GROUNDWATER AGE AT LOS ALAMOS, NEW MEXICO

BY

PATRICK LONGMIRE AND STEPHEN YANICAK

[1]DEPARTMENT OF ENERGY - OVERSIGHT BUREAU
NEW MEXICO ENVIRONMENT DEPARTMENT

1183 Diamond Dr., Suite B
Los Alamos, New Mexico 87544
Email: patrick.longmire@state.nm.us

February 13, 2014

GROUNDWATER AGE AT LOS ALAMOS, NEW MEXICO

Introduction

Hydrology

Radioactive Isotopes

Tritium/Helium Dating of Groundwater

Carbon-14 Dating of Groundwater

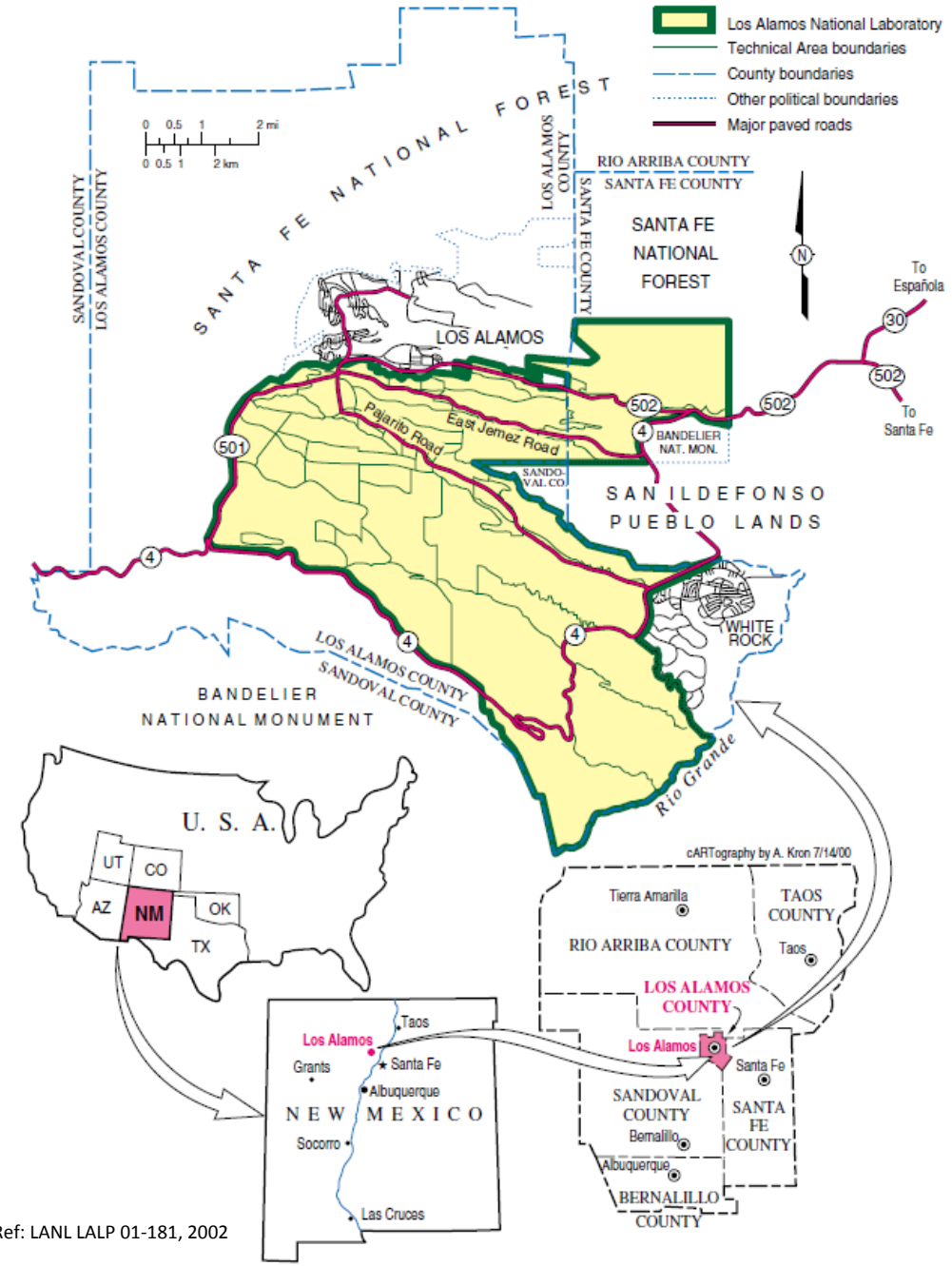
Summary and Conclusions

Motivation of Study

Establish an understanding of the groundwater flow system at Los Alamos (water sources, mixing relations flow paths, and travel times) that is independent of numerical models.

This understanding can be used either to guide the development or evaluate results of corresponding flow models.

Of particular interest is the vulnerability of water supply wells and sustainability of groundwater resources.



Ref: LANL LALP 01-181, 2002

LANL Hydrostratigraphy and White Rock Canyon Springs

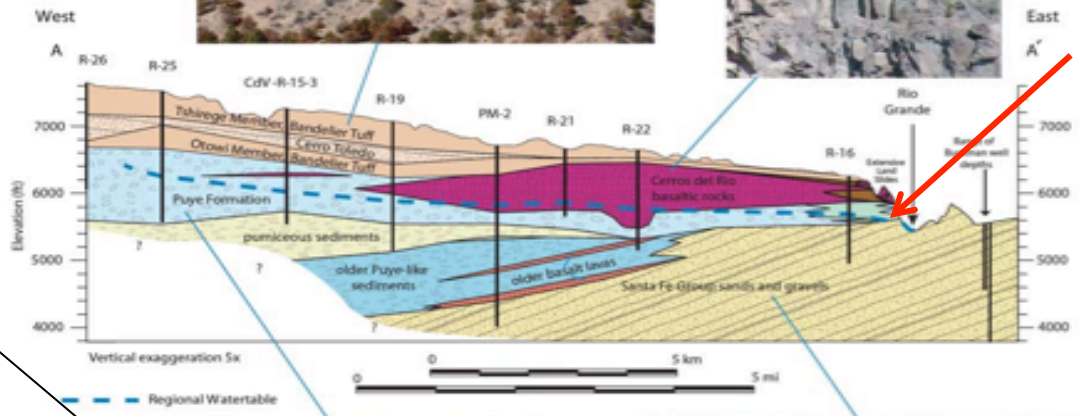
No WRC Springs discharge from the Bandelier Tuff.

