National Transportation Safety Board

Office of Aviation Safety

Washington, D.C. 20594-2000

February 1, 2011

METEOROLOGICAL FACTUAL REPORT

DCA10MP007

A. ACCIDENT

Location: Marshall, Michigan
Date: July 25, 2010
Time: 2158 eastern daylight time (EDT)
Accident: Enbridge Liquids Pipeline rupture

B. METEOROLOGICAL SPECIALIST

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C. SUMMARY

At 2158 EDT on Sunday, July 25th 2010, after having initiated what was to be a 10 hour pipeline shutdown from the Edmonton Control Center, the Enbridge Energy 30-inch 6B crude oil transmission line, extending from Griffith, Indiana to Sarnia, Ontario, experienced a sudden pressure drop resulting in low pressure alarms, initiating local shutdown of the Marshall Pump station. This pressure drop was the result of a line break approximately 2/3 of a mile east (downstream) of the Marshall Pump station. The released crude oil entered a low lying area 700 feet north of Tallmadge creek. As a result of the initial failure, and subsequent attempts to operate the pipeline, an estimated 19,500 bbls of crude oil were released.

D. DETAILS OF INVESTIGATION

The National Transportation Safety Board's (NTSB) Senior Meteorologist was not on scene for this investigation and gathered all the weather data for this investigation from the Washington D.C. office from official National Weather Service (NWS) sources including the National

Climatic Data Center (NCDC). All times are eastern daylight time (EDT) based upon the 24 hour clock. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 42.2395° N and longitude -84.9662° W.

1.0 Synoptic Situation

The NWS Surface Analysis Chart for 1000 EDT on July 25, 2010 is provided as figure 1, with the approximate location of the accident site marked by a red cross. The chart depicted a dissipating frontal system that stretched east-to-southwest over southern Michigan into northwestern Indiana, with another dissipating frontal system over Ohio into southern Indiana. The pipeline accident site is located immediately north of the dissipating front, which had been the focal point for several days of rainfall across lower Michigan.

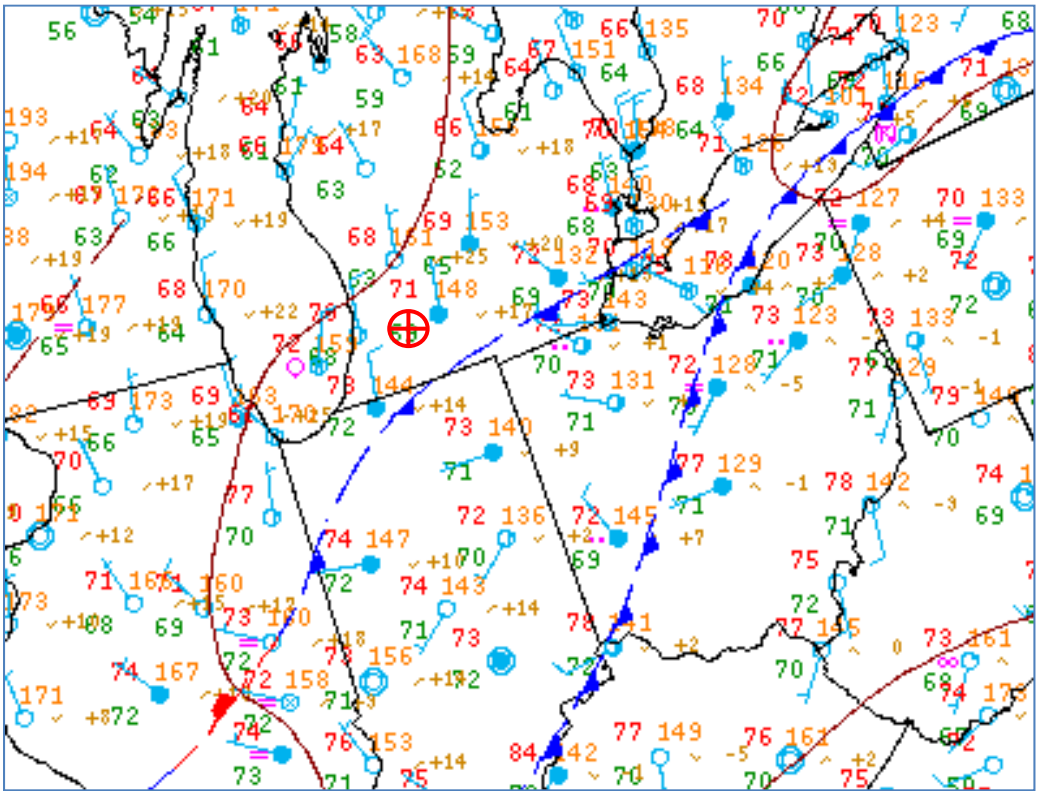


Figure 1 – NWS Surface Analysis Chart for 1000 EDT

The station models in the vicinity of the accident site indicated north to northeasterly winds at approximately 5 knots, overcast skies, with temperatures in the upper 60's to low 70's degrees Fahrenheit (F).

