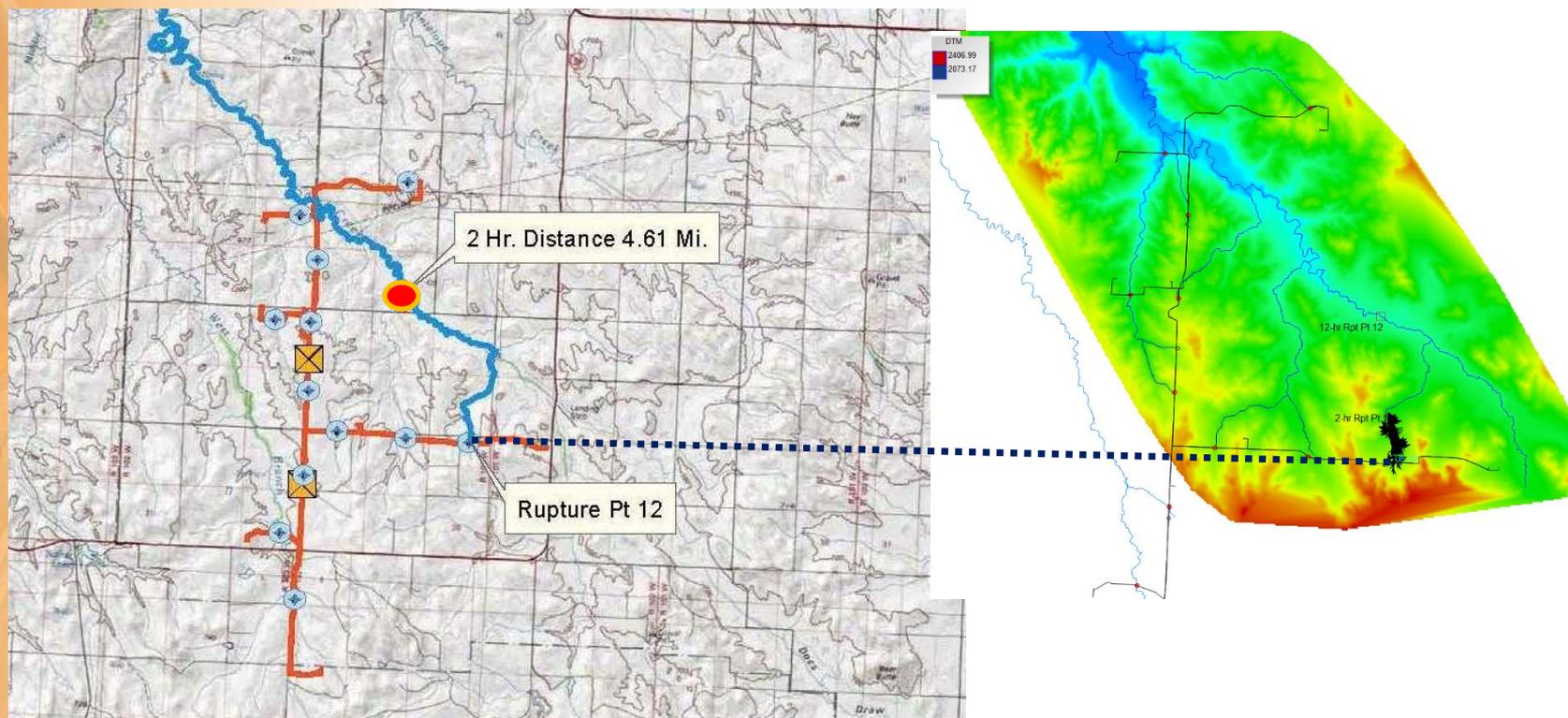


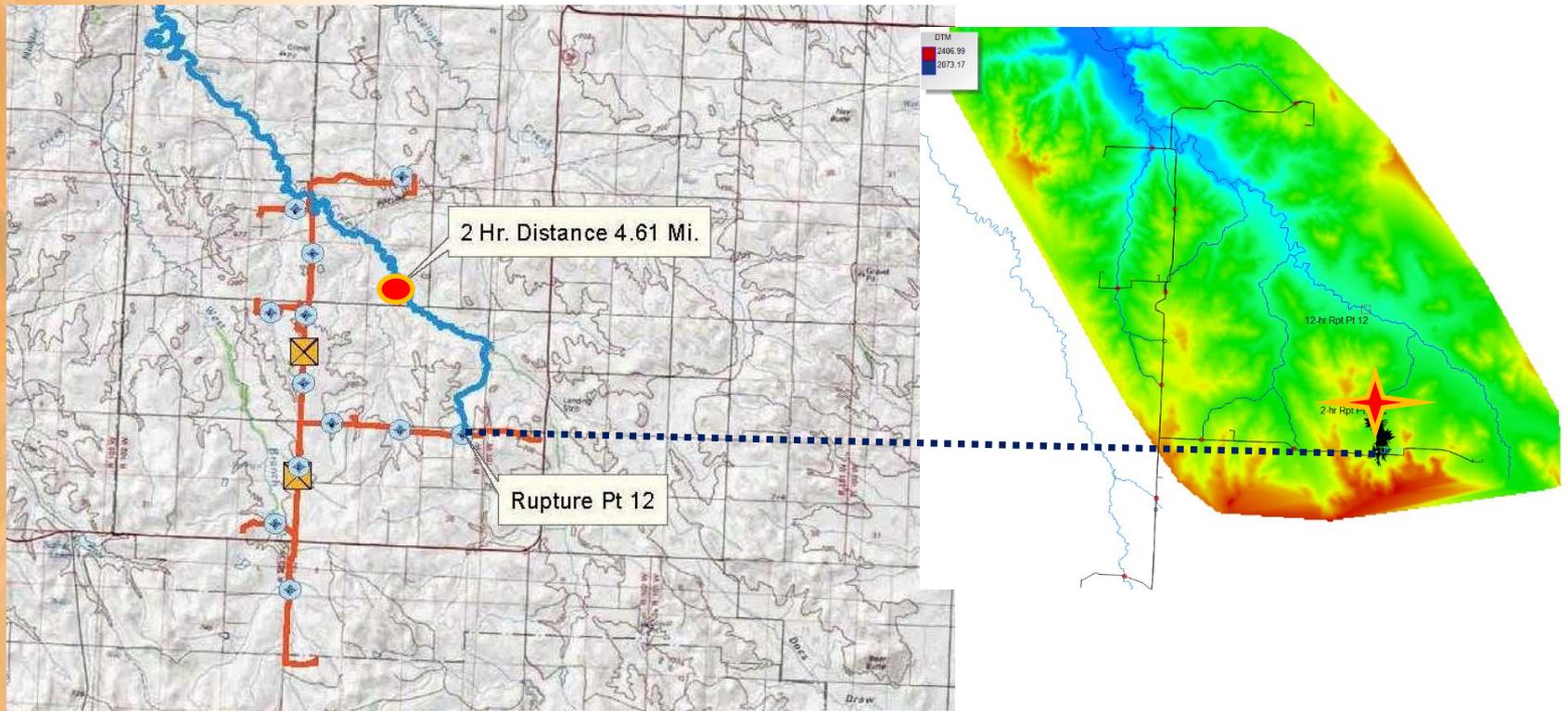


