



Overview of the Amargosa Desert Research Site (ADRS)

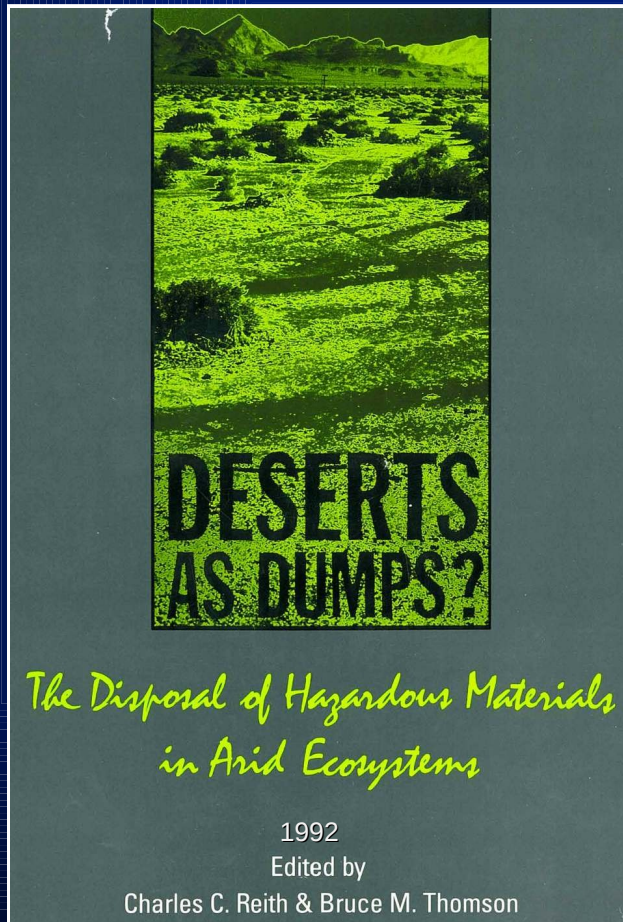
A Field Laboratory for the Study of Arid-Site Processes

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USGS-Nevada Water Science Center & National Research Program

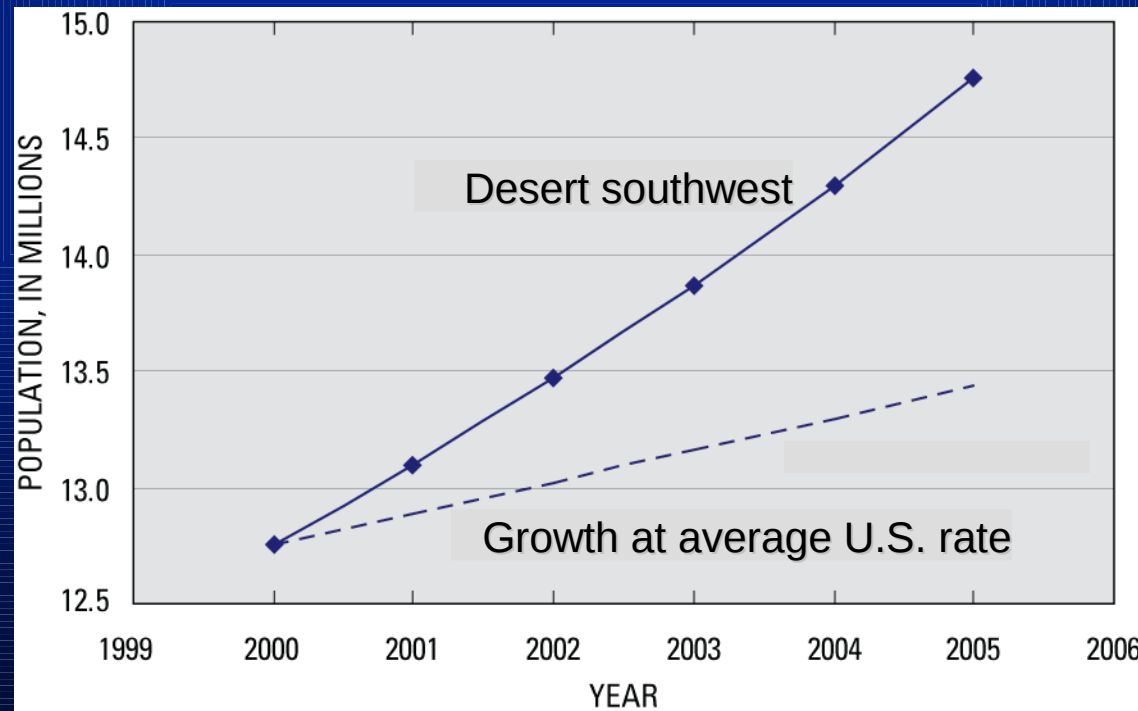
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Modified from
Stonestrom & Harrill (2007)