Perched Zones (Bandelier Tuff)

Perched Zones and Regional Aquifer (Cerros del Rio basalt)

Springs 6 and 9B

WRC Springs
Ancho Spring, 5 series, 6 series, 7, 8, 9 series, and 10

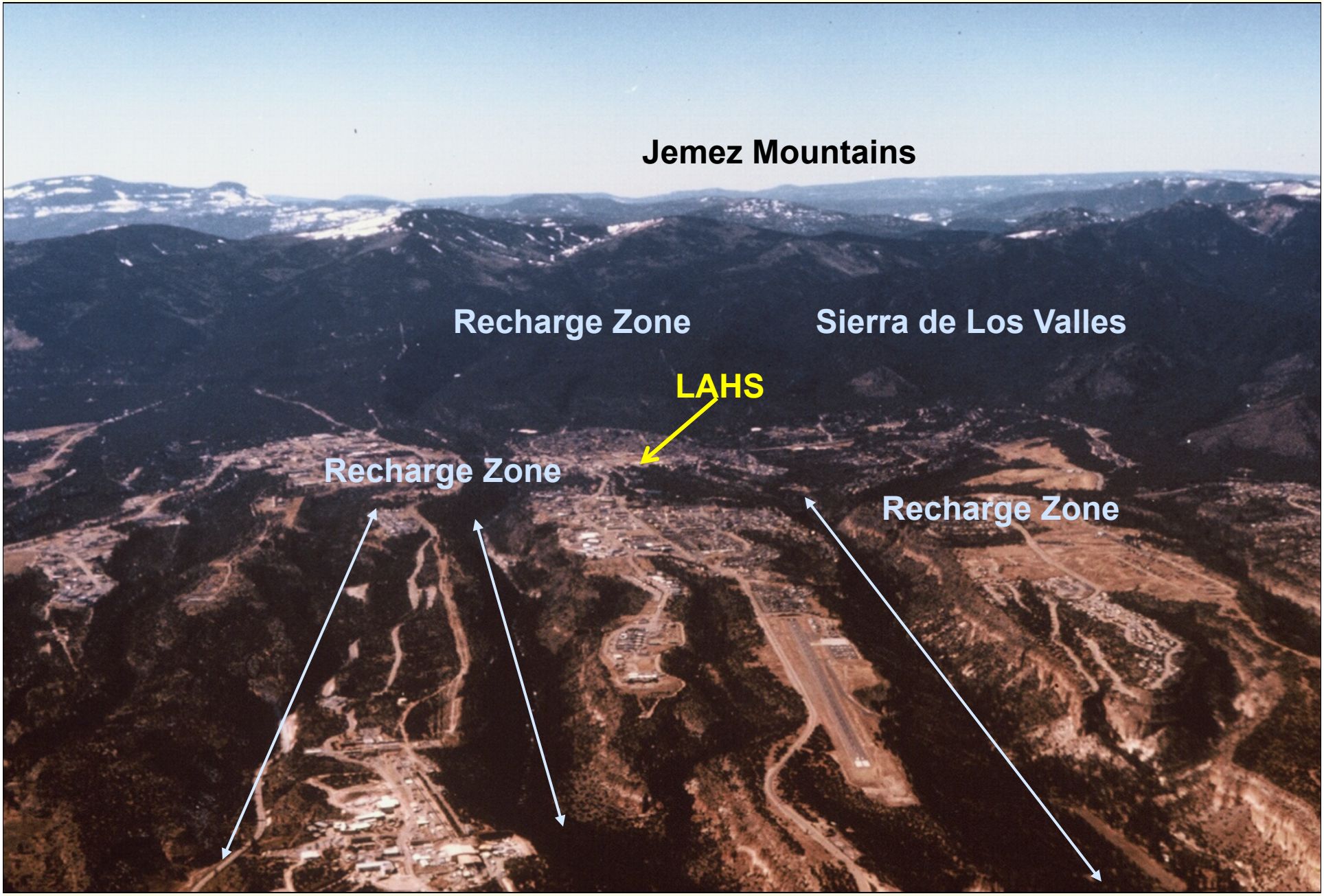


White Rock Canyon Springs

