Ground Water Reclamation & Treatment

Bruce Thomson
Water Resources Program &
Civil Engineering
(bthomson@unm.edu)
Questions to Address

- What are methods available for remediation of ground water contaminated with hydrocarbons?
- What is the threat to ABQ public water supply?
Terminology

- DNAPL – dense non-aqueous phase liquid (chlorinated solvents)
- LNAPL – light non-aqueous phase liquid (petroleum fuels)
- VOCs – volatile organic compounds – will evaporate at room temperature
- Adsorb – stick to a surface
- GROs - Gasoline Range Organics – hydrocarbons in gasoline
- BTEX – benzene, toluene, ethylbenzene, xylenes
- EDB – ethylene dibromide
General Classes of Ground Water Contaminants

- Inorganic contaminants – (don’t have carbon atom in molecule) – metals (arsenic to zinc), non-metals (nitrate, salinity, etc.), radionuclides
- Organic contaminants
  - DNAPLs
  - LNAPLs
  - Others – pesticides, herbicides, etc.
LNAPL Remediation Alternatives Depend On:

- Soil & hydrogeologic properties – Affect contaminant transport
- Solubility – Most hydrocarbons not soluble
- Adsorption – Most hydrocarbons adhere to soil
- Volatility – Gasoline range organics are volatile, Diesel range organics are less volatile
- Biodegradation – Most soluble hydrocarbons are degradable

- Remediation focus is on BTEX & EDB because they’re regulated: soluble, volatile, less adsorption, biodegradable
Remediation Strategies
Excavation & Disposal
(Muck & Truck)

• Excavate heavily contaminated soil near source
  • Removes the source of underlying contaminants
  • Limited to practical limits of excavation
Free Product Recovery

- Pump water to create cone of depression
- Pump free product to surface

Comments
- Difficult to pump thin layer of free product
- Free product flows VERY slowly
- Often limited success
Pump & Treat

- Pump contaminated water to surface & treat
- Discharge treated water or re-inject (depends on regs & local cond conditions)

- Comments
  - Most contaminants adsorb to soils & slow to desorb
  - Must pump large volumes of water for long times
  - Pump & treat provides gradient control
  - Not often used for petroleum spills
Soil Vapor Extraction (SVE)

- Suck soil gases through unsaturated zone (vadose zone)
- VOCs evaporate & are removed with air
- Treat air at surface
  - Catalytic oxidation (catox)
  - Internal combustion engine

- Comments
  - Widely used in NM
  - Comparatively fast & cost effective
  - Will enhance biodegradation
VOC Distribution at KAFB

- Distribution at 450 ft depth
Biodegradation

- BTEX, EDB, alcohols & low molecular weight hydrocarbons will biodegrade
- Degradation by natural soil microorganisms – augmentation with engineered cultures is not needed
- Conditions for biodegradation
  - Aerobic ($O_2$ present) (EDB degrades faster under anaerobic conditions)
  - Nutrients (N & P)

$$C_xH_yO_z + O_2 = CO_2 + H_2O + \text{Bacteria}$$

- Natural degradation & dilution forms basis of “Monitored Natural Attenuation”
Threat to ABQ Water Supply

NMED, 5/3/2011
Threat of KAFB Fuel Plume to ABCWUA Water System

- Contaminants must migrate horizontally & vertically
  - Need to determine plume depth
- Large dilution factor

- Monitoring
  - ABCWUA monitors wells monthly (paid by KAFB)
  - No VOCs detected in Ridgecrest or Burton wells
Summary Remarks

- Depth & size of the KAFB fuel plume make remediation difficult.
- Design of remediation system depends on extent of plume, nature of contaminants, soil characteristics, & hydrogeology.
- Immediate threat to public water supply is small.
- Important to:
  - Monitor well water quality.
  - Further characterize plume’s 3-D extent.