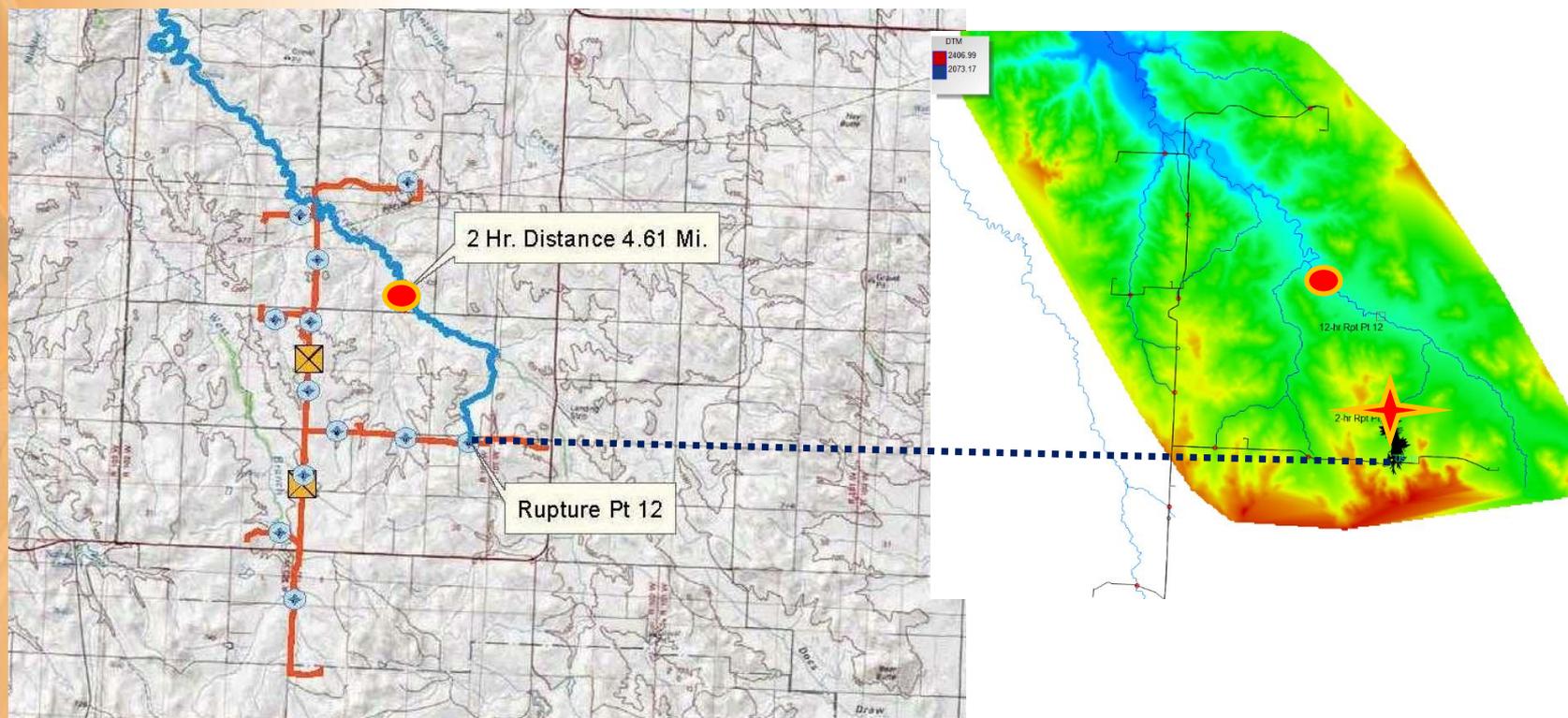
Side-by-side Comparison

