

## **In-situ treatment of a hydrocarbon spill in Vienna with Bioversal**

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A pipe from a heating oil tank of an international transport company at a railway yard in Vienna leaked over many years. The oil spill was first discovered in 1999 upon investigation for final measures before removing the tank. Since 1999 a conventional pump and treat system was in place. During this years a mass of approximately 20.000 kg of hydrocarbons (in liquid phase) was recovered and disposed off properly.

In 2003 the Authorities were concerned that due to the construction of a new subway line nearby the groundwater table had to be lowered considerably. Not only would this most probably contaminate the deeper soil matrix but also due to a change in the direction of groundwater flow would bring a shift in the direction of the plume.

We (Donauconsult Zottl & Erber, Professional Consulting Engineers in Vienna) were hired by the WIENER LINIEN in late Spring of 2003 for our experience in connection with other major site remediation projects for the city of Vienna (Zentraltanklager Lobau, Siebenhirten, Mobil-Breitenlee, Gaswerk Simmering, etc.).

After careful consideration and discussion of many different alternative solutions with the proper authorities (MA 45 – Water Resources Department; MA 29 – Soil Mechanics Department) and the client (Wiener Linien) a first time application of a biotensid (BIOVERSAL) for the restoration of groundwater was allowed to take place. The plume, which was investigated carefully with several borings and chemical analysis extended about 70 m downstream, 30 to 40 m lateral and reached a depth of about 7 m below surface. Most of the plume was located under a storage and shipping facility, which was fully operating. An evacuation or shut down of the business was infeasible.

With the existing conventional pump and treat installation no more heating oil could be recovered and the first conclusion was, that the subsoil is clean. However, from the investigation of the soil matrix (samples from the borings) it was clear, that a layer of 0.5 to about 1.5 m of aquifer was still contaminated with a content of up to 5000 mg of hydrocarbons per kg dry substance. The contamination was concentrated particularly in the zone of the amplitude of the groundwater table. A pumping test at different extraction rates was conducted to determine the radius of influence of the pumping well.

Between the effective lowering of the groundwater table due to the construction of the subway and the beginning of the groundwater cleanup only less than 3 month were left. Since there was no time to be spared some of the existing installation parts were reused in the cleanup effort. The pumps and pipes as well as the oil-water-separators were recycled. A new activated carbon filter with a usable content of approximately 2 m<sup>3</sup> was installed. During the

discussion and preparation period the groundwater table kept on sinking steadily. Therefore we were not able to clean up the entire contaminated zone. It has been agreed with the client that after the subway line has been finished within the next 3 years, another cleanup effort will take place, but at a much higher groundwater table.

It has been determined that the immediate cleanup effort will take place in 2 phases each lasting 2 weeks and a final observation period over several weeks till the groundwater level has dropped below the lower edge of the contaminated zone.

After a careful selection process for a proper tenside together with the authorities the highly effective biodegradable surfactant BIOVERSAL has been chosen. The volume of the contaminated soil was estimated to be approximately 4 000 m<sup>3</sup>. Because a large part of the contamination has been removed already within the past years the recommendation was, to use only about 0.1 l of concentrated surfactant per m<sup>3</sup> of soil. It turned out that this amount was quite sufficient to mobilize and then remove a considerable amount of hydrocarbons.

On the first day in Phase I 200 l Bioversal HC diluted as a 1 % solution were injected in a short time in 3 wells around the original center of the contamination (close to the old leak). After that water was pumped out of the center well at a rate of about 3 l/s. The treated groundwater (AC-filter) was re-injected in an up-stream well. An Oil-water mixture was recovered and treated separately at a water-oil separator. The effluent of the separator was discharged to the sewer system. This pump and treat operation with the enhancement of a surfactant took two weeks.