2.0 Surface Observations

The closest weather reporting facility was from Brooks Field (KRMY), location in Marshall, Michigan approximately 1 mile north of the rupture site at an elevation of 941 feet msl. The airport had an unmanned Automated Weather Observation Station (AWOS-3) and reported the following conditions near the time of the accident on July 25, 2010:

Marshall weather at 1755 EDT, automated, wind from 010 at 4 knots, visibility 10 statute miles, scattered clouds at 4,800 feet above ground level (agl), temperature 79° F (26° Celsius(C)), dew point temperature 59° F (15° C), altimeter 30.08 inches of mercury (Hg).

The airport reported a period of moderate to heavy rain earlier in the morning hours between 0335 and 0635 EDT.

The next closest reporting station with a precipitation gauge was from W. K. Kellogg Airport (KBTL), Battle Creek, Michigan, located 15 miles west and immediately downstream of the spill along the Kalamazoo River at an elevation of 952 feet msl. The airport was equipped with an Automated Surface Observation System (ASOS) and was augmented by NWS certified weather observers. A review of the observations indicated that between 0250 and 0649 EDT the Battle Creek area was impacted with continuous light to heavy rain showers and thunderstorms, with 1.37 inches of rainfall recorded during the period.

A review of both the Marshall and Battle Creek observations indicated that the ground was fully saturated at the time of the pipeline rupture.

3.0 Precipitation Data

A review of the daily observations from Battle Creek (KBTL) indicated the following significant weather conditions and precipitation from June 25 through July 25, 2010, and between July 26, to August 1, 2010.

Precipitation between June 1 through July 25, 2010

Date	Significant Weather	Rainfall
July 25	Morning rain showers & thunderstorms	1.37”
24	Morning rain showers & thunderstorms	0.60”
23	Morning & afternoon rain showers & thunderstorms, high 92° F	2.40”
22	Morning & afternoon rain showers & thunderstorms	2.41”
21	Clear conditions	
20	Morning rain showers & thunderstorms	0.82”
19	Afternoon rain showers	0.01
18	Thunderstorms & rain showers in the vicinity of the station	0.06”
17	Clear, high temperature 86° F	
16	Clear, high temperature 87° F	0.00”
15	Severe thunderstorms in the afternoon & evening, high 91° F	1.38”
14	Dense morning fog, with clearing in the afternoon, high temperature 87° F	0.01”
13	Morning rain showers & mist	Trace
12	Early morning thunderstorms	0.11”
11	Evening thunderstorms in the vicinity of the station	Trace

10	Morning mist, afternoon thunderstorms in the vicinity	0.00”
9	Morning mist/fog	
8	Scattered rain showers & thunderstorms	0.27”
7	Isolated afternoon thunderstorm in the vicinity, temperature 91° F	
6	Clear conditions, high temperature 91° F	
5	Clear conditions, high temperature 90° F	
4	Clear conditions, high temperature 91° F	
3	Clear conditions, high temperature 84° F	
2	Clear conditions, high temperature 81° F	
1	Clear conditions	
June 30	Clear to partly cloudy	
29	Clear conditions	
28	Clear conditions	
27	Scattered thunderstorms & rain showers	0.09”
26	Morning rain showers, high temperature 84° F	0.01”
25	Clear conditions	
24	Early morning rain showers	0.03”
23	Morning thunderstorms & rain, high temperature 87° F	0.76”
22	Early morning thunderstorms & rain showers, high 85° F	0.28”
21	Isolated afternoon thunderstorms & rain, high temperature 82° F	Trace
20	Clear conditions, high temperature 80° F	
19	Morning rain showers	0.01”
18	Severe afternoon thunderstorms & rain, high temperature 87° F	0.51”
17	Morning mist, clear conditions afternoon	0.00”
16	Morning rain showers	0.24”
15	Hazy conditions with evening rain & mist	0.18”
14	Morning rain & mist	0.19”
13	Morning mist, evening rain	0.01”
12	Morning mist, afternoon light rain	0.02”
11	Rain showers & thunderstorms, high temperature 83° F	0.09”
10	Clear conditions	
9	Morning rain showers, mist & fog	0.18”
8	Rain & mist	0.36”
7	Clear conditions	
6	Morning rain showers	trace
5	Rain showers & thunderstorms	2.58”
4	Clear conditions, high 82° F	
3	Mist & haze, overcast day	
2	Rain showers & thunderstorms	0.66”
1	Dense fog & mist	0.00”
	Total rainfall	**15.64”**

