WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

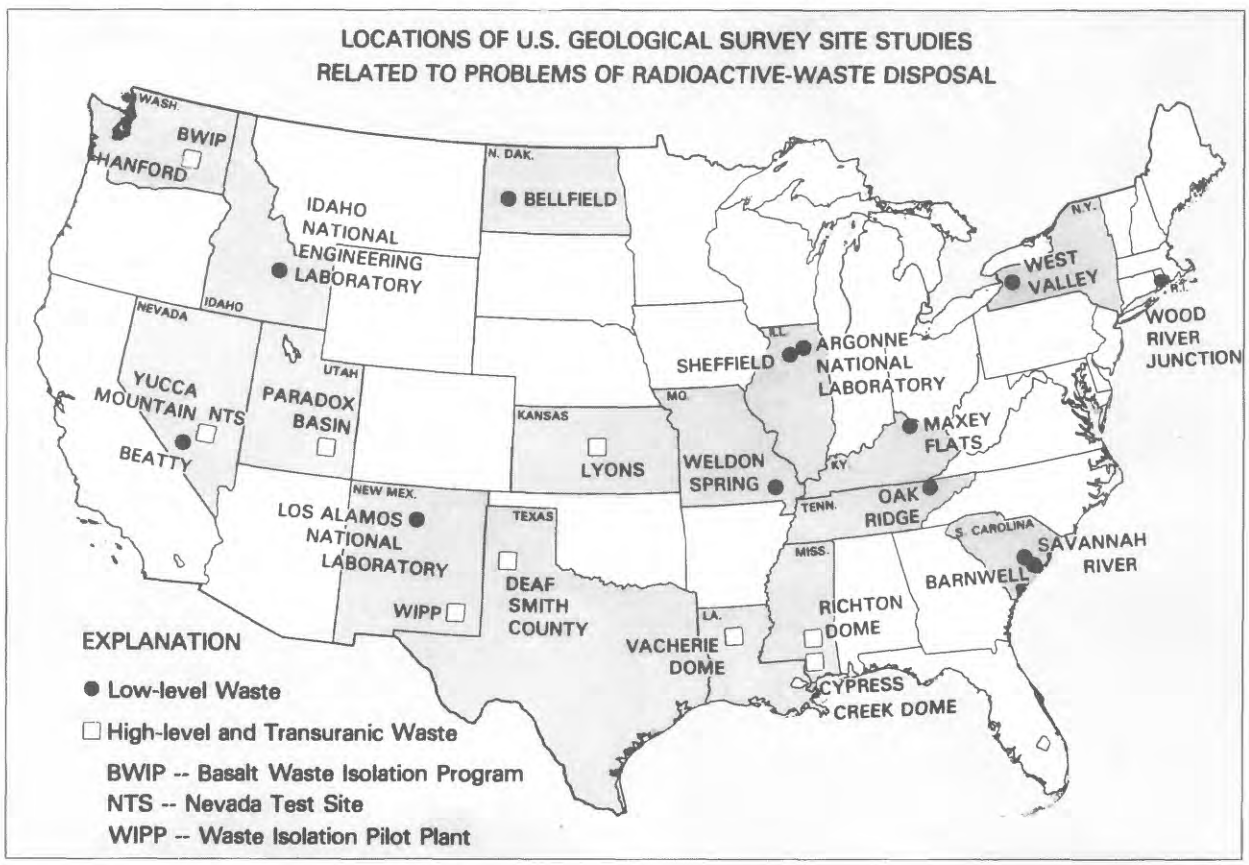
NUCLEAR-WASTE HYDROLOGY PROGRAM

Effective management of nuclear wastes requires a thorough knowledge of the hydrology and geology of the disposal sites and their surroundings, and of engineered and natural barriers to prevent spread of the contaminants. The U.S. Geological Survey (USGS) Branch of Nuclear Waste Hydrology makes use of the many years of USGS expertise in the earth sciences to analyze and develop information about these problems. The program is closely coordinated with related USGS programs, such as the National Research Program, the Regional Aquifer Systems Analysis (RASA) Program, and the Federal-State Cooperative Program.