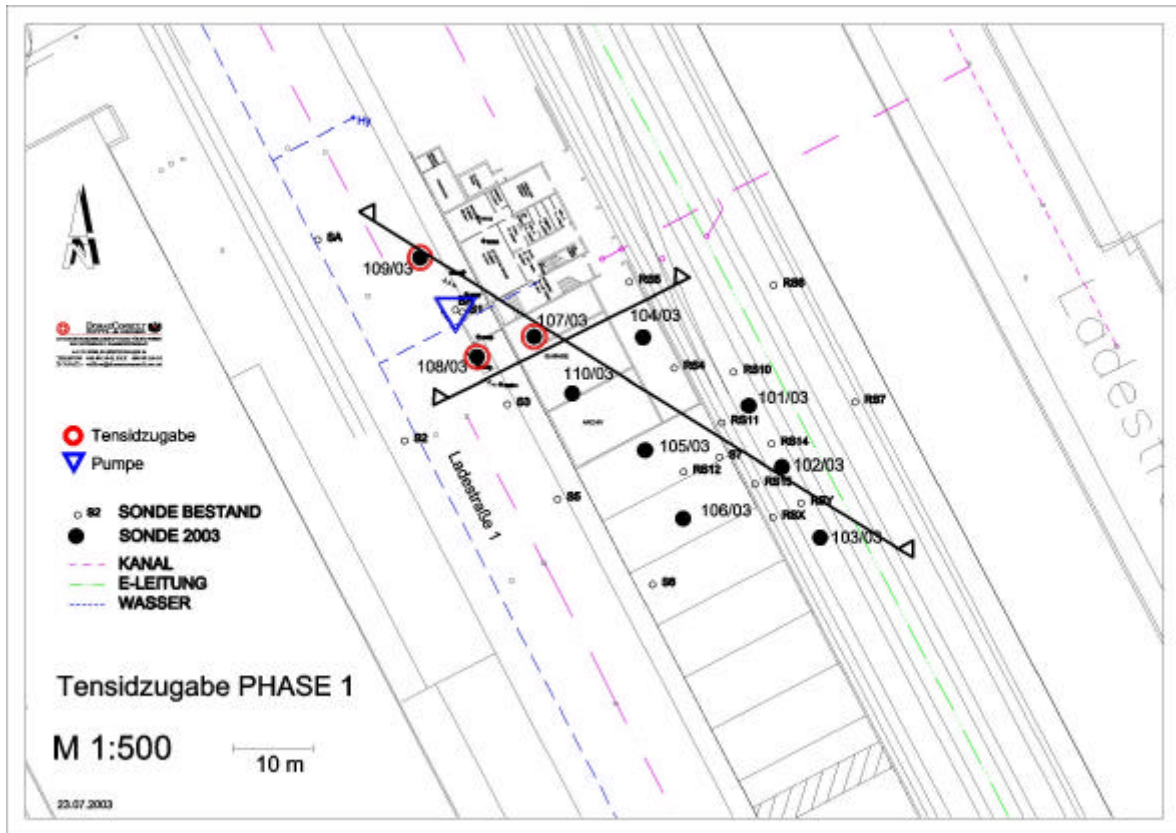
After 2 weeks phase II started. The pump was removed and placed in a well which was considered to be at the heart of the current plume. Again 200 l of Bioversal HC diluted as a 1 % solution were introduced to the groundwater via 5 different surrounding wells. The extraction rate was kept at approximately 3 l/s and the pumped water was again after treatment re-injected in the same upstream well.

Within this 4 weeks the groundwater table was falling at a rate of 5 cm a week. Although this condition was not in favor to recover more hydrocarbons approximately 600 kg of oil in free phase were recovered and properly disposed off. It demonstrates that through the introduction of the surfactant a dramatic increase of recoverable hydrocarbon took place. A few weeks before the introduction of the new scheme no free phase could be recovered with the traditional pump and treat system.