Precipitation between July 26 through August 1, 2010

Date	Significant Weather	Rainfall
August 1	Clear with morning mist, high temperature 82° F	
July 31	Mostly cloud, rain showers, high temperature 78° F	Trace
30	Afternoon light rain showers, high temperature 78° F	Trace
29	Partly cloudy, high temperature 80° F	0.01
28	Thunderstorms, rain showers & mist, high 87° F	0.89”
27	Clear conditions, high temperature 84° F	
26	Clear conditions, high temperature 82° F	
	Total rainfall	0.90”

The NWS summary for Kellogg Airport indicated that there were 32 days of greater than 0.01" inches of precipitation during July and June 2010, with 14 days of thunderstorms. The total rainfall for July was 9.45" and for June was 6.21". The climatological data indicated that June and July 2010 were slightly warmer and wetter than normal, with 6 days with temperature of 90° F or higher. The greatest 24 hour rainfalls occurred between June 5-6 with 2.58", and July 22-23, 2010 with 3.44".

Figures 2 and 3 are the NWS maps of precipitation across the region for June and July respectively, and the mean departure from normal.

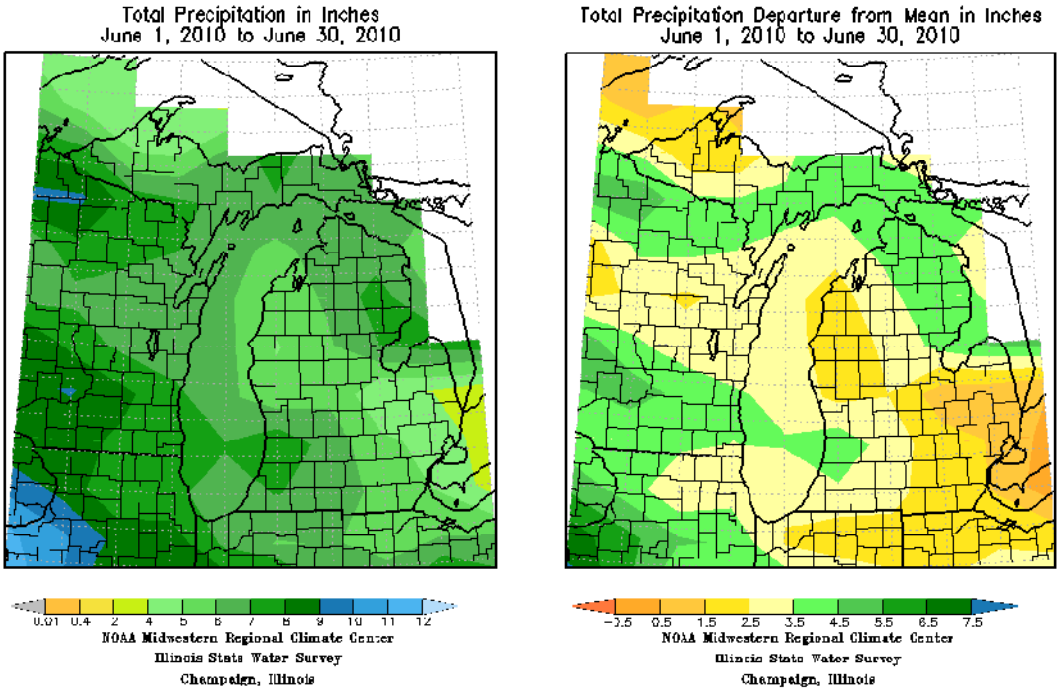


Figure 2 – June 2010 total precipitation and departure from normal

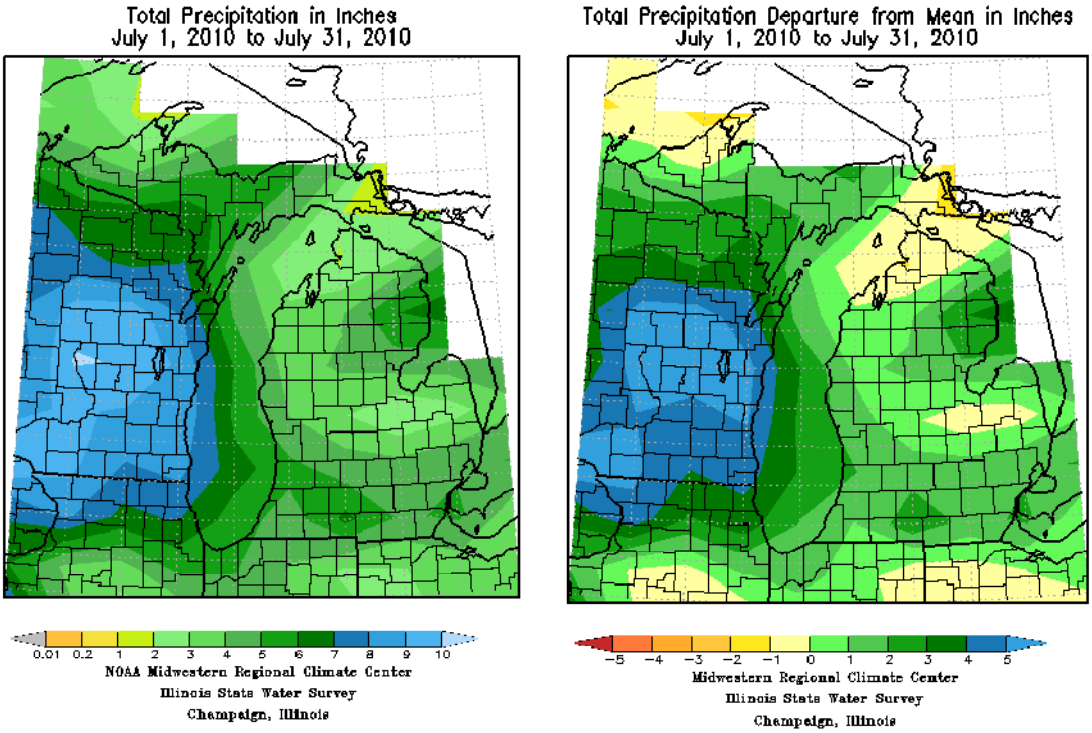


Figure 2 – July 2010 total precipitation and departure from normal

4.0 River Forecast

The NWS Grand Rapids, Michigan Weather Service Forecast Office (WSFO) issued their daily river stage summary at 0956 EDT which indicated the following:

Location	Flood Stage	Bankfull Stage	Observed Stage	Day/Time	24-hour change