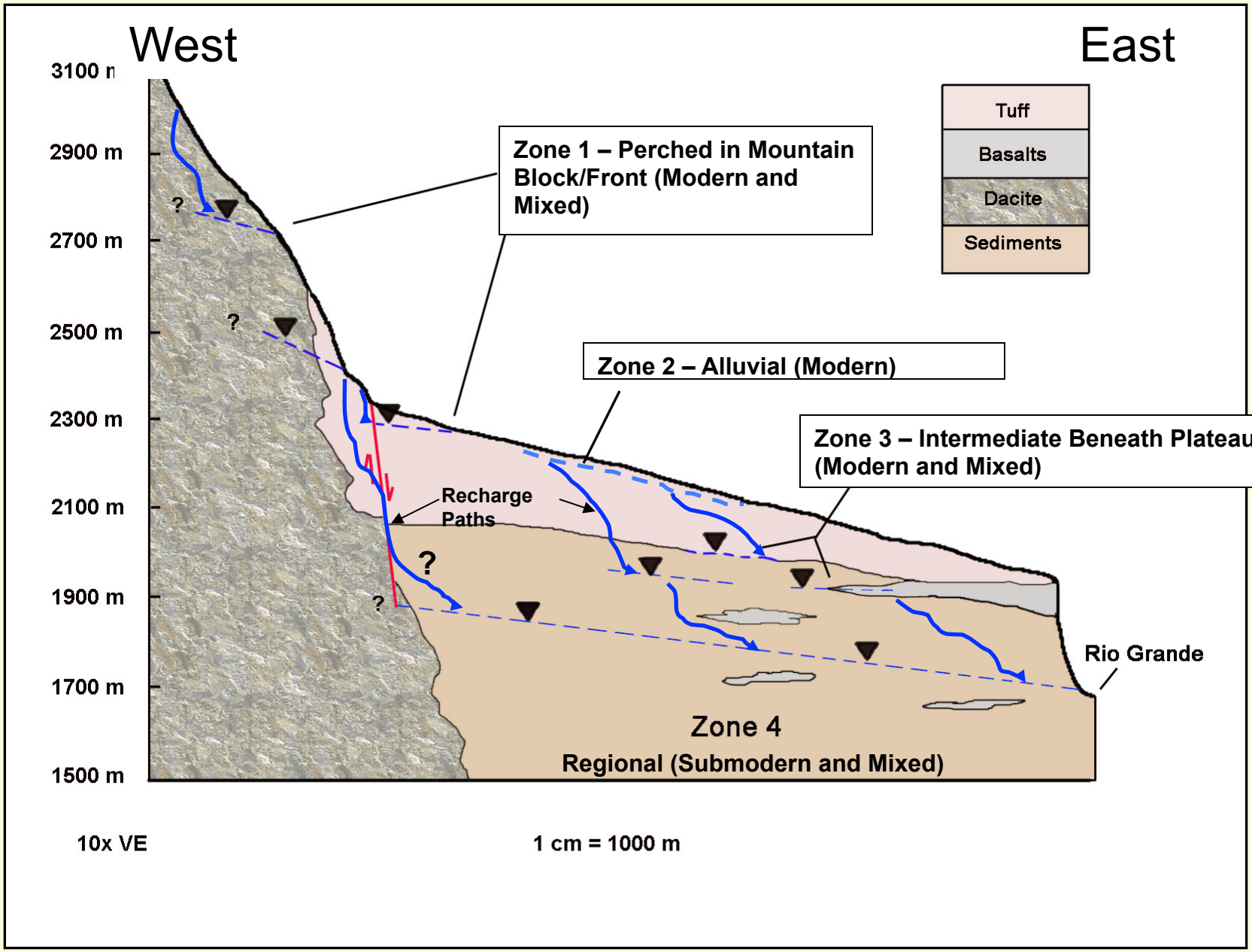
WRC Springs
1, 2 series, 3 series, 4 series, 5 series, 6 series, La Mesita, and Sandia

Perched Zones and Regional Aquifer (Puye Formation, Phreatomagmatic Deposits)

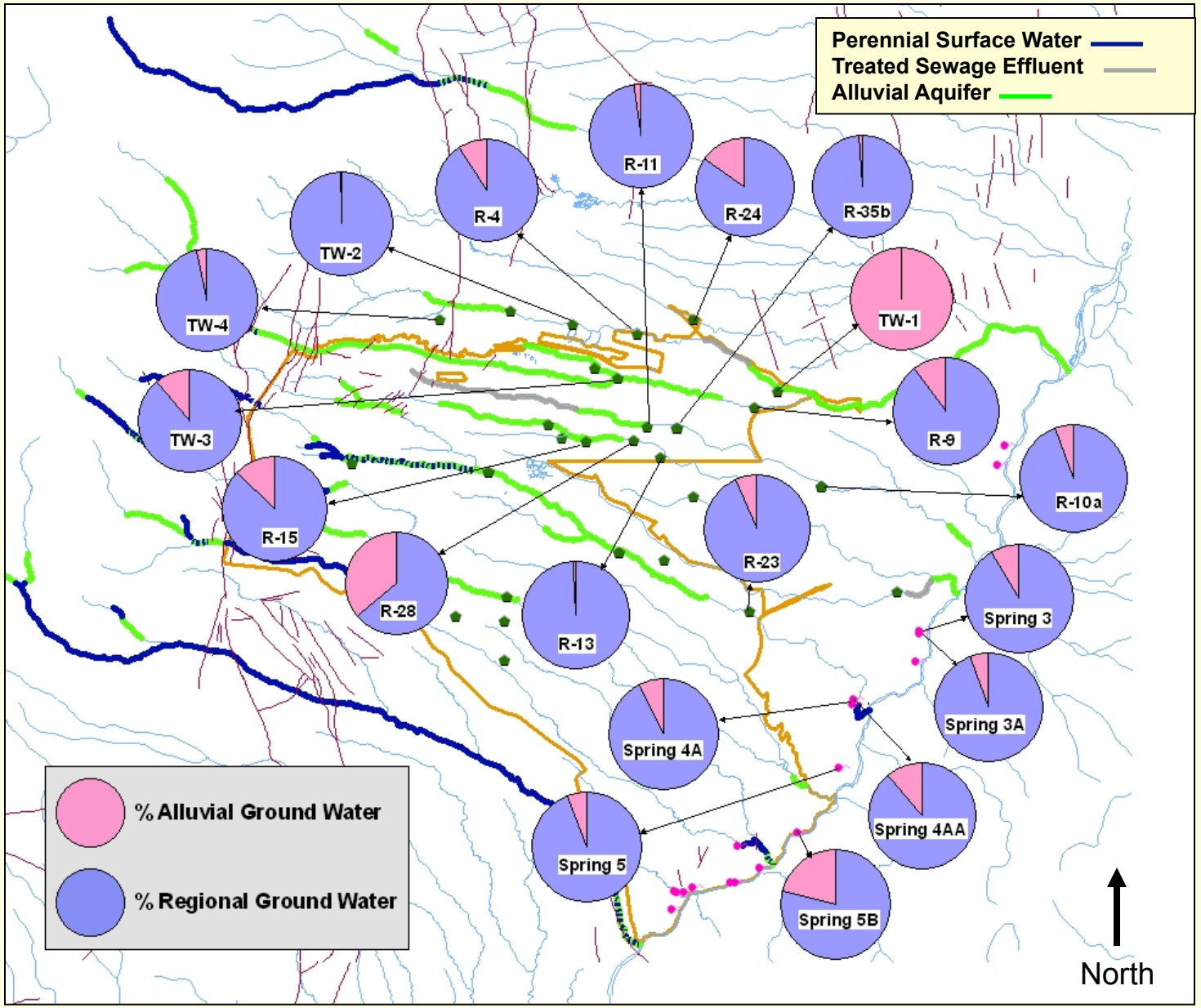
Regional Aquifer (Santa Fe Group)


