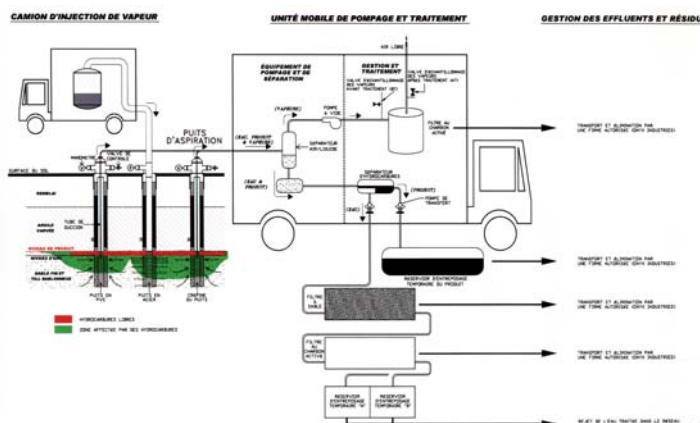


## PROJECT DESCRIPTION

<input checked="" type="checkbox"/> <b>Characterization</b>	<input checked="" type="checkbox"/> <b>Restoration</b>	<input checked="" type="checkbox"/> <b>Hydrogeology</b>	<input checked="" type="checkbox"/> <b>Modeling</b>	<input type="checkbox"/> Risk Analysis
<input type="checkbox"/> Water Management and Treatment	<input checked="" type="checkbox"/> <b>Research and Development</b>			

## LNAPL VACUUM EXTRACTION, IN SITU CHEMICAL OXIDATION AND BIOAUGMENTATION

<b>Parameters of Concern</b>	Petroleum hydrocarbons, BTEX
<b>Project Duration</b>	1 year
<b>Performance :</b>	LNAPL recovery and significant reduction of dissolved petroleum hydrocarbon
<b>Cost:</b>	568 000 \$
<b>Client :</b>	Industrial site



### Issue

Following the detection of hydrocarbon odors in a private water well, environmental characterization studies completed in a commercial/residential area in Rouyn-Noranda, revealed petroleum hydrocarbon concentrations exceeding the Quebec Ministry of Environment criteria, over an area of approximately 3,500 m<sup>2</sup>. Moreover, free phase hydrocarbons (LNAPL), with an apparent thickness of up to 4 m, was observed in the confined aquifer (till) in two separate zones of the same area. The environmental studies revealed that the main source of petroleum hydrocarbons (diesel) was a former fuel storage installation at the site company of A. de la Chevrotière Company, located northeast of the impacted zone.

### Work Performed

Different rehabilitation technologies among the most aggressive and efficient were selected to rapidly reduce the initial hydrocarbon concentrations to favor the reduction of residual concentrations by natural processes. The rehabilitation program included: 1) complementary characterization work to better delineate the contamination plume, 2) the installation of recovery and injection wells, 3) the vacuum extraction of LNAPL, 4) the in situ treatment of soil and groundwater by chemical oxidation and bioaugmentation, and 5) the monitoring and mathematical modeling of the natural attenuation of residual hydrocarbons. The treatment activities included the injection of hydrogen peroxide, inorganic nutrients and a specialized bacteria consortium. Monitoring activities included the measurements of groundwater level and physico-chemical parameters, as well as groundwater analysis for a series of inorganic, organic and biologic parameters.

### Results

A total of 34,000 liters of LNAPL was recovered by vacuum pumping and 400,000 liters of impacted groundwater were treated. Following the pumping and treatment operation, the LNAPL apparent thickness was reduced by 92 to 100%. However, residual hydrocarbons are still present at a few locations with restricted access (underneath buildings and main road, around underground gas transport facilities, etc.). In situ chemical oxidation and bioaugmentation work resulted in 94% reduction of petroleum hydrocarbon concentrations in the most affected wells. The evolution of residual hydrocarbons was modeled through time in taking into account the contribution of natural attenuation processes. The results of the groundwater monitoring and modeling indicated that natural attenuation processes are active and contribute to degrade residual contamination still present at the site.