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TechData Sheet

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Determination of the Ecological Risk Associated With a Plume of MTBE at NCBC, Port Hueneme, California

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WHAT IS METHYL *TERT*-BUTYL ETHER?

Methyl *tert*-butyl ether (MTBE) is a gasoline additive that is used in many states to lower emissions of carbon monoxide (CO) by chemically converting it to carbon dioxide. The effectiveness of MTBE and other fuel oxygenates lies in increasing the oxygen content of the fuel, therefore, allowing more complete combustion. As a result of using federally mandated oxygenates, like MTBE, reductions in CO emissions have been detected in many urban areas.

When released to the subsurface environment through a gasoline spill or leaking underground storage tank (UST), MTBE can migrate rapidly through an aquifer. The primary reasons for this rapid migration is its high solubility in water and tendency to resist biodegradation. Once it has entered the groundwater, it can reach surface or coastal waters and eventually impact aquatic organisms.

MTBE2000 PROJECT

The MTBE2000 Team was created in an attempt to quantify the ecological risk associated with a gasoline and MTBE release at the Naval Construction Battalion Center (NCBC), Port Hueneme, California. The MTBE2000 project consists primarily of an Ecological Risk Assessment (ERA), which is focused on the threat that the presence of MTBE poses to the local organisms and ecosystems surrounding the underground plume. Currently, the plume is approximately 4,575 feet long and encompasses an area of 45 acres (see Figure 1). The MTBE2000 project will also examine the effects that MTBE might have at similar oxygenated fuel spill sites that are less developed and industrialized than at Port Hueneme.

Project Development

A preliminary ecological risk screening was conducted at the Port Hueneme site in the summer of 1998. This study determined that there was little or no ecological risk associated with the existing plume because MTBE concentrations were low and exposure routes limited. According to Environmental Protection Agency (EPA) guidelines, an ERA should be undertaken when a risk screening determines that there is a need. Although the preliminary screening did not suggest a need for a full ERA, the dynamic nature of the plume and the extreme temporal variation in MTBE levels observed lead the Navy to pursue one. This forward-looking decision may stem from the fact that as the plume migrates closer

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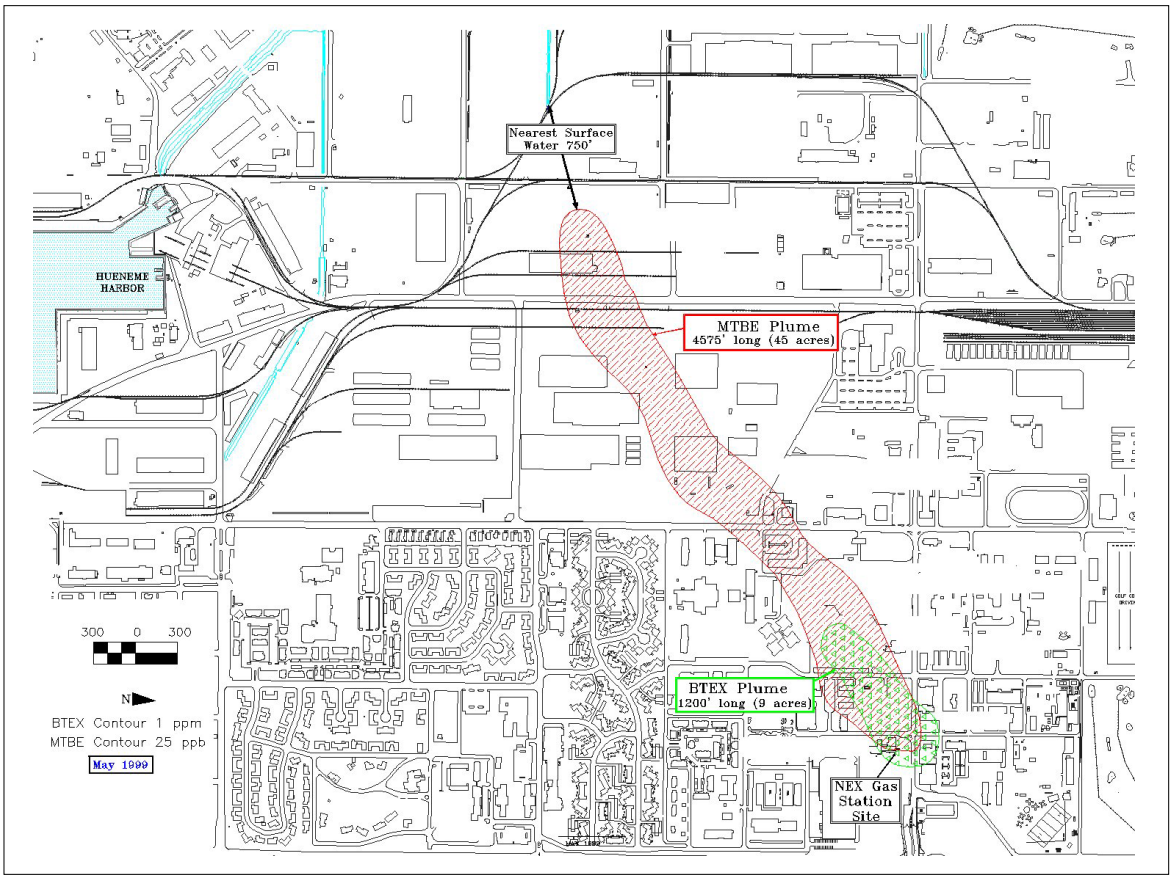

