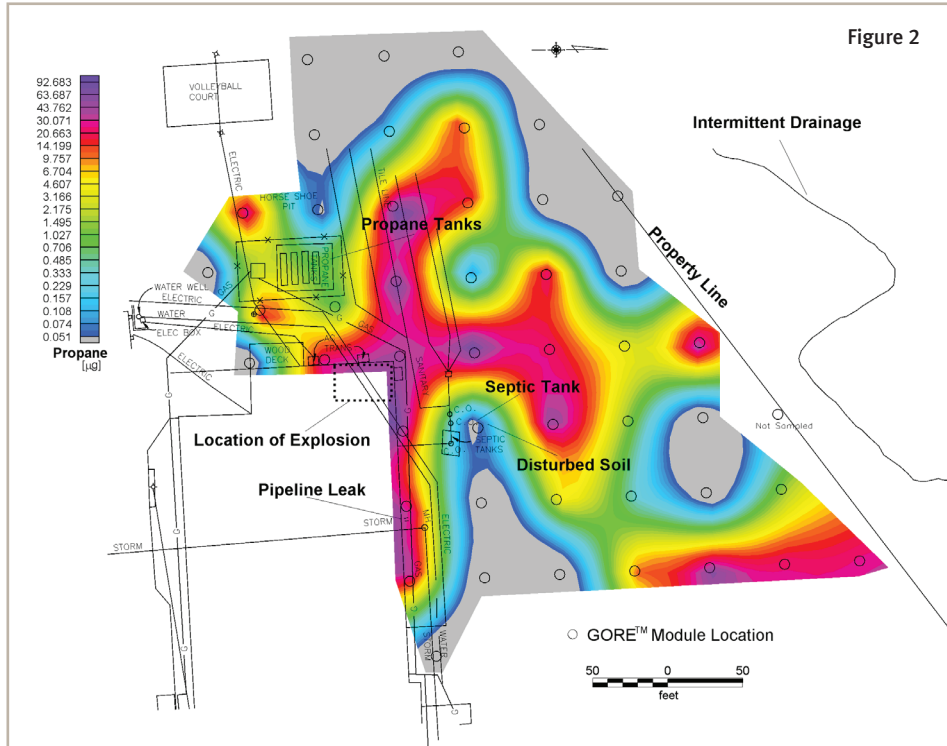


**VAPOR INTRUSION INVESTIGATION – POST-EXPLOSION**



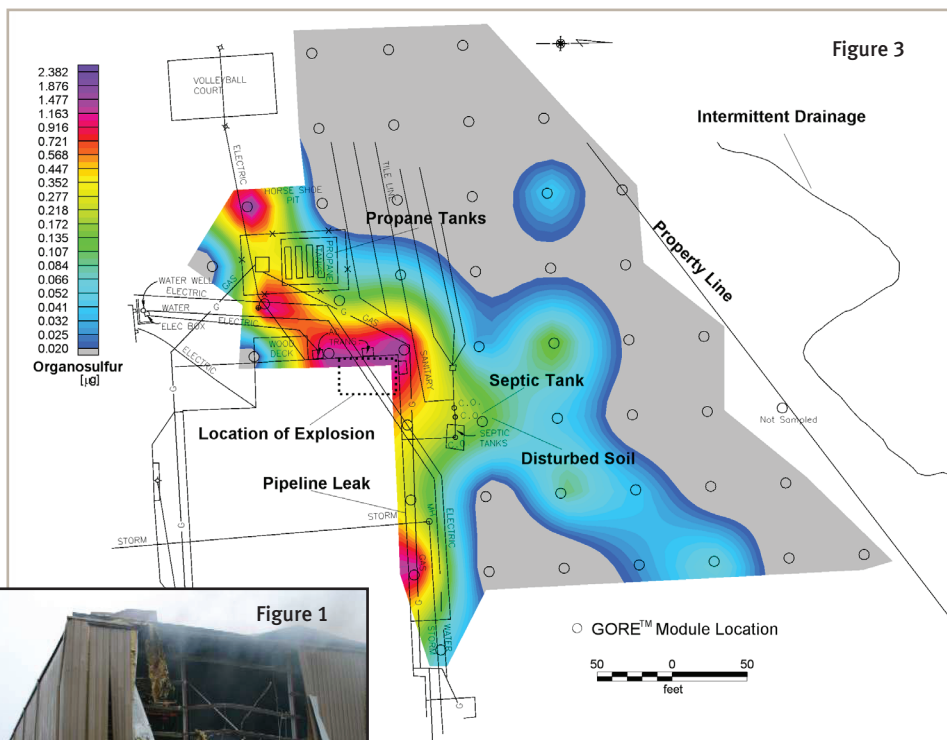
**Survey Summary**

**Location:** Mid-Atlantic US, rural

**Property:** Light Manufacturing Facility

**Objective:**

- Propane explosion in warehouse basement
- Mercaptan-like odor in indoor and outdoor air
- Intrusion of propane suspected beneath slab during heavy rain events
- Leak in exterior pipeline located following explosion
- AGI Survey delineated extent of propane and organosulfurs (oxidized mercaptans) in soils, three months after explosion



**Survey Objective**

A light manufacturing facility, located in a rural area in the mid-Atlantic US, suffered a catastrophic explosion likely due to a leaking propane pipe, infiltration of propane beneath the building slab, and pooling of vapors in a basement room (Figure 1). Concentrations reached the lower explosive limit (LEL) and ignited. The explosion occurred during a heavy rain event. Mercaptan-like odors had been noticed in the indoor and outdoor air previously. Despite extensive damage to the warehouse, no injuries or fatalities were reported. The AGI Survey was performed three months after the explosion to delineate the extent of soil contamination and focus the remediation effort.



**Figure 1**

Figure 1: Warehouse

Figure 2: Delineation of propane in soil gas.

Figure 3: Delineation of organosulfur compounds in soil gas.

## VAPOR INTRUSION INVESTIGATION – POST-EXPLOSION

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### Site Background & Geology

- Light manufacturing facility, mid-Atlantic US, rural
  - 25 years old
  - Minimal solvent use
  - Propane stored in above ground storage tanks and supplied to building through subsurface piping
- Groundwater depth shallow
- Fine silty clays, low permeability
- Building site slopes moderately to west-northwest to intermittent drainage

### AGI Survey

- 46 AGI passive samplers on 1.85 acres
- Regular grid, 50ft. spacing, 2ft. deep
- Seven-day exposure
- Modified EPA method 8260/8270 GC/MS/SCD analysis at AGI labs
- Additional modules placed through building slab into the subsurface soils

