

Site Name: Crude Oil Spill Site
Location: Mayflower, Arkansas
Type of Site: Marsh environment
Contaminants of Concern: Crude oil–related sheens
Remedy: Reactive cap and in situ amendment placement
Current Site Status: Closed

Case Study Objectives: Present the basis of design and implementation approach for the mitigation action at the site affected by a crude oil release.

Site Description: The Crude Oil Spill Site (site) in Mayflower, Arkansas, consists of a cove, which receives surface water drainage from a nearby residential neighborhood. In March 2013, a breach in a pipeline resulted in release of crude oil near this residential neighborhood. An emergency response action implemented immediately after the release removed a substantial amount of the crude oil along with the crude oil–impacted vegetation in the western portion of the cove. The mitigation action was implemented at the following three subareas of the cove to address crude oil–related sheens:

- **Inlet Channel:** A 1,300-foot-long main channel between the highway and the Open Water Area of the cove
- **Open Water Area:** An approximately 4.5-acre open marsh and water area located between the Inlet Channel and the Heavily Vegetated Area
- **Heavily Vegetated Area:** An approximately 2-acre vegetated area located east of the Open Water Area, including several natural channels

Site Investigation and Conceptual Site Model Summary: An extensive environmental sampling program was implemented at the site that included collection of soil, sediment, and surface water samples from the areas downstream of the crude oil release and background locations. The laboratory analysis of these samples included crude oil–related constituents such as PAHs, VOCs, and metals. A refined ecological risk evaluation was completed using the data collected between March 2013 and February 2014, which indicated that no action was necessary to protect ecological populations at the site.

A sheen monitoring and sampling program was initiated in October 2013 to evaluate the presence of surface water sheens resulting from the low levels of residual crude oil in sediments within the cove. Based on the data evaluation, the limited areas with crude oil–related sheens appeared to be primarily located in the Inlet Channel and the Open Water Area. A predesign field study was completed at the site between March and April 2014 to confirm and refine the mitigation areas. The field study included sediment probing followed by sheen stir testing on sediment core samples to evaluate the horizontal and vertical extent of sheen-bearing material in the Inlet Channel, Open Water Area, and Heavily Vegetated Area.

Remedy Design and Construction: The RAO identified for the site was to mitigate surface water sheens related to crude oil from the release, to the extent technologically feasible. The RAO was developed based on the results from environmental sampling activities, a refined ecological risk evaluation, and sheen monitoring and sampling results. To meet the RAO, the selected remedy consisted of sediment removal and backfilling in the Inlet Channel, reactive capping in the Open Water Area, and in situ amendment placement in the Heavily Vegetated Area. These remedies were selected based on the varying amount of residual crude oil in sediments.

The following bench-scale tests was completed to determine the type and amount of organoclay to use in the reactive cap in the Open Water Area and to apply as amendment in the Heavily Vegetated Area:

- **Pore fluid saturation and core photography** to evaluate crude oil mass in the reactive capping and in situ amendment areas.

Remedy Design and Construction (continued):

- Reactive-media settling test to evaluate the settling rate and characteristics of select organoclay products available in the market and organoclay-sand mixtures.
- Organoclay sorption capacity test to estimate the mass of site-specific oil that could be sorbed by a specific mass of organoclay such that a sheen is not produced from the resulting material upon contact with water.

The bench-scale test results were evaluated and indicated that the reactive cap in the Open Water Area should include a 3-to-6-inch layer of clean sand mixed with organoclay and that in situ amendment in the Heavily Vegetated Area required placement of 1 pound of organoclay per square foot. Before material procurement, laboratory analysis of sand was completed to compare against the required criteria, and organoclay was tested for quaternary amine loading, oil sorption capacity, and bulk density.

Implementation of the mitigation action was completed between August and December 2014, as described below:

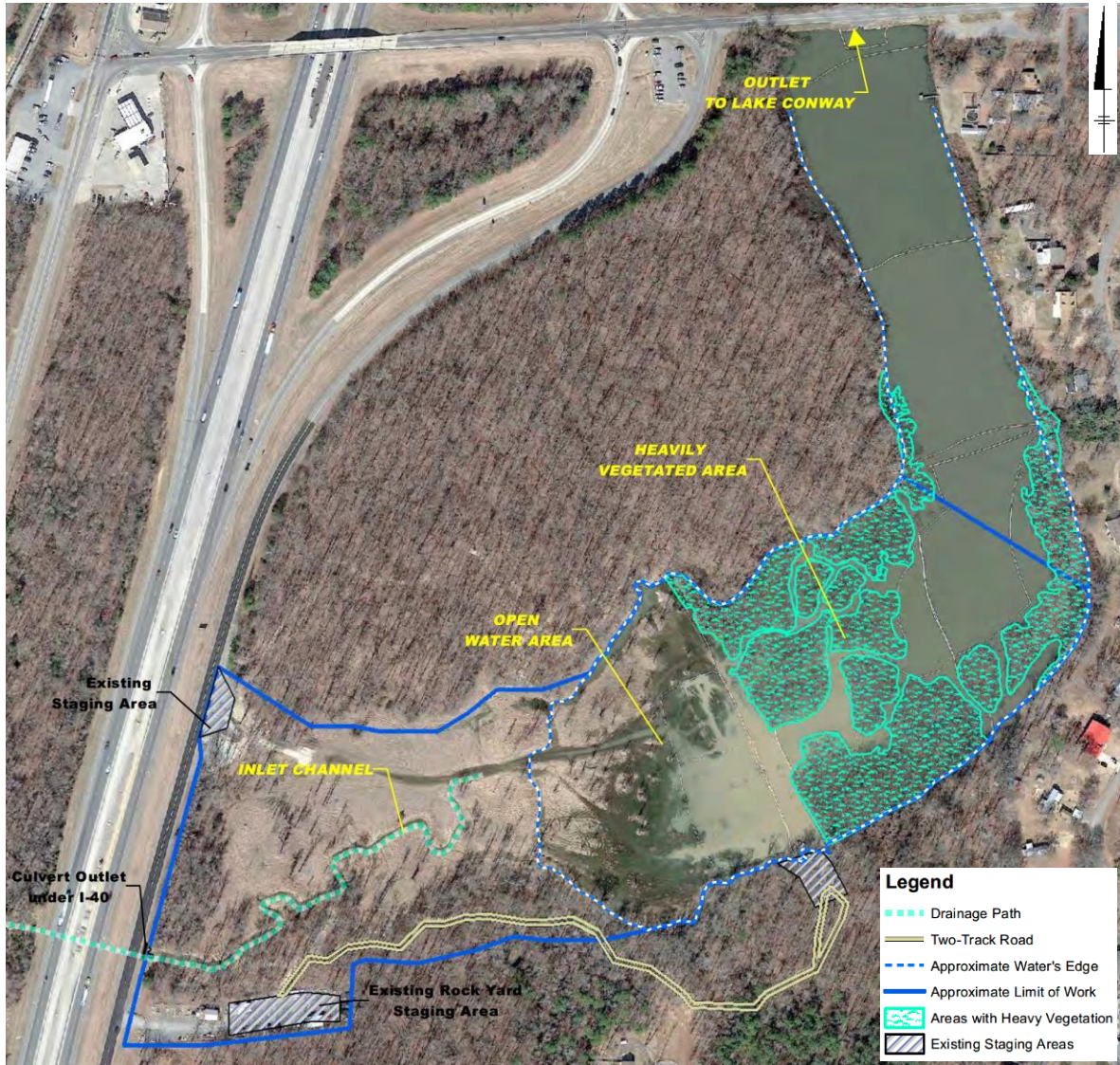
- Reactive capping: The reactive cap material placed in the Open Water Area consisted of a sand/organoclay layer of approximately 3 to 7 inches, with an average thickness of 3.6 inches. The reactive cap material was mixed using an open-top concrete mixing hopper placed at the staging area. The reactive cap material was placed directly on the sediment surface using an amphibious long-reach excavator equipped with a global positioning system to achieve uniform distribution of cap material. Layer thickness verification was completed using catch pans.
- In situ amendment placement: Approximately 47 tons of organoclay was placed using the amphibious excavator in the Heavily Vegetated Area. Organoclay was manually distributed from the airboat in two distinct small areas located near the banks. Amendment weight was verified to ensure that the application rate of 1 pound per square foot was achieved.
- Sampling and monitoring: Surface water sampling and sheen monitoring and sampling were completed during the construction activities.

Post-Remedy Monitoring: After implementation of the mitigation action, sheen monitoring continued at the site to visually observe the presence of surface water sheens. Select sheen samples were also collected for the laboratory analysis of PAHs and aliphatic and total petroleum hydrocarbons. The results of the sheen monitoring and sampling activities were used to assess the achievement of RAOs at the site and to identify additional maintenance activities required to mitigate crude oil-related surface water sheens. Maintenance activities were completed in 2015 and 2016 in the natural channels of the Heavily Vegetated Area. These activities included placement of additional organoclay directly over the sediment surface in small localized areas where repeated observations of crude oil-related sheens were documented. The sheen monitoring program was discontinued in December 2017 after crude oil-related sheens were not observed during a 7-month period (March through November 2017).

References:

- Arcadis. 2014a. Downstream Areas Data Assessment Report, Revision 5. Mayflower Pipeline Incident, Mayflower, Arkansas. March.
- Arcadis. 2014b. Mitigation Action Plan, Revision 1. Mayflower Pipeline Incident Response, Mayflower, Arkansas. June 26.
- Arcadis. 2015. Mitigation Action Completion Report, Revision 1. Mayflower Pipeline Incident Response, Mayflower, Arkansas. April 17.
- Arcadis. 2017. Discontinuation of Sheen Monitoring, Post-Construction Maintenance. Mayflower Pipeline Incident Response, Mayflower, Arkansas. December 14.

Figures/Photos (used with permission):



Site plan.



Typical crude oil-related sheen patch/streamer observed at the site.

Figures/Photos
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permission):



Reactive cap placement in the Open Water Area.



Placement of test catch pan in the Open Water Area.



Amendment placement in the Heavily Vegetated Area.