Kalamazoo River					
Marshall	8.0 ft	6.0 ft	7.13 ft	Sun 07 am	0.61 ft
Battle Creek	9.0 ft	7.0 ft	5.42 ft	Sun 08 am	0.22 ft
Comstock	9.0 ft	7.0 ft	7.72 ft	Sun 07 am	1.64 ft
New Richmond	11.0 ft	9.0 ft	8.91 ft	Sun 07 am	0.39 ft

The river stage roundup for July 26, 2010 was as follows:

Location	Flood Stage	Bankfull Stage	Observed Stage	Day/Time	24-hour change
Kalamazoo River					
Marshall	8.0 ft	6.0 ft	7.28 ft	Mon 07a m	0.15ft
Battle Creek	9.0 ft	7.0 ft	5.80 ft	Mon 08 am	0.39 ft
Comstock	9.0 ft	7.0 ft	7.16 ft	Mon 08 am	-0.67 ft
New Richmond	11.0 ft	9.0 ft	9.05 ft	Mon 08 am	0.13 ft

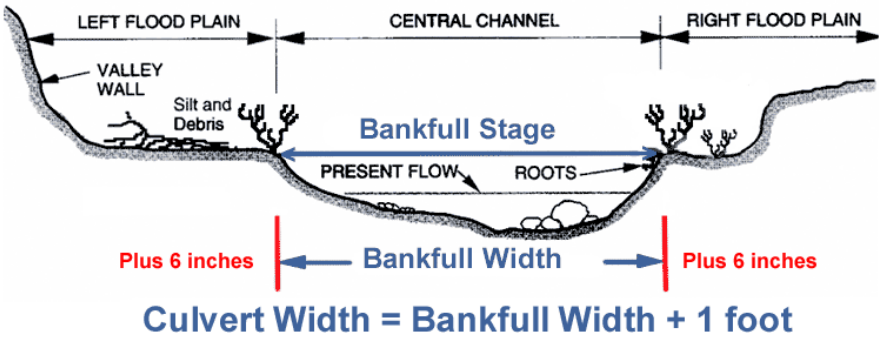
Definitions:

Flood Stage - A gage height at which a watercourse overtops its banks and begins to cause damage to any portion of the defined reach. Flood stage is usually higher than or equal to bankfull stage.

Bankfull Stage - An established river stage at a certain point along a river which is intended to represent the maximum safe water level which will not overflow the river banks or cause any significant damage within the reach of the river.

Observed stage - The observed level of the water surface above a given datum at a given location.

Travel time - The time required for a flood wave to travel from one location to a subsequent location downstream.



The river gages were at the following locations in Michigan:

Marshall – South Kalamazoo Avenue
Battle Creek – South Kendall Street
Comstock – River Street
New Richmond – 58th Street

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