

## Sustainable Management of a Former Waste Disposal Area

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**Background/Objectives.** An area located in the State of Minas Gerais, Brazil, was used between 1960 and 1980 for the disposal of waste streams (iron slag, tar residue, oil sludge, foundry sand and debris) originating from a steel factory. Since 1980, the site has been used as a sports center in a residential neighborhood. In the last 6 years, this area has remained totally disabled, due to the execution of environmental investigation activities. In order to allow the occupation of the area as a sports center, the initial remediation concept considered the following actions: waste removal from the vadose zone up to 2 mbgs for the elimination of a potential risk to human health; solidification/stabilization of the oil sludge in the saturated zone (from 2 mbgs to 8 mbgs) to confine the chemicals of concern; and in situ chemical oxidation to reduce the benzene concentrations in the aquifer. However, with the advancement of the environmental site assessment over time, it was possible to improve the conceptual site model of the former waste disposal area, providing subsidies for the construction of a new sustainable site management strategy, based mainly on the implementation of institutional controls associated with monitoring activities.

**Approach/Activities.** Over the past 3 years several environmental site assessment efforts and biannual monitoring campaigns were conducted, in addition to the completion of a human health risk assessment, mathematical modelling and remediation tests (in situ chemical oxidation tests and solidification/stabilization feasibility studies).

The results indicated that the industrial waste disposal pattern was random, in heterogeneous layers from the surface up to the depth of 8 mbgs. The oil sludge is present mostly between 6-8 mbgs. The impacts identified in the soil are related to the waste disposal, being the waste streams characterized by the presence of aromatic hydrocarbons and polycyclic aromatic hydrocarbons. Impacted soil and industrial waste from the vadose zone which posed potential risks to human health were removed by mechanical excavations.

In the shallow aquifer, benzene concentrations above the legal reference levels prevail, in the region where the higher concentrations were observed at the beginning of the environmental site assessment. The mathematical model indicated that the benzene concentrations tend to remain stable and restricted to the areas of their known occurrence. Due to the low hydraulic gradient and to the low flow velocity of the groundwater (3 m/year), benzene does not move significantly in the area and no offsite migration is observed, as shown by the results of the regular groundwater monitoring campaigns.

**Results/Lessons Learned.** Through the advancement of the environmental site assessment, it was possible to conclude that the concentrations of the chemicals of concern are in equilibrium with the aquifer, and that actions that break this equilibrium result in the release of these compounds into the groundwater. Thus, no further remediation actions were recommended, since the remaining benzene dissolved concentrations did not indicate potential unacceptable risks to human health for the sports center scenario. The new site management strategy allowed the reoccupation of the area, based on institutional controls, i.e. occupation restrictions and groundwater monitoring program, which were approved by the environmental authorities. Therefore, economic and environmental gains were obtained, since it was possible to avoid remediation actions at the remaining contamination sources, which would comprise high complexity civil works (shoring systems, groundwater table lowering), generation of significant

amounts of waste and contaminated groundwater, and disturbance in the neighborhood (nuisance odors, noise and heavy traffic).