BACKGROUND

- Arid sites often proposed for isolating Nation's radioactive & other hazardous wastes
 - Low precipitation, high ET, thick unsaturated zone
- Rapid population growth in the desert southwest is placing increased demands on ground-water resources
- Dual needs ... waste management & resource protection ... require an understanding of both natural-hydrologic systems & contaminated systems

So what's the problem?

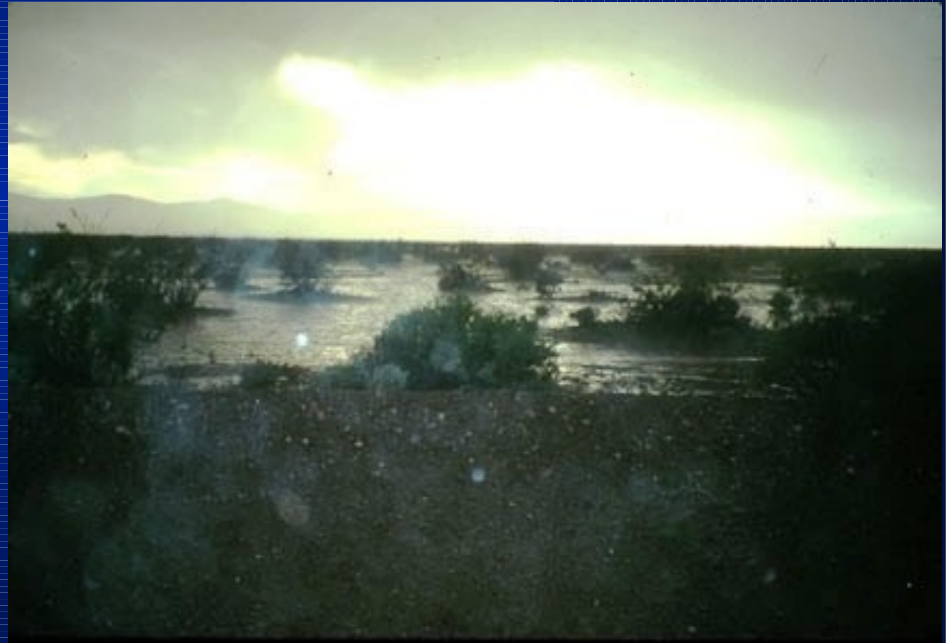
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Dry, dust-storm



Heavy rain, standing water

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 - Precipitation – annual average is low, but large temporal variability
 - Short-term field studies do not capture extreme variations
 - **Thick unsaturated zone (100+ m) – highly variable; dry, rocky sediments**
 - Complexities in characterization, instrumentation, & monitoring



Waste trench under construction –
18 m ... 1/6th of the way to the water table



UZB-3 borehole (115-m deep, 15-cm diam.) –
~2 km of cables & tubing ... “The White Mamba”

