Kalamazoo River\Enbridge Pipeline Spill 2010

March 17, 2011

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ABSTRACT

On July 26, 2010 Enbridge reported that approximately 19,500 barrels (819,000 gallons) of oil had been released from its ruptured oil pipeline near Marshall, Michigan to Talmadge Creek and the Kalamazoo River at a point approximately 80 miles upstream from Lake Michigan. Enbridge's 30-inch pipeline transported Cold Lake Crude Oil (with benzene diluent) from western Canada to refineries in Michigan and Ohio.

Over 2,000 responders (comprised of personnel from the United States Environmental Protection Agency [U.S. EPA], U.S. EPA contractors, other federal agencies, local agencies, state agencies, Enbridge and Enbridge contractors) worked to stop the flow of oil, contain and recover the released oil, and to prevent the spilled oil from reaching Lake Michigan. Eighty miles of shoreline and adjacent lands (e.g., overbank areas) were assessed and cleaned. Submerged oil was assessed and recovered at over 25 locations. Over 100 residents were displaced and relocated in response to air quality (benzene) concerns.

This manuscript describes some of the challenges of conducting response actions over a broad geographic scale quickly. This manuscript addresses organizational concepts beyond the basics of Incident Command System (ICS) and the technical, scientific and logistical considerations of managing an oil spill response that covered nearly forty miles of river (eighty miles of shoreline).

The response actions required (and continue to require) a delicate balance between cleaning a riverine environment and minimizing adverse impacts to the ecosystems and/or changing river dynamics.

INTRODUCTION

This Enbridge Oil Spill (EOS) response can be divided into two major components. The first component deals with organizational challenges and methods to achieve an effective and safe response. The second major component is related to the procedures that were employed to systematically evaluate and mitigate the adverse effects resulting from the spill.

Organizational Challenges

Maintaining open communications with the public was an essential component of the spill response at the EOS. During the response, informational meetings were, and continue to

be, held with the public to keep them apprised of the response. Additionally, U.S. EPA officials routinely met with concerned citizens to answer questions and address concerns.

Cleanup of a Delicate Riverine System

The EOS occurred following a significant rain event which approached that of a 50-year flood event, and which significantly increased the mobility and footprint of the released oil. As a result of the high water level in Talmadge Creek and the Kalamazoo River, the oil not only affected the creek and river channels, but was also transported and deposited on the waterway banks and ecologically sensitive overbank and floodplain areas. Pockets of oil were also deposited along the river bottom in areas of reduced water velocities (i.e. overflow channels, upstream of dams and spillways, and river delta).

In addition to the investigation of surface (surface soil and/or surface water) or near surface (shallow soil and/or sediment) impacts associated with the spill, a subsurface and groundwater investigation was designed and implemented to evaluate risks to potential receptors associated with groundwater use.

RESPONSE ORGANIZATION

The response management was organized using the ICS from July 26, 2010 through November 7, 2010, and the U.S. EPA served as the Federal On-Scene Coordinator (FOSC) during the response.

A Unified Command (UC) was employed early on during the EOS response, and was comprised of the following entities: U.S. EPA; Michigan Department of Natural Resources and the Environment (MDNRE); Michigan State Police; City of Battle Creek; Calhoun County Public Health Department; Calhoun County Emergency Management; Kalamazoo County Sheriff and Enbridge (the responsible party). In addition, there were 23 other cooperating and assisting agencies. The first Incident Command Post (ICP) was established at a local elementary school in Marshall, Michigan. In September 2010, the ICP was moved to a warehouse facility near the release site in Marshall, Michigan.

A Science Advisory Team (SAT) was established to provide recommendations to the UC regarding various response methods and objectives. The SAT was comprised of environmental representatives from federal, state and local stakeholder agencies and had the primary mission of making recommendations to the UC and to the FOSC to help guide oil recovery in a manner least damaging to the environment.