Jemez Mountains
Recharge Zone
Sierra de Los Valles
LAHS
Recharge Zone
Recharge Zone

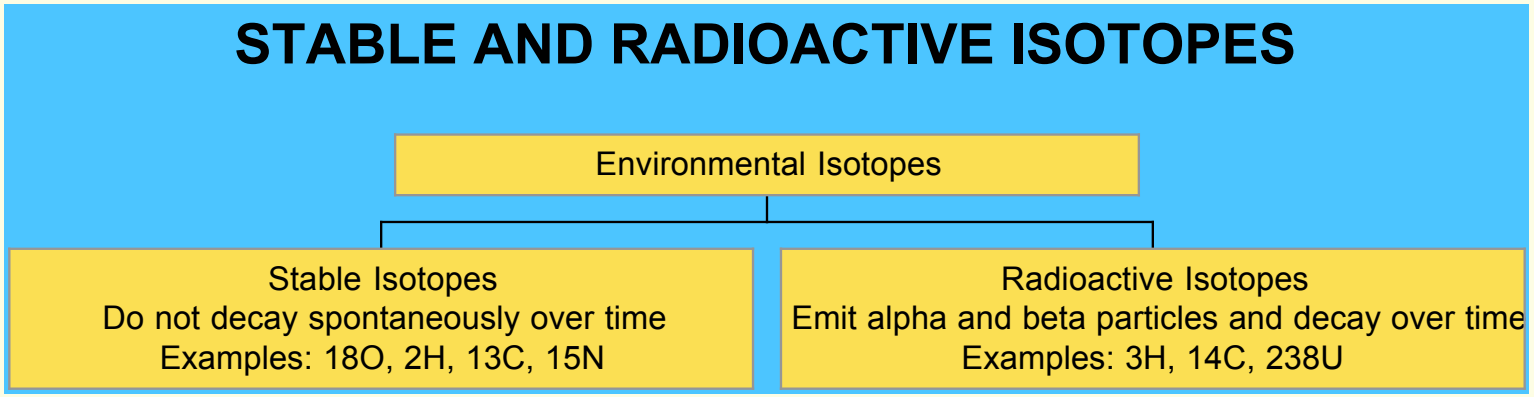
Generalized Cross Section Showing Groundwater Type and Expected Trends in Groundwater Age for Conceptual Model of Groundwater Flow



Average Mixing Ratios for the Regional Aquifer Containing Chloride from Alluvial Groundwater, Pajarito Plateau, New Mexico