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 - Short-term field studies do not capture extreme variations
 - Thick unsaturated zone (100+ m) – highly variable; dry, rocky sediments
 - Complexities in characterization, instrumentation, & monitoring
- Detailed data for arid sites are often lacking ...
 - Limits ability to test assumptions about natural & contaminated systems
 - Increases uncertainty in predictive models

AMARGOSA DESERT RESEARCH SITE (ADRS)

Field laboratory for sustained study of arid-site processes

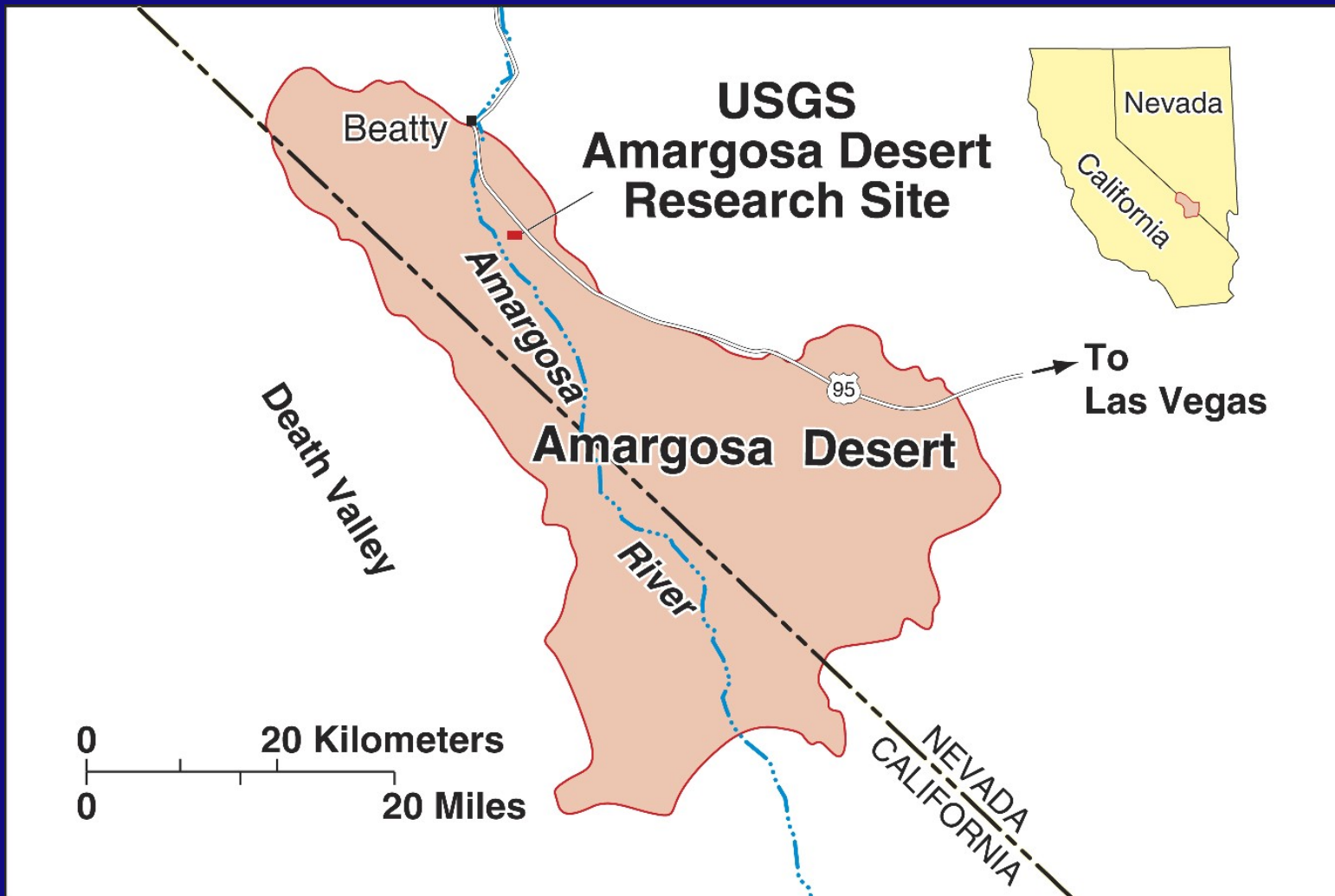
- **1983 – USGS, BLM, State of Nevada**
 - USGS Low-Level Radioactive Waste Program, Toxic Substances Hydrology (1997)
- **Adjacent to Nation's first commercial low-level radioactive waste (LLRW) facility – Beatty, Nevada**