Figure 1. Naval Exchange MTBE plume.

towards the ocean, groundwater mechanics start being influenced by tidal action that may further smear the plume toe and expose it to a more direct marine exposure route.

Experimental Analysis

To better understand the ecological risk associated with the plume, the MTBE2000 Team searched for information relating MTBE levels to the health of soil microbes and found a lack of pertinent data. The MTBE2000 Team decided to perform an assay to determine the relationship between MTBE concentrations and groundwater toxicity. To fulfill this goal, the MTBE2000 Team used the Microtox™ Acute Toxicity Test to analyze the groundwater associated with an MTBE leak at the NCBC, Port Hueneme, California.

The MTBE2000 Team selected the Microtox™ method of testing acute toxicity due to its ease of use, reliability, and precision. Comparison of Microtox™ tests and other aquatic toxicity bioassays shows that the Microtox™ test produces consistently robust results and has been identified as the "best available choice" for conducting toxicity screenings and assessments in a timely manner.

The Microtox™ analysis will provide information critical to the MTBE2000 ERA project by rendering general toxicity data that is currently unavailable (see Figure 2). The biological assay will also prove a useful tool for estimating the toxicity effects that the migrating MTBE plume may eventually have on marine organisms as the plume reaches the Hueneme Harbor.

Experimental Design

The plume has been divided into four distinct regions (see Figure 3). The first region is the area that is referred to as the head or source area of the plume at the Naval Exchange (NEX) gasoline station, where the leak originally occurred. This region has the highest MTBE concentrations and is additionally contaminated with gasoline (the benzene, toluene, ethyl benzene, xylene (BTEX) compounds). The second region is the middle section of the plume. The third region, the toe of the plume or the farthest down gradient region from the NEX station, should prove especially interesting as

MTBE levels and toxicity findings change between sampling events. There will be four samples taken from each of these three regions. A fourth region is a storm drain system; the storm drain system intersects the water table. MTBE has been recently detected in the system, possibly accelerating the transport of MTBE toward the harbor via stormwater channels and associated wetlands. Findings in this region will provide knowledge about the most immediate toxicity risk to the marine and fresh water communities. Samples will be taken from different sites along the drainage system outflow. The sampling locations within Region Four will be used: one where the storm drain is in contact with the plume, another at the approximate toe of the plume, and one at the drainage system outfall.

Sampling events have been scheduled for July, August, and September of 1999. A Hydrolab™ is used to collect groundwater samples and obtain field groundwater chemistry measurements (see Figure 4). Field measurements include pH, temperature (°C), Redox (mV), conductivity (mS/cm), and DO (mg/l), as well as water table elevation.

Results

The Microtox™ results will be analyzed in order to provide a comprehensive toxicity analysis, which will include but not limited to the toxicity of MTBE in the groundwater. The results will be analyzed addressing four goals:

1. Spatial examinations to see how toxicity results compare with known MTBE concentrations down the plume.

2. Outlier examinations to find out why suspiciously high or low toxicity measurements have been detected. Reasons could include traveling BTEX or the presence of unexpected chemicals.