ISOTOPES



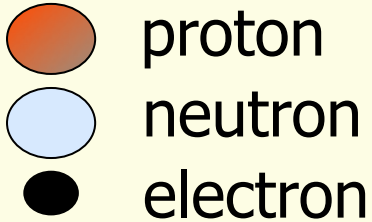
USED AS TRACERS

USED FOR DATING

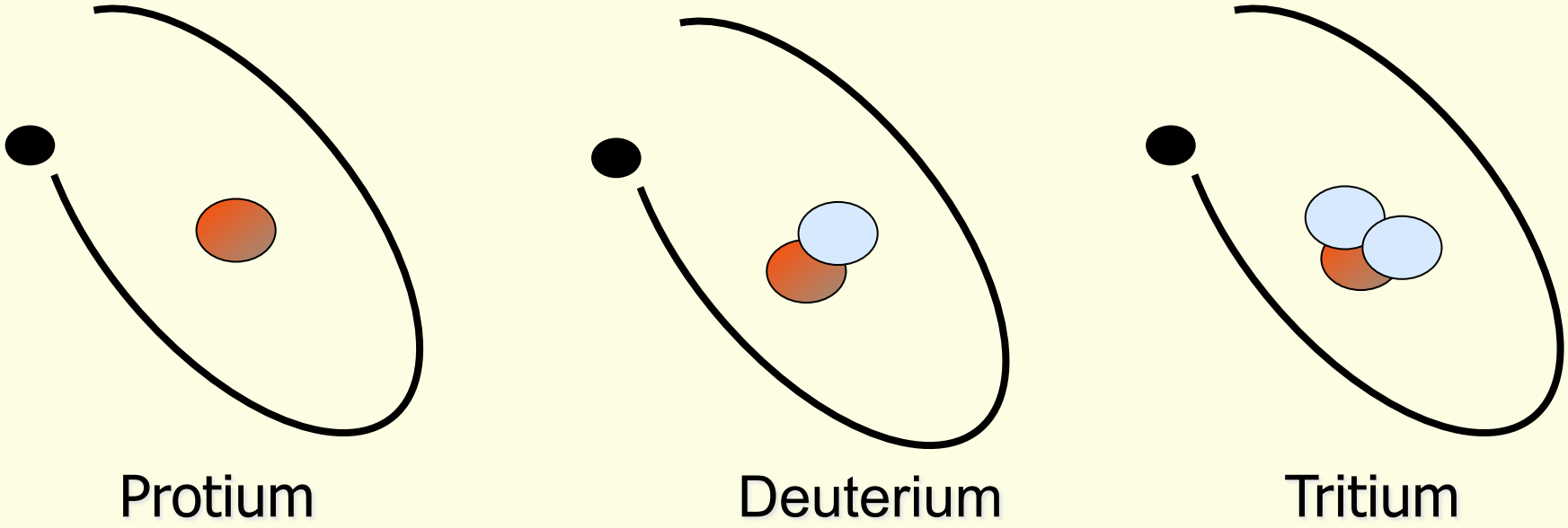
STABLE AND RADIOACTIVE ISOTOPES

Atoms: **composed of protons, neutrons and electrons**

Isotopes: **elements with different numbers of neutrons**