Overall objective

- **Improve understanding of processes controlling unsaturated-zone transport of water & contaminants in arid environments**

LLRW typically is “mixed waste”

- **Contains both radioactive & hazardous components**
- **LLRW**
 - “... waste not classified as high-level, spent-nuclear fuel, or mill tailings” (Regulated by USNRC, Agreement States; LLRW Policy Amendments Act; 10 CFR Part 61)
 - **Commercial sources & forms**
 - Hospitals, research, industry, nuclear-power plants, ...
 - Shoe covers & lab coats, tools, nuclear-power reactor filters & residues, ...
 - **Hazard to public health**
 - Up to 500 yr for high-concentration/long-lived radionuclides
- **Hazardous components**
 - **May include radioactive organics & heavy metals**
(Regulated by USEPA; RCRA; 40 CFR Part 261)
 - Scintillation vials, cleaning solvents, mercury amalgam, ...





Amargosa Desert Research Site

- **Waste facility**
 - State owned; surrounded by BLM
 - LLRW, 1962-92
 - USNRC & State of NV regulation/oversight
 - Hazardous chemical, 1970-present
 - RCRA Subtitle C
 - USEPA & State of NV
- Precipitation (25-yr record)
 - 112 mm/yr average
 - min = 4, max = 225 mm/yr
- Creosote bush (*Larrea tridentata*)
- Alluvial/fluvial sediments
- Depth-to-water ~110 m

Shallow-land burial of LLRW

- Excavation, waste emplacement, backfill with stockpiled soil
- No liner required
 - Rely on natural- & disposal-site features to minimize water-waste contact
- Liquid waste solidified/dewatered prior to burial
 - “Early days” ... some liquids disposed directly into trenches