Figure 2. Microtox™ instrumentation for bioassays.

3. Temporal examination to determine how toxicity results change as the plume migrates downgradient and MTBE concentration changes.

4. An extrapolation of the general Microtox™ toxicity findings to include known relationships with flora and fauna at Port Hueneme and at other potentially affected locations.

SUMMARY

The MTBE2000 Team will perform and complete an ERA for the MTBE plume at Port Hueneme by March of 2000. This study will provide a holistic examination of the risk associated with the presence of MTBE at the Port Hueneme site and of similar leaks in other regions.

Funding for the MTBE2000 Team research at Port Hueneme is from the University of California Toxic Substances and Teaching Project and on-site support is from the Strategic Environmental Research and Development Program's National Environmental Technology Test Site (NETTS), Port Hueneme.

For more information about the MTBE2000 Team, the ERA or Microtox™, test procedures, and findings, contact:

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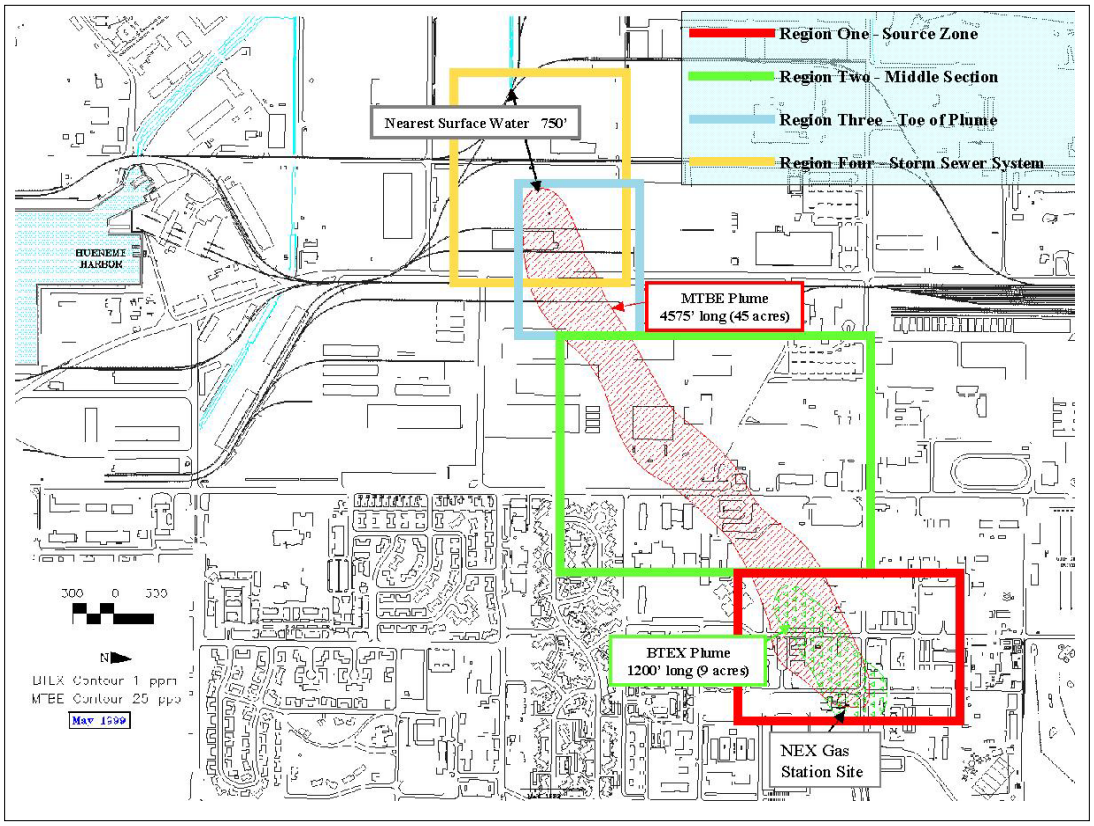

Figure 3. Three eco-risk screening sampling regions and storm drainage system location.

Figure 4. Hydrolab™ for collecting groundwater samples and obtaining water chemistry measurements.