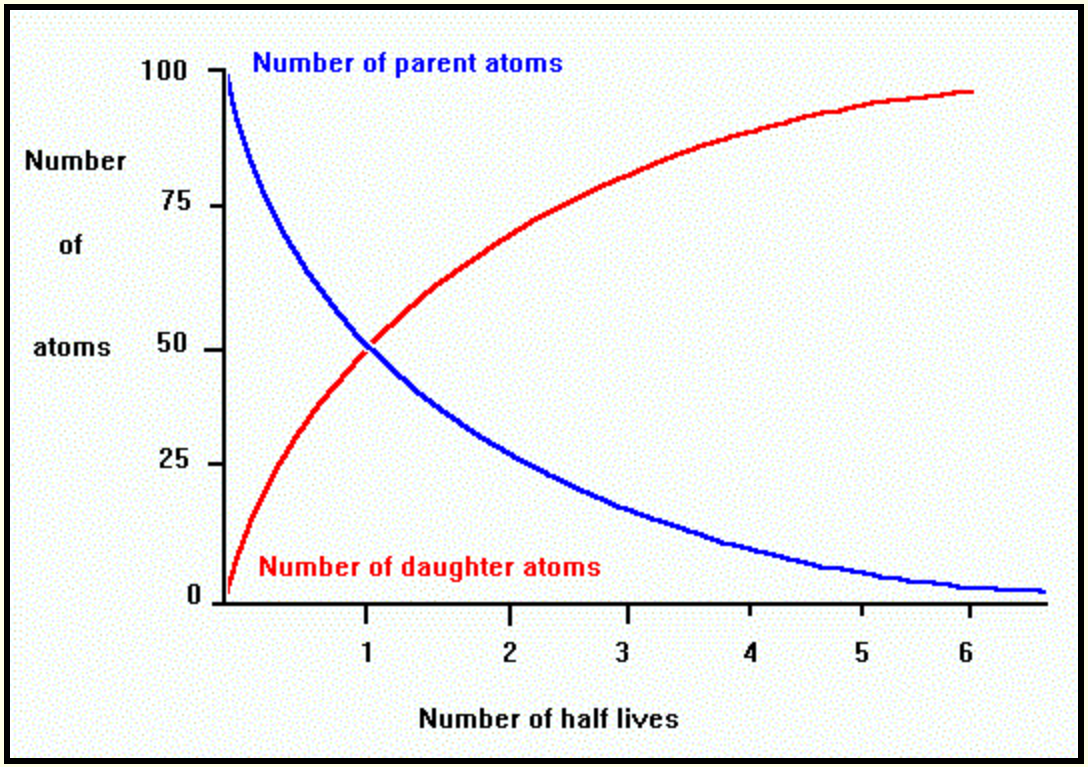


Hydrogen

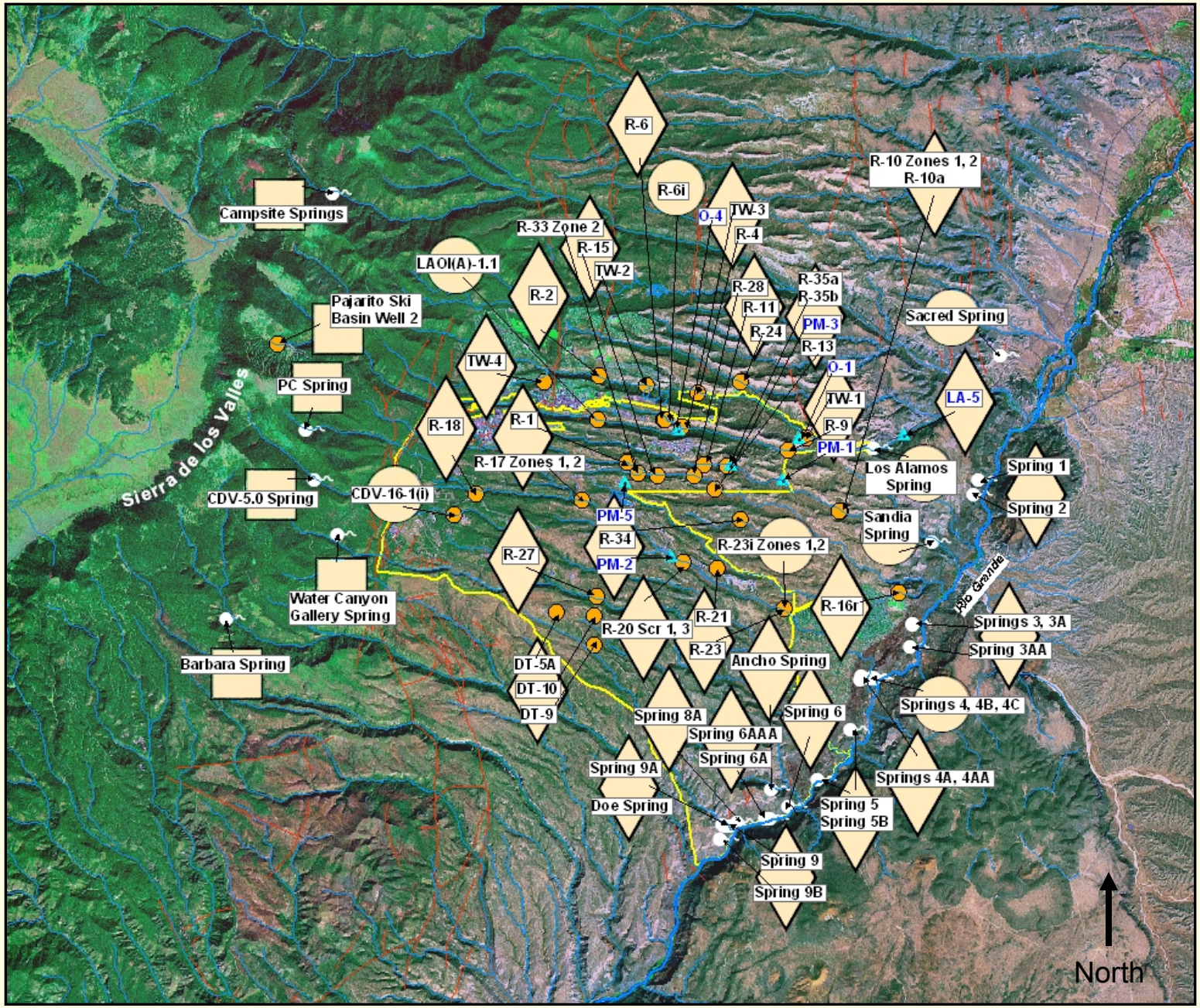


Radioactive Isotopes

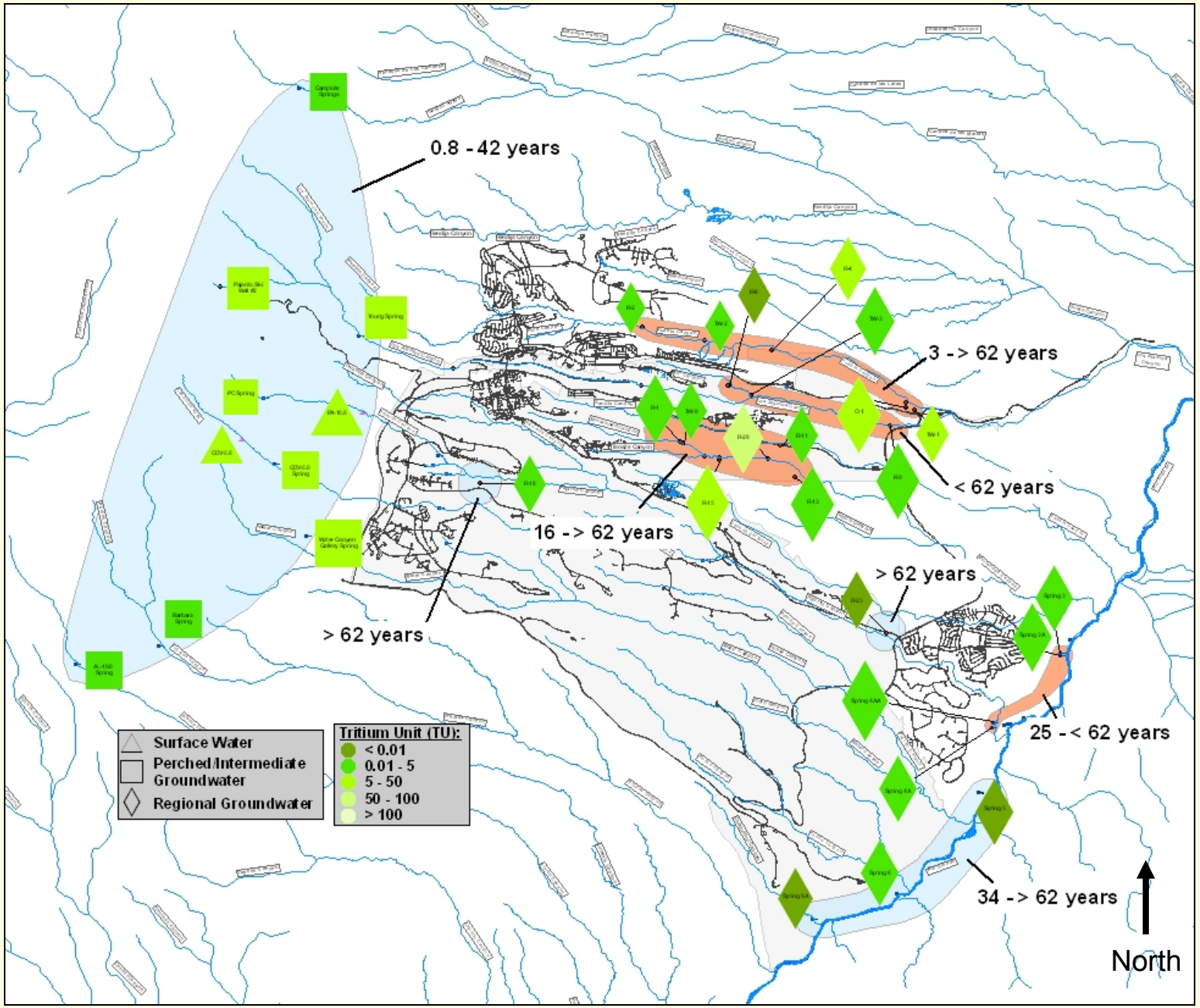
- ^{14}C half life is 5730 years
- Tritium half life is 12.32 years