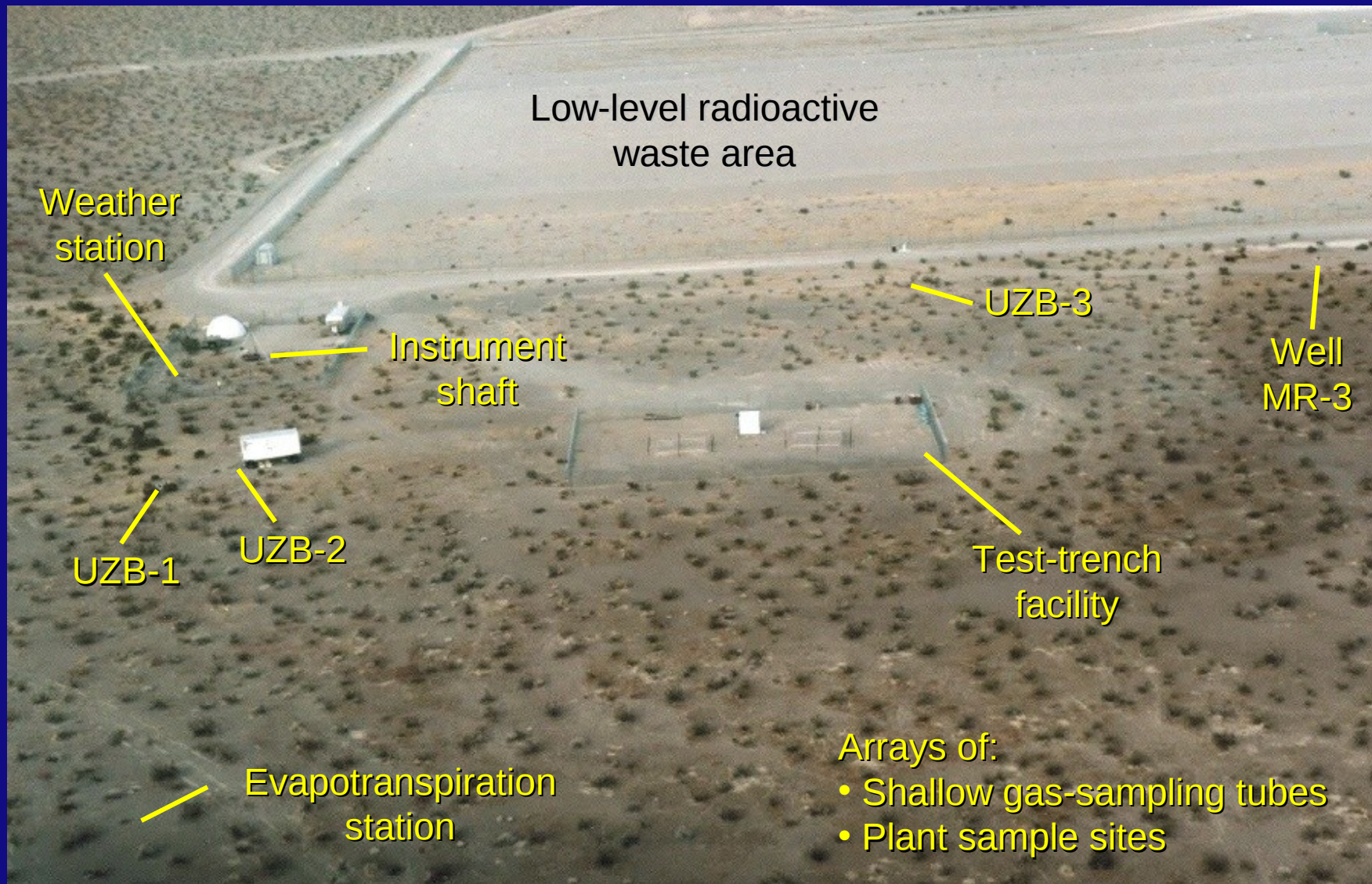
- Surfaces of completed trenches during operational period
 - Kept free of vegetation
- Final cover over entire LLRW area (22 trenches)
 - Additional backfill to 2 m above land surface



ADRS Experimental Approach

- **Field-intensive research with multiple lines of data**
 - **Weather; ET; plants; microbiology;**
soil properties; soil water & gas monitoring;
geology; geophysics; ground water
- **Natural & perturbed/contaminated conditions**
 - **Water & gas movement**
 - **Mixed-waste contaminants data**
 - Tritium, carbon-14, VOCs, elemental mercury
 - **Natural nitrate, perchlorate**
- **Methods development**
- **Field data integrated with modeling**
 - **Test & refine conceptual & numerical models**
- **Multidisciplinary collaboration**
 - **USGS, University, Research Institute, National Lab, Other Agency**