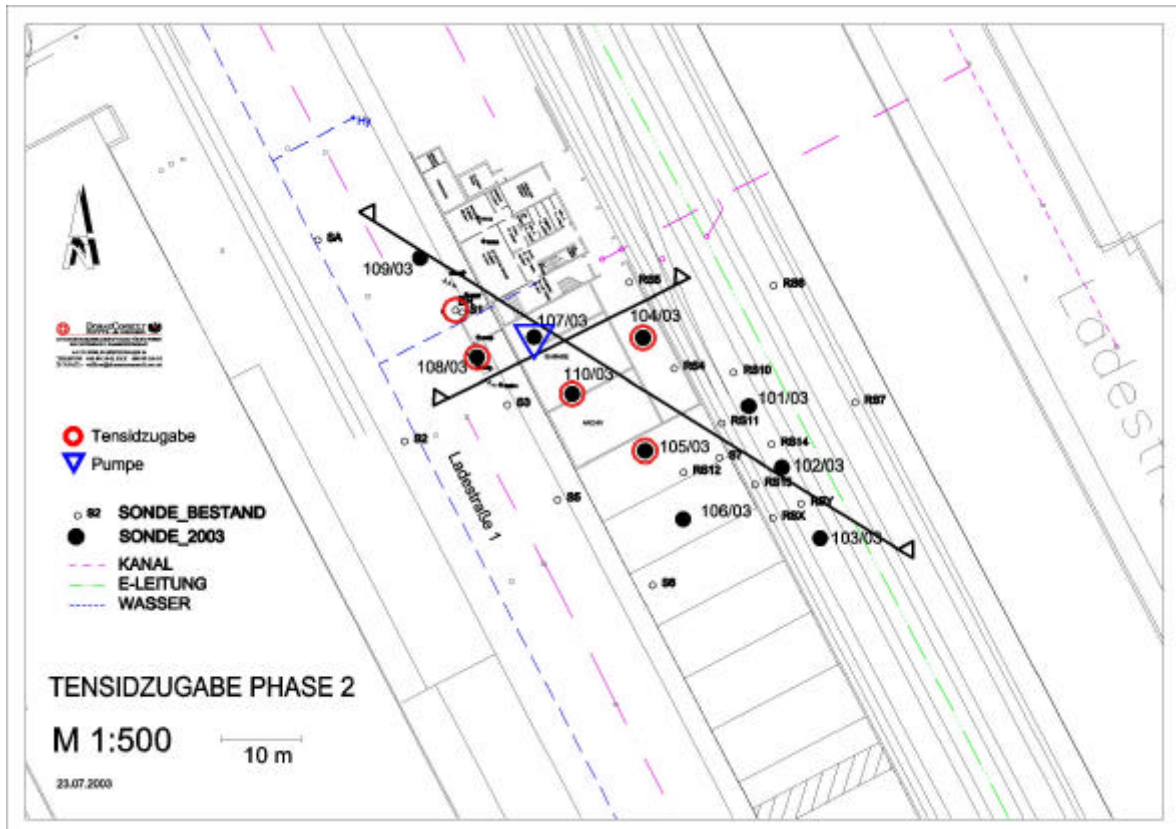
The success of a groundwater clean-up effort depends strongly on the hydro-geological conditions (gravel or sandy aquifers), the type of contaminant and the used surfactant (biodegradability of BIOVERSAL was essential) and on the stage or amplitude of the groundwater level.

We have been supported during the cleanup effort by our client, the authorities, the international removal company and the representatives of BIOVERSAL in Austria.

Phase I:



Phase 2:



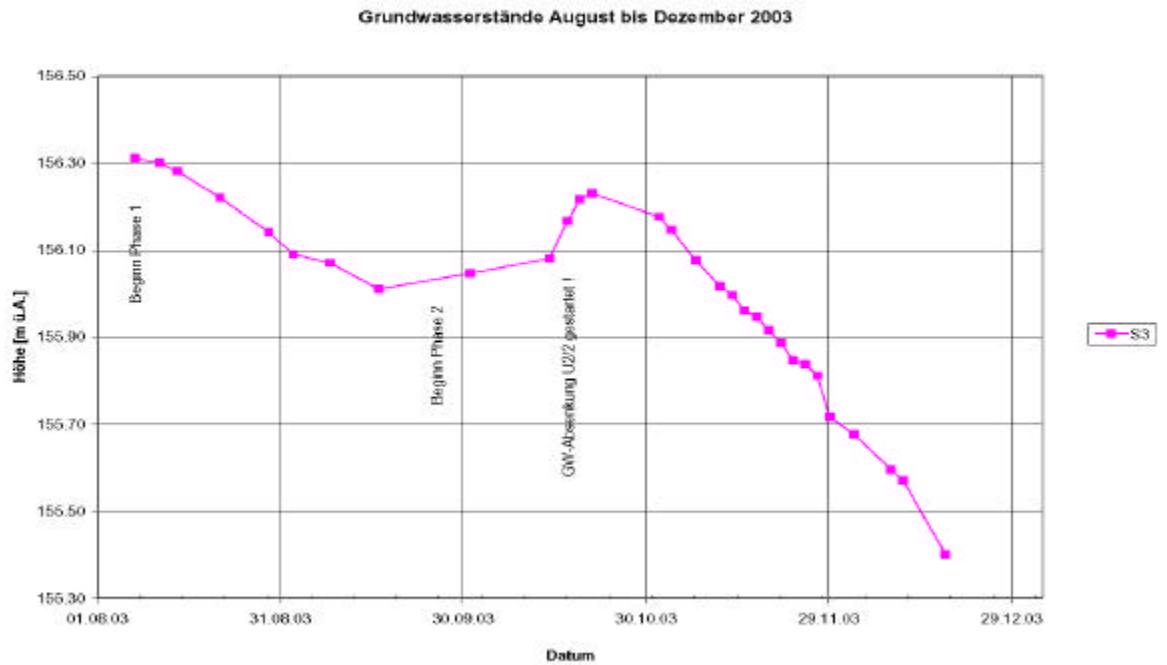
Bioversal 1 % solution is injected into a well:



View of the site (pumping well left; AC-filter in the background):



Continuously falling groundwater table (final weeks due to pumping for the subway line):



Effect of surfactant measured in 1 well (increase of surfactant, increase of hydrocarbon concentration):