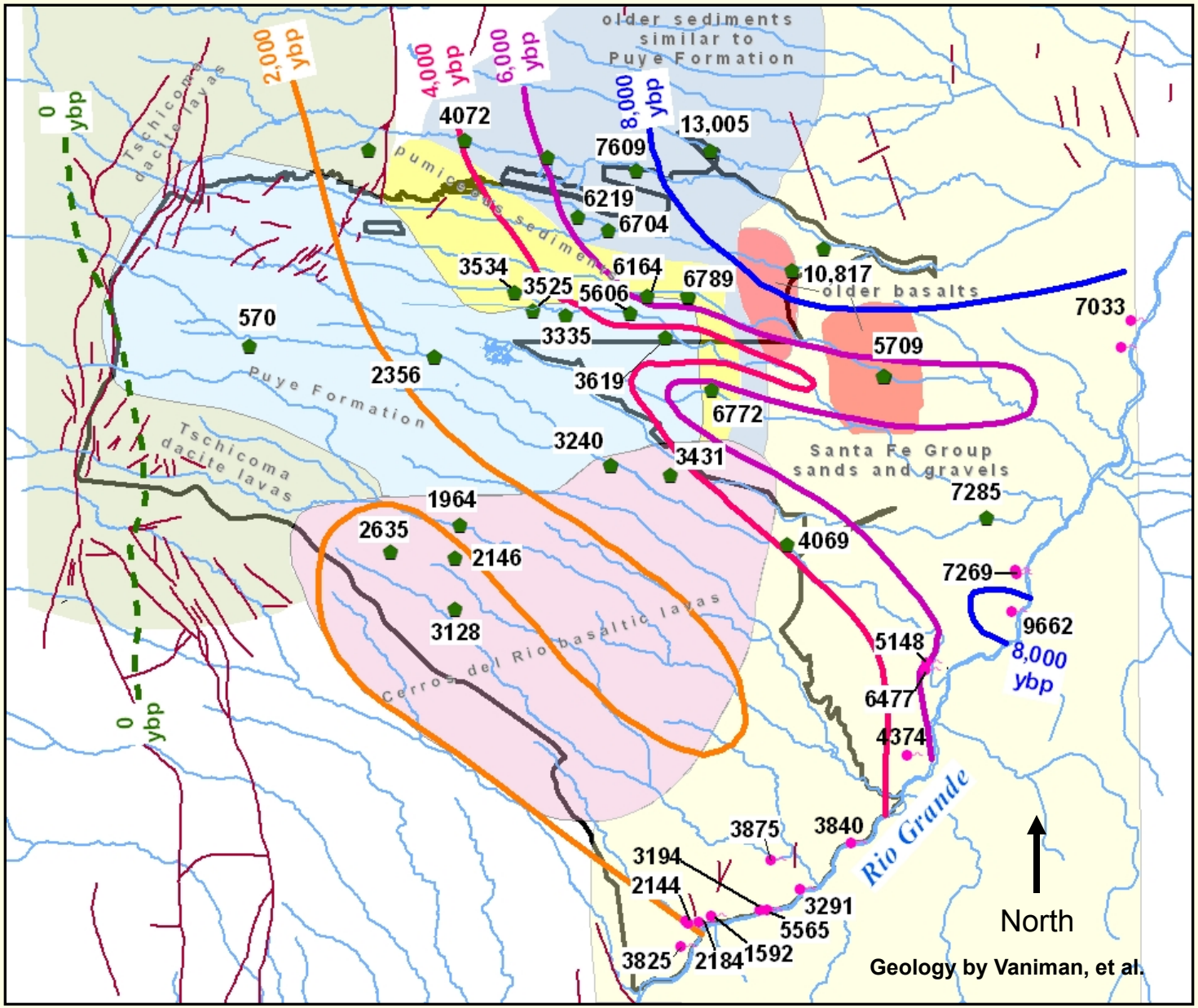
Sampling Stations for Tritium/Helium and Radiocarbon (^{14}C) Dating



Ranges of Apparent $^{3}H/^{3}He$ Ages in the Regional Aquifer



Unadjusted Radiocarbon Ages of DIC and Geology near the Regional Aquifer Water Table, Pajarito Plateau, New Mexico



Summary and Conclusions

- **The regional aquifer at Los Alamos consists of submodern (pre-1943) or mixed (pre- and post-1943) ages.**
- **Submodern-groundwater is common in the regional aquifer. Average ages for the regional aquifer range from 570 to 12,518 years based on unadjusted ^{14}C results.**

Summary and Conclusions

- **Groundwater with younger unadjusted ^{14}C ages are associated with canyon bottom recharge (Frijoles, Water, Pajarito, Mortandad, and Los Alamos Canyons).**
- **Application of ^{14}C ages with chloride, tritium, and other mobile chemicals define preferred groundwater flow paths within the regional aquifer.**

Supplemental Material

Analytical Methods (LANL and NMED)

Major Ions

Ion chromatography, titration, and inductively coupled plasma-optical emission spectroscopy

Trace Elements

Inductively coupled plasma-optical emission spectroscopy and (high resolution) inductively coupled plasma-mass spectrometry

Field Parameters

Dissolved oxygen, pH, ORP, temperature, specific conductance, and turbidity

Analytical Methods (LANL and NMED)

Stable Isotopes

Isotope ratio mass spectrometry ($\delta^{2}H$, $\delta^{18}O$, $\delta^{15}N$, and $^{13}\delta C$)

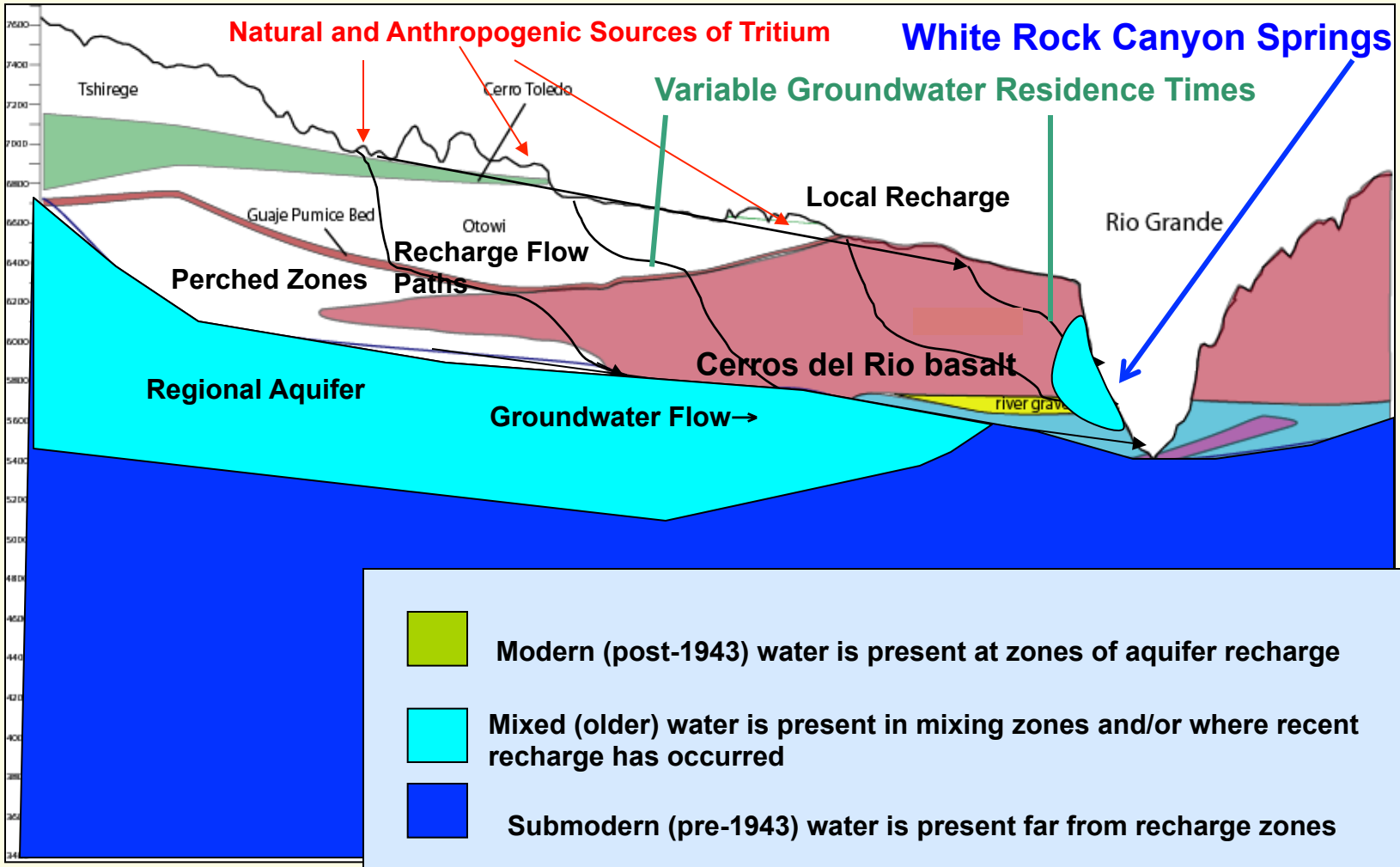
Carbon 14 (NMED)