Following the completion of the majority of response work pursuant to an U.S. EPA Administrative Order (AO) issued to Enbridge, the response organizational structure changed to a project management mode in November 2010 (which was a period of limited response actions due to winter conditions) and continued through February 2011. Since February 2011, the response organizational structure has consisted of a scaled down command comprised of the U.S. EPA, MDNRE, and Enbridge, with periodic input provided from a Multi-Agency Coordination (MAC) Group comprised of the same entities as the earlier UC.

PROCEDURES TO EVALUATE AND MITIGATE THE ADVERSE EFFECTS

Surface Containment

Containment of the released oil was the first response priority. The 40 mile stretch of affected waterway was geographically subdivided into five operational elements:

Division A – a vegetated marsh from the pipeline release location to Talmadge Creek

Division B – Talmadge Creek (from the location where the released oil entered the creek) to the confluence of Talmadge Creek and the Kalamazoo River.

Division C – Kalamazoo River, between the Talmadge Creek confluence and Downtown Battle Creek.

Division D - Kalamazoo River, between downtown Battle Creek and the Calhoun County/Kalamazoo County Line.

Division E – Kalamazoo River, between the Calhoun County/Kalamazoo County Line and the Morrow Lake Dam.

As a precautionary measure, a contingency plan was developed for unimpacted portions of the Kalamazoo River, downstream of the Morrow Lake Dam. The plan contained response strategies for protecting Lake Michigan should containment efforts upstream of the Morrow Lake Dam fail to stop the oil. The contingency plan was prepared in cooperation with county officials from Kalamazoo and Allegan Counties.

Containment of released oil on the river/creek was performed concurrently with the removal of the section of ruptured pipeline and immediately adjacent oil-containing soils. Containment consisted of installing a series of underflow dams, weirs and containment boom between the spill site and Morrow Lake. At the peak of containment activities in August 2010, approximately 171,162 feet of boom (over 30 miles) were deployed in the river/creek system.

Shoreline Cleanup Assessment Technique

Shoreline Cleanup Assessment Technique (SCAT) teams were assembled to identify affected shorelines and to prescribe menus of response activities for oil removal on shorelines. Members from the regulatory agencies and Enbridge performed SCAT operations to systematically evaluate shorelines within 10 feet of the affected waterways for the presence of oil, oiled vegetation and/or oil-containing soils. The SCAT process used a five-step iterative process:

1. Initial SCAT inspection
2. Operational removal of oil/oiled-material using a SCAT response technique menu
3. Post removal inspection by Enbridge and the U.S. EPA
4. Final SCAT assessment
5. Approval from the U.S. EPA

SCAT inspectors were provided a uniform set of criteria for evaluating the shorelines. Similar to shorelines, overbank areas (i.e., more than 10 feet from an affected waterway's edge) were visually inspected for the presence of pooled oil or oiled vegetation. Inspections were performed daily by inspectors on the ground, as well as by aerial reconnaissance performed via helicopter during the response actions.

Removal options were then evaluated and implemented (if appropriate) for each affected overbank area where oil was observed. Removal response actions consisted of oil absorption, soil excavation, soil flushing (with recovery of the rinsate), and/or vegetation pruning or removal.

Surface Recovery

Oil collected in 40 containment areas along the system was removed using vacuum trucks, absorbent pads, motorized skimming devices and other skimming or recovery techniques. A mechanized vegetation removal device was used to harvest heavily oiled submerged vegetation in the Kalamazoo River. In addition to a massive labor campaign to manually remove oiled vegetation from the shorelines, heavily oil-saturated soils, particularly at the pipeline leak area (Division A) and along the 2 mile stretch of Talmadge Creek, were also excavated and disposed of off-site.

Submerged Oil Assessment and Removal

Oil released during the spill initially floated on top of the water. As the volatile fraction of the oil evaporated, the density of the oil became greater than that of water. As a result, the floating oil subsequently sank and remained submerged. Submerged oil was most prevalent in areas where the velocity of the surface water was reduced, enabling the settling and sinking of the oil.