Instruments & monitoring within 400-m buffer zone*



* Distant/background study area located 3 km from waste facility

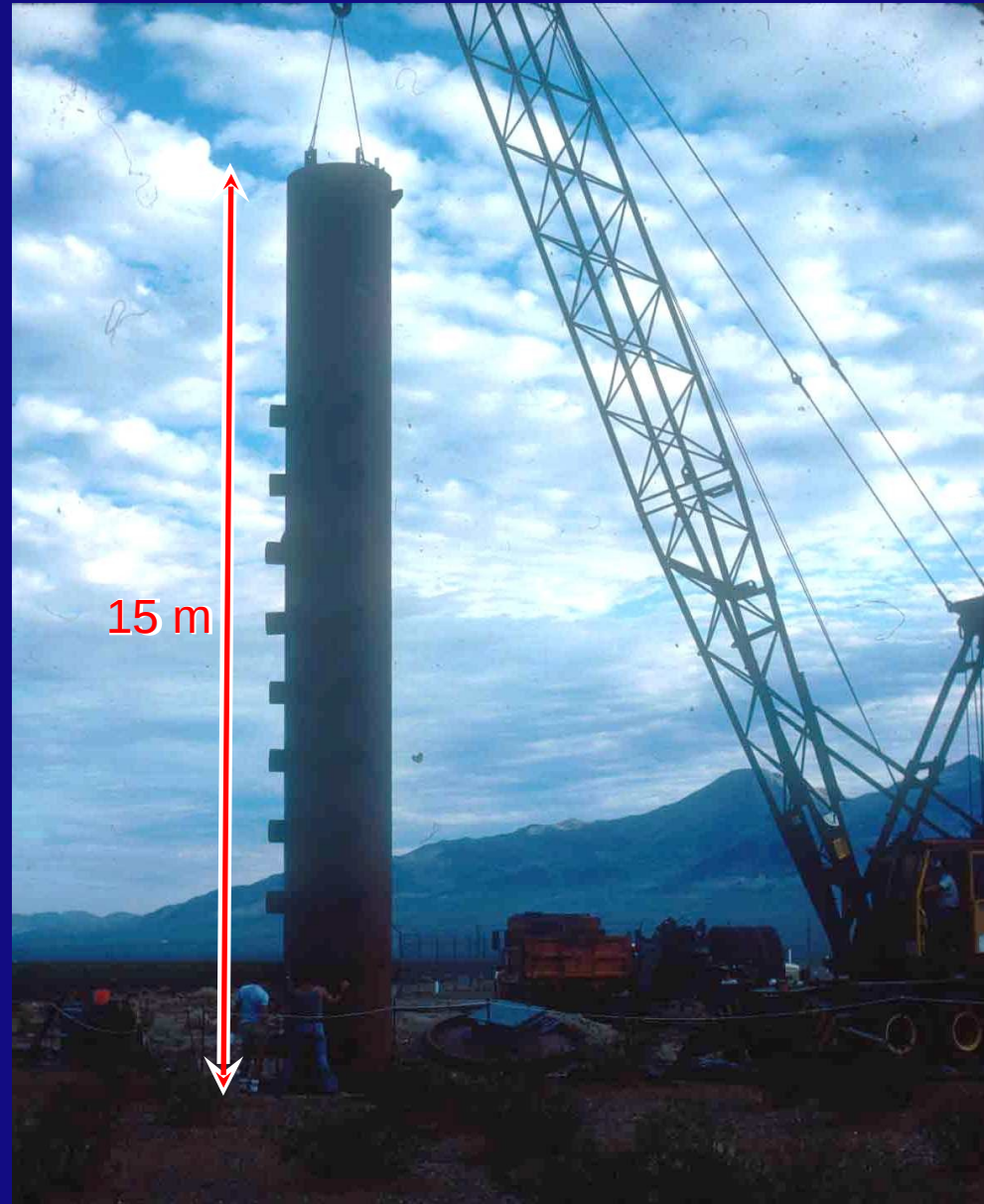


Cape Cod tracer-test array is impressive ...



Cape Cod tracer-test array is impressive ...

but we've got the instrument shaft!



Installation
August 1983

Topical Outline for ADRS Session

- **Oral**
 - **Overview**
 - **Water & gas flow**
 - **Tritium transport**
 - **VOC distribution & fluxes**
 - **Mercury transport**
 - **Tritium release by evapotranspiration**
 - **Wrap up ... Use of results**
- **Poster**
 - **Dispersion of contaminants by barometric pumping**
 - **Diurnal distillation for dewatering non-volatile point sources**
 - **Modeling water movement in desert soils**
 - **Natural perchlorate in precipitation, soils, & plants**
 - **Geologic framework**
 - **Geophysical mapping of hydrogeologic features**