Accelerator mass spectrometry

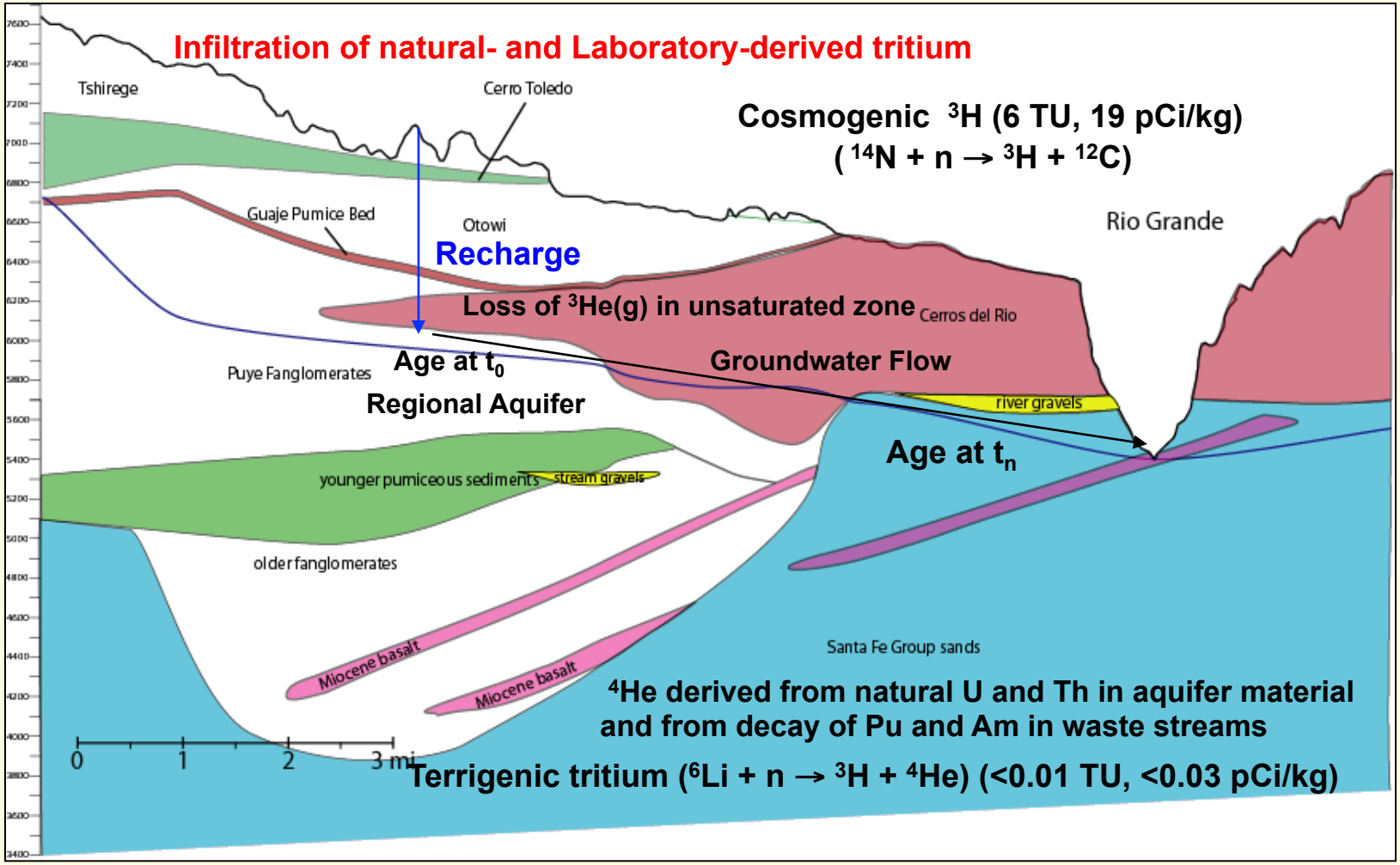
Tritium-Helium

Electrolytic enrichment (^{3}H) and mass spectrometry ($^{3,4}He$) for He ingrowth

Generalized Trends in Groundwater Age for Conceptual Model of Groundwater Flow



Conceptual Model for Tritium and Helium



Acknowledgment: "This material is based upon work supported by the Department of Energy Office of Environmental Management under Award Number *DE-EM0002420*."