### Survey Results

The AGI Survey identified residual propane in the subsurface soils immediately adjacent to the manufacturing facility, extending north and west downslope toward an intermittent stream (Figure 2), three months after the explosion. Sulfur-based compounds, commonly added to propane as odorants, were also mapped (Figure 3). The results revealed elevated levels of these compounds in the soils around the pipeline leak, and in the area where the explosion occurred. Propane migrated downslope away from the building, and along the buried utilities adjacent to the building, and into the septic drain field. The extent of the subsurface impact was delineated. The modules placed through the building slab also had elevated subslab compound levels.

Heavy rains saturated the soils above the leaking pipeline and may have caused vapor migration into drier, more permeable soils beneath the building slab, until an explosive concentration was reached, and subsequently ignited.

Modification of the soils in the vicinity of the septic tank prior to the soil gas survey, likely reduced the presence of the propane and associated compounds, and suggested similar modification to the soils in the impacted area would remediate the soils naturally. The LEL for propane was computed using the soil gas results, and indicated explosive levels no longer existed outside of the facility.

### Survey Conclusions

Propane vapor intrusion beneath the slab of a light manufacturing facility, and subsequent pooling of vapors in a basement room of the warehouse, was investigated following a catastrophic explosion. Propane, leaking from a buried pipeline adjacent to the building, was identified as the potential source. Propane migrating away from the leak in the low permeability soils, likely moved beneath the building slab into drier, higher permeability soils, during a heavy rainfall event. The vapors accumulated beneath the slab and in a basement room until concentrations exceeded the lower explosive limit and ignited.

The AGI Survey accurately delineated the propane impact to the soil adjacent to and under the building, and down-gradient from the facility, approximately three months after the explosion. Propane and organosulfur compounds were detected, identified and mapped, using AGI's advanced soil gas sampling and analytical techniques.

The return on the investment of the AGI Survey was realized by the site owner immediately. The survey delineated the subsurface impact accurately, focusing future remedial activities in areas now known to be contaminated with residual propane. Observable soil modification in the vicinity of the septic tank showed low propane levels when compared to adjacent sample locations. The results suggested simple soil modification (turning over) would reduce levels significantly, and accelerate the natural reduction of propane and organosulfur compounds in the soil.