# Containment and Stabilization of Subsurface Hydrocarbon Contamination Former Texaco Refinery - Casper, Wyoming

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Abstract: Two major containment/stabilization projects have been conducted at the former Texaco Refinery near Casper, Wyoming. The first was Texaco's ambitious four-year program to completely decommission and stabilize the 200-acre refinery site. This project involved removal of all refinery structures, including more than 200 miles of subsurface refinery piping, thousands of tons of concrete, and thousands of cubic yards of petroleum contaminated soils. The second project was installation of a state-of-the-art Waterloo Barrier® to provide reliable, long-term protection of surface water quality in the North Platte River. The river forms the northern, down-gradient border of the site and is highly valued as a regional water supply, fishery and recreational resource.

Both projects are complementary to Resource Conservation and Recovery Act (RCRA) Cleanup Reforms established by USEPA under the Government Performance and Results Act (GPRA) of 1993. The RCRA Cleanup Reforms are designed to stimulate progress toward a set of ambitious national cleanup goals to be achieved by the end of 2005. The cleanup goals focus on 1,712 RCRA facilities nation wide and are being monitored by USEPA and State Agencies using a set of Environmental Indicators (EIs). Under the current scope of the Cleanup Reforms, one of the EIs is a determination as to whether a facility has "migration of contaminated groundwater under control." Both of these projects were instrumental in the facility's achievement of a positive EI determination under that category. The Wyoming Department of Environmental Quality (WDEQ) is the lead regulatory agency for RCRA corrective action at the facility; USEPA's role has been to provide oversight and technical assistance.

Both projects also helped to inspire formation of a new Remediation Technology Development Forum (RTDF) supported by USEPA's Technology Innovation Office. The RTDF is called the Non-Aqueous Phase Liquid (NAPL) Cleanup Alliance. The goal of the Alliance is to develop improved scientific and regulatory approaches to remediation of groundwater and soils at large, complex sites contaminated by petroleum hydrocarbons. The Alliance will create and test an improved decision-making framework, using scientific principles and innovative technologies, to attain cleanup goals acceptable to regulatory and public interests. The Texaco Casper Refinery is the first member site of the Alliance.

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Texaco's voluntary program to decommission the former refinery began in mid 1996 and was completed in 2000. This project was the first major phase of Texaco's overall efforts to stabilize the site and eliminate sources of environmental contamination. During the planning phase, Texaco worked closely with the Wyoming Department of Environmental Quality to develop creative programs to identify, isolate and remove all subsurface refinery components, including piping, concrete structures and other potential contaminant sources. Texaco also developed and dovetailed in a program to identify, field screen, and remove petroleum contaminated soils that met certain criteria, thus providing added measures of risk reduction to human health and the environment.

The program commenced with review of refinery drawings, piping location maps and aerial photos to identify known and suspected subsurface piping and structures throughout the refinery. This information was compiled into a Geographic Information System to increase its utility. Field inspections and exploratory excavations were then conducted to verify piping and structure locations, determine if structures contained fluids, determine the presence of petroleum-contaminated soils, evaluate excavation side-wall stability, and identify other conditions that could influence isolation and removal activities.

Initial removal activities frequently required deployment of vacuum trucks, liquid containment devices and special cold-cutting tools to isolate and remove the contents of subsurface piping and structures. Hot and cold cutting tools, track-mounted shears, track-mounted demolition hammers, and conventional excavators were then used to completely expose and remove all target structures. Much of the piping larger than three-inch diameter was carefully removed in segments up to 40 feet long, processed, sorted by size and type, and then delivered for reconditioning and resale to used piping suppliers. Other metal materials were processed and segregated for recycling. Subsurface concrete structures were excavated, broken up, removed, and crushed into gravel aggregate for beneficial reuse on-site. More than 200 miles of piping and 100,000 tons of concrete were removed.

Following removal of piping and structures, resulting excavations were inspected for petroleum-contaminated soils (PCS) and other contaminants. If identified, such materials were flagged and evaluated using qualitative and/or quantitative field screening criteria. Texaco used results of these evaluations to determine if the soils should be immediately removed or surveyed, documented and left in place for potential future remediation. Texaco removed approximately 90,000 cubic yards of PCS during this phase of the project.

Completion of the subsurface project involved filling and grading of completed excavations, followed by a three-step structure removal verification program. Conventional excavating equipment was first used to conduct deep cross-trenching at angles to prevailing piping corridors to identify structures that may have been missed. A cross-ripping program was then implemented to provide further "fence-to-fence" verification. Finally, electromagnetic surveys were conducted to locate, identify and remove selected remaining metal and metal-containing objects. The majority of items identified and removed during these steps were small pieces of piping, scrap metal, concrete rubble, re-bar and other demolition debris.

Texaco's efforts to stabilize the site and contain residual groundwater contaminants culminated with installation of the steel sheet piling barrier wall. Texaco began the barrier

design process with a feasibility study in late 1997. Key objectives of the study were to select the design barrier alignment and evaluate various barrier technologies to determine which would be best suited to accomplish project objectives. Results of the study indicated that the barrier alignment would need to encroach into the main channel of the river by as much as 50 feet in order to maximize its effectiveness. Considering this design element, Texaco evaluated a number of barrier technologies including conventional steel sheet piling, several types of synthetic materials and various slurry wall technologies. In addition, Texaco conducted groundwater modeling to evaluate hydraulic effects that the barrier could have on groundwater flow within and around the project. Results of the study indicated that Waterloo Barrier®, a patented form of steel sheet piling with sealed joints, would provide the most effective solution, and that Texaco would be able to successfully manage changes in groundwater hydraulics associated with the anticipated barrier design.

Waterloo Barrier® is similar to conventional steel sheet piling with respect to basic design and shares the same installation advantages in near-shore and off-shore applications. However, the patented joint and foot-plate features of Waterloo Barrier® allow each joint to be individually cleaned and inspected. These capabilities provide the highest level of quality assurance and integrity verification available among the barrier types considered. Following cleaning and quality assurance inspections, a pressure grouting system is used to individually seal each joint from bedrock to surface.

Because the design barrier alignment significantly encroached into the main channel of the river, a number of challenging design and construction elements had to be carefully investigated and addressed. Most important were preservation of the flood conveyance capacity of the river and mitigation of fringe wetlands that would be disturbed. Government entities involved with design and permitting included the WDEQ, USEPA, US Army Corps of Engineers, the Bureau of Reclamation, the Wyoming Game and Fish Department, Natrona County and the cities of Evansville and Casper. Texaco's development of a healthy public relations program was also a key component of the project success.

The barrier construction project commenced during mid July 1999 and was completed by the end of December, within the original schedule. The barrier completely penetrates the alluvial aquifer and is pressure grouted into bedrock at depths of 10 to 40 feet below ground surface along its entire alignment. With an overall length of 3,400 feet and surface area of more than 87,000 square feet, it is one of the largest of its kind in the world.

Combined, the refinery decommissioning program and barrier project have fully achieved Texaco's and WDEQ's shared objective to stabilize the site, provide containment of contaminated groundwater and progress toward full achievement of positive EI determinations. Texaco and WDEQ are in the planning and permitting process for future corrective actions and are seeking long-term remedies consistent with their goals, public interests and future land use.