The Kalamazoo River and Talmadge Creek were evaluated by fluvial geomorphologists to identify likely depositional areas. Approximately 35 locations were initially identified as priorities for further evaluation for the presence of submerged oil. Bathymetric evaluation of the waterways (including Morrow Lake) were performed using global positioning system (GPS) based survey methods to map the top of sediment, thereby providing another method of identifying potential depositional areas where submerged oil might be present. These areas were then assessed using poling techniques (e.g., probing), which yielded qualitative indications as to the presence of submerged oil. Cores of sediment were also collected for detailed physical inspection and laboratory analysis, thereby quantitatively evaluating the sediment for the presence of oil.

The final step in the evaluation of submerged oil included an ecological screening of each priority area where oil removal actions were deemed necessary. Results of the ecological screening were considered, in conjunction with the estimated quantity and potential exposure risk of the submerged oil, when determining the appropriate removal technique that would minimize the disturbance to the ecological system.

Submerged oil recovery actions were performed using both conventional and improvised techniques. The least invasive recovery method consisted of sediment flushing (using river water), sediment raking, and/or aeration to liberate the submerged oil and float it to the surface for subsequent recovery via absorbents or vacuuming. The second primary method of submerged oil recovery consisted of sediment dredging to remove 5,500 cubic yards of oil-containing sediment from the Kalamazoo River immediately upstream of Ceresco Dam (approximately 5.75 miles downstream of the release). During the dredging operations, over 14,000,000 gallons of water were removed from the Kalamazoo River, treated and returned back

to the river, under a National Pollutant Discharge Elimination System (NPDES) permit issued by the MDNRE.

Once the submerged oil had been removed to the extent practical, the affected area was reassessed using the aforementioned qualitative and/or quantitative evaluation.

Stabilization Efforts

After primary removal actions were completed, measures were implemented to restore the disturbed areas. Temporary measures to stabilize and minimize future erosion of the disturbed areas included the placement of organic mats, vegetative seeding, and the installation of semi-permanent erosion controls (e.g., coconut shell based rolls). The MDNRE has issued an order to Enbridge requiring restoration of the disturbed areas.

Transportation, Disposal and Decontamination

Soil, debris and liquids (oil and water) generated during the oil removal actions were managed at several constructed transportation and disposal (T&D) staging areas and disposed of off-site. Lined and bermed staging areas were constructed to temporarily store wastes while they were sampled/characterized for off-site disposal or recycling. Solids were placed directly into the lined/bermed areas, while liquid wastes were placed in fractionation storage tanks located within the lined and bermed staging areas. When necessary, solidification agents were mixed into wet soils to solidify the soils prior to loading and transportation for off-site disposal.

The types and quantities of wastes entering and leaving the T&D staging areas were recorded and documented on manifests. As of March 7, 2011, the following metrics summarize waste management.

Metric	Units	Quantity
Liquids disposed off-site as hazardous waste	gallons	3,595,404
Liquids disposed off-site as non-hazardous waste	gallons	9,611,363
Oil recovered and recycled	gallons	766,288
Soil disposed off-site	cubic yards	95,771
Debris disposed off-site as non-hazardous	tons	1,800
Debris disposed off-site as hazardous	cubic yards	12,075

Equipment, boom and boats using during the oil removal process were decontaminated prior to redeployment or decommissioning. Decontamination consisted of washing with biodegradable cleaning solutions, manual brushing and/or high-pressure washing. Rinsate from the decontamination process was containerized, characterized, staged and disposed of off-site, similar to other liquid wastes.

NATIONAL RESOURCE TRUSTEES CONSULTATION

Concurrent with containment and recovery actions, close consultation with national resource trustees ensured that any adverse effects were properly documented. The trustees also provided valuable ecological expertise for decision-making when evaluating response actions.

