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Closed-loop drilling systems
- a cost-effective alternative to pits-

CASE 1: Comparing closed loop drilling to a conventional system: A tale of two wells (M-I Swaco Company)[1]

Closed-loop systems employ a suite of solids control equipment to minimize drilling fluid dilution and provide the economic handling of the drilling wastes. For one company, a typical closed-loop system includes a series of linear-motion shakers, mud cleaners and centrifuges followed by a dewatering system. The combination of equipment typically results in a "dry" location where a reserve pit is not required, used fluids are recycled, and solid wastes can be landfarmed, hauled off or injected downhole.

Two wells drilled only 200 ft apart in Matagorda Cty, TX, provided a unique opportunity to compare the costs between conventional solids-control equipment and the company's closed-loop system. Both wells drilled through the same formations, used the same rig crew, mud company and bit program.

The closed-loop system resulted in significant savings:

- 43% savings in drilling fluid costs
- 23% fewer rotating hours
- 33$ fewer days to drill to a comparable depth
- 37% reduction in the number of bits used
- up to 39% improvement in the rate of penetration

CASE 2: Reducing waste volume and costs using closed-loop systems (New Mexico Oil Conservation Division) [2]

Challenge— Challenges associated with conventional reserve pits include volume of drilling wastes; drill site installation and restoration costs; pollution of land and/or surface water due to failure of pits and/or containment system and associated cleanup costs; and potential for subsurface pollution due to downward migration from pits and/or surface soil permeability.

Solution— Use closed-drilling pit system to reduce volume of drilling waste. The drilling contractor maintained "safe pit levels" and recycled drilling fluid to

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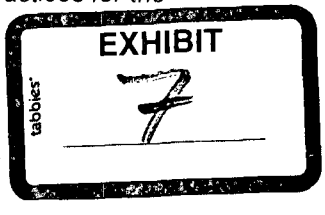
[1] M-I Swaco. "Swaco closed-loop systems: A tale of two wells." *This is Swaco.* http://www.miswaco.com/More_Info/About_Us/98131.pdf

[2] New Mexico Oil Conservation Division. *Pollution Prevention Best Management Practices for the New Mexico Oil and Gas Industry.* http://www.emnrd.state.nm.us/ocd/



minimize pit volumes and disposal requirements. Waste management costs due to procedures other than those specified were also the responsibility of the drilling contractor. Cost savings provided the incentive to implement and maintain proper procedures to minimize waste generation in the closed-loop system.

	Conventional reserve pit	**Closed-loop drilling fluid system**
Surface disturbance	• reserve pit (235' x 77' x 5') • cuttings pit (20' x 10' x 5') • water pit (40' x 10' x 5')	• no reserve pit necessary.
Total drilling mud and wastes in pits	• 16,625 barrels	• 1,100 barrels
	Total reduction in drilling mud and wastes using closed-loop system	15,625 barrels

Benefits— The following benefits were realized:

- Total estimated cost savings (considering reduced costs for drill site installation, fluid hauling and disposal, dirt work, and surface damage payment): $11,000.00
- Reduced surface disturbance by 18,000 square feet (0.4 acres).
- Reduced drilling mud and wastes in pits by 15,625 barrels.
- Reduced potential for environmental impact to surface and groundwater.

CASE 3: **Closed-loop system helps reduce drilling waste** (Oklahoma Department of Environmental Quality)[3]

A large oil and gas production company used a number of pollution prevention techniques, including closed loop drilling, to drill an exploratory well adjacent to the Tishomingo Wildlife Refuge in Johnston County, OK. The well was drilled on land owned by the U.S. Army Corps of Engineers. Some of the measures taken in drilling the well included:

- a closed-loop mud system that allowed for reuse of drilling fluids and smaller quantities of water for dilution of the mud to control viscosity and density
- compressed air as the drilling fluid where possible, which allowed for the use of smaller quantities of water and drilling fluid
- smaller casing, which allowed for the use of a 25% smaller hole. This generated a smaller volume of drill cuttings and required less drilling fluid

Savings and Benefits— The hole-size reduction, use of air drilling and closed-loop system reduced wastes by close to 1.5 million pounds. A material and disposal cost savings of $12,700 was achieved.

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[3] Oklahoma Department of Environmental Quality. *Pollution Prevention Case Studies.* http://www.deq.state.ok.us/CSDnew/P2/Casestudy/oxyusa%7E1.htm