BACKGROUND

The study of the movement of water and its chemical constituents through surface-water and ground-water systems (hydrology), and the study of the earth and the processes acting on it (geology), provide major elements of scientific information necessary to properly manage the long-term storage of nuclear wastes. Water flowing on and beneath the land surface can dissolve and transport wastes. The natural water circulating in its geologic framework (soils and rock) distributes and, in some cases, cleanses contaminated water. Waste disposal and contamination of water are inseparable issues. The USGS has, for several decades, studied both environments and processes relevant to transport and containment of radionuclides at many places, as illustrated in the figure.

Even where disposal sites are located in simple geohydrologic environments whose waste-containment properties can be predicted with a relatively high degree of confidence, some uncertainty about the accuracy of the predictions will always remain. The multiple-barrier concept of waste management provides added safety factors to help overcome the uncertainty. This management involves a combination of several independently engineered and natural obstacles to the movement of contaminants from disposal sites. The concept is applied to disposal of high-level radioactive waste (generally resulting from chemical reprocessing of spent fuel) in deep geologic environments, but can apply equally to disposal of low-level waste (generally short-lived and of low radioactivity). Investigations into geologic and hydrologic processes, predictive models, and natural and engineered barriers are important to the successful management and disposal of nuclear wastes.



THE U.S. GEOLOGICAL SURVEY NUCLEAR-WASTE HYDROLOGY PROGRAM

Similar hydrologic and geologic processes apply to high-level and low-level contaminants. The USGS, through its Nuclear-Waste Hydrology Program, is applying its expertise and experience in geology, geophysics, chemistry, and hydrology, to evaluate the problems of nuclear-waste disposal. Elements of the program are discussed below.

High-Level Radioactive Waste Program

Research conducted under this program:

- Provides information that assists the U.S. Department of Energy to establish criteria for waste sites, and to select and characterize potential sites;
- Provides information that assists the Nuclear Regulatory Commission to develop regulations and to license repository sites; and
- Includes research on the geochemistry of plutonium and related isotopes in ground water; the flow of fluids and radionuclides through porous and fractured materials; the thermomechanical properties of rocks; the development of geophysical techniques to measure physical and chemical properties of rock masses; the improvement of mathematical simulation models; and the characterization of long-term geologic processes and events that could disrupt repository sites.

Low-Level Radioactive-Waste Program

USGS scientists working under this program:

- Conduct research and field investigations into processes that control the leaching (dissolution) and migration of radionuclides from shallow land-disposal sites;
- Develop techniques and determine geohydrologic factors that will aid other Federal agencies in the selection and design of disposal sites;
- Provide information to assist other Federal and State agencies that are responsible for developing and implementing effective low-level waste-management programs; and
- Develop comprehensive earth-science criteria important to the selection and characterization of future sites for the shallow disposal of low-level waste.

Nevada Nuclear Waste Storage Investigations Program

The USGS has primary responsibility to assist the Department of Energy in the hydrogeologic characterization of the Yucca Mountain, Nev., site for possible use as the Nation's first repository for disposal of high-level radioactive waste in the geologic environment. Within the USGS, the Branch of Nevada Nuclear Waste Storage Investigations supplies the required earth-science expertise that is derived from decades of experience at and near the Nevada Test Site. The principal purpose of site characterization is to understand the ground-water system sufficiently well to allow prediction of the movement of radionuclides. Major elements of the program of site characterization are discussed below.

Geologic Program

Research conducted under this program includes:

- Studies of seismicity and the geologically-latest structural history of the earth's crust;
- Definition of host-rock properties (studies are performed on the land surface and underground);
- Analysis of climate in the geologic past; and
- Assessment of mineral, fuel, and geothermal resources.

Hydrologic Program

Research conducted under this program includes:

- Investigations of surface-water hydrology;
- Interpretation of hydrology in that part of the geologic framework that is saturated with water (studies include flow in fractured rock, hydrochemistry, regional and site-specific hydrology, and hydrology of the geologic past); and
- Studies of unsaturated-zone hydrology (studies include infiltration and percolation hydrochemistry, gas flow, and mathematical simulation).

For further information about the Nuclear Hydrology Program and reports, contact:

U.S. Geological Survey
Hydrologic Information Unit
419 National Center
Reston, Virginia 22092

George A. Dinwiddie, 1988