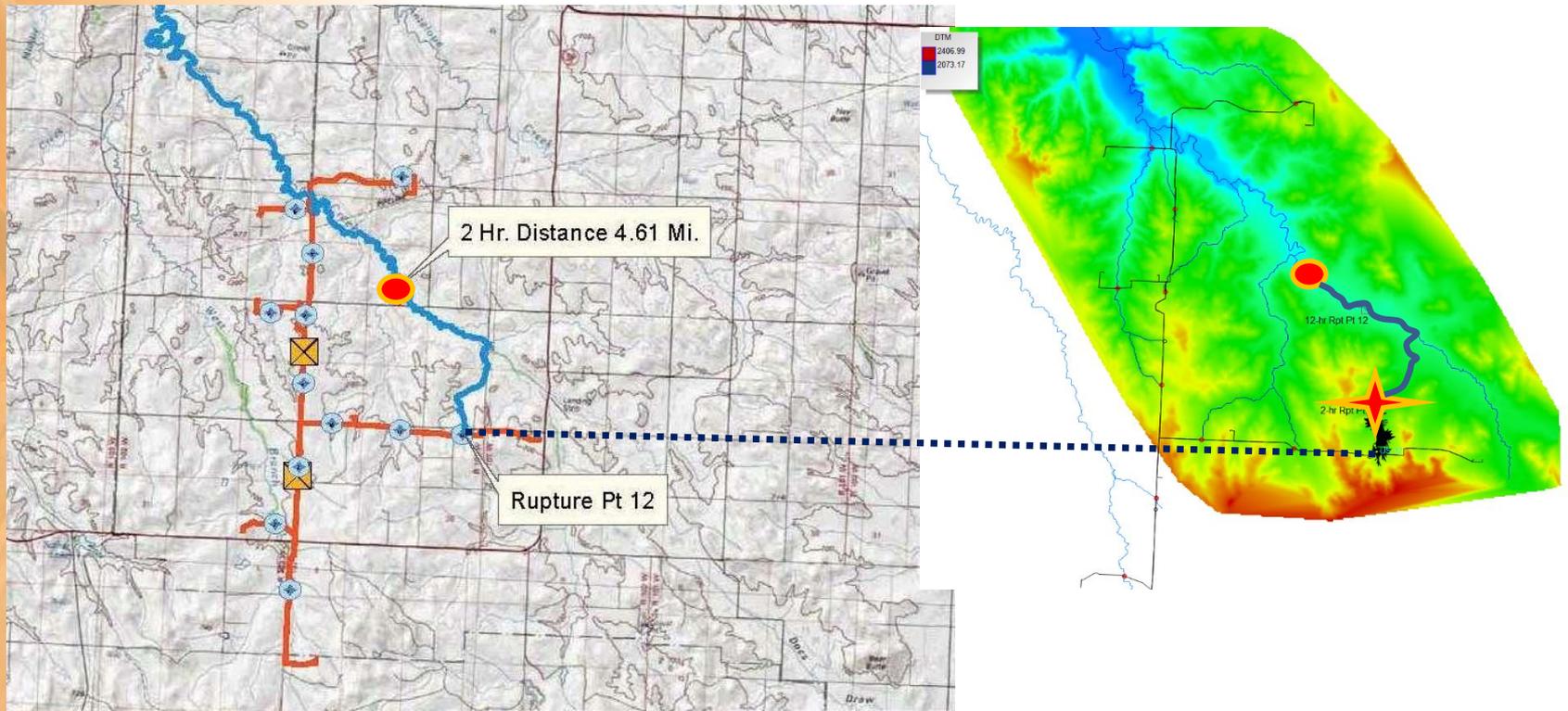












Questions?