NATIVE AMERICAN TRIBAL CONSIDERATIONS

In early 2011, pursuant to U.S. EPA's request under the National Historic Preservation Act (NHPA), Enbridge submitted to U.S. EPA a study of the impacted waterways and adjacent lands which identified and evaluated any cultural, historic, or archeological sites, , within the response areas. U.S. EPA is currently reviewing the report and continuing to consult with Tribal Historic Preservation Officers and the Michigan Historic Preservation Offices to ensure that any historical or archaeological sites are being identified and appropriately protected during the oil spill response actions.

Apart from its responsibilities under the NHPA, U.S. EPA also initiated consultation with Tribal governments whose reservations are located near the spill area and whom U.S. EPA identified as having potential concerns about possible off-reservation impacts to their reservation environments or populations from the spill and response activities. U.S. EPA's consultation included briefing tribal government representatives about spill response activities, providing a fly-over of the spill and response activity sites, and providing an open channel of communications between the Tribes and U.S. EPA's regional office, via the U.S. EPA's Incident Commander**,** so that tribal concerns, such as impacts to off-reservation natural resources and on-reservation air quality could be immediately communicated, assessed, and addressed.

PUBLIC HEALTH, DRINKING WATER AND HYDROGEOLOGICAL STUDY

Protection of the public health was a primary objective during the entire response. An extensive air monitoring and sampling program was implemented with thousands of air monitoring data points and samples collected. Air monitoring was performed by both U.S. EPA and Enbridge contractors using real-time field instruments measuring volatile organic compounds (VOCs), benzene, lower explosive limit (LEL), and hydrogen sulfide. Air samples were also collected in Summa canisters and Tedlar bags for analysis of benzene and other VOCs by a mobile and/or fixed laboratory.

In response to concerns about air quality, Calhoun County issued a voluntary evacuation of residential areas along the most heavily impacted of the Talmadge Creek and Kalamazoo River. Residents were relocated to temporary housing while initial containment and recovery operations were conducted. Residents were allowed to reoccupy their homes after safe benzene levels were confirmed through the implementation of a robust air monitoring and sampling plan developed by the various public health agencies involved with the response.

Affected portions of the waterways were closed , and continue to be closed, to the public to limit potential exposure to the oil. A hydrogeological assessment near the Kalamazoo River was performed to determine the vertical and horizontal flow directions of groundwater near the affected waterways. The assessment included the installation, monitoring and sampling of groundwater from various locations along the Kalamazoo River. Drinking water wells identified near the affected waterways were placed into a systematic sampling program to evaluate for the presence of oil-related contaminants. The county health departments also issued a drinking water advisory for water wells located within 200 feet of the affected waterways. After the flow patterns near the waterways were determined and sampling confirmed that drinking water wells had not been contaminated, the county health departments lifted the restriction on the use of groundwater for drinking.

ONGOING OPERATIONS AND MAINTENANCE

O&M activities include supplemental monitoring, boom maintenance, continued sheen collection, and when necessary, additional response actions to address the presence of oil in or threatening navigable waterways. As of February 21, 2011, there were 101 individual locations where O&M activities are being performed.

A substantial component of the O&M activities includes removal of oil-containing soils in winter conditions. The cold weather and associated subsurface frost allows for access to remote and ecologically sensitive areas with much less adverse effects on the ecology than would occur if access were made during thawed or warmer conditions. Innovative and ecologically-friendly methods, such as driving frost, are being used to construct temporary access roads to remote areas.

The MDNRE has issued an order to Enbridge requiring assessment and remediation of affected areas using contaminant constituents.

CONCLUSIONS

There were many organizational, operational and logistical challenges encountered during this spill, which was the largest oil spill into navigable waters in history within the Midwestern United States. The lessons learned from this spill will certainly contribute to more effective response organization and recovery operations on future major releases.

The views expressed herein do not necessarily represent the views of U.S. EPA or the United States.