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Date: March 31, 2005
Refer To: ER2005-0179

Mr. James Bearzi
NMED – Hazardous Waste Bureau
2905 Rodeo Park Drive East
Building 1
Santa Fe, NM 87505-6303

SUBJECT: GENERAL FACILITY INFORMATION REPORTS AND MAPS

Dear Mr. Bearzi:

Enclosed please find one hard copy and one electronic copy of the Los Alamos National Laboratory (LANL) and the Department of Energy (DOE) General Facility Information report and accompanying maps. This deliverable is being provided pursuant to Section IV.A.2 of the Compliance Order on Consent.

If you have any questions, please contact Gabriela Lopez-Escobedo at (505) 665-7352 or David Gregory at (505) 667-5808.

Sincerely,

David McInroy, Deputy Project Director
Remediation Services
Los Alamos National Laboratory

Sincerely,

David Gregory, Federal Project Director
Department of Energy
Los Alamos Site Office

DM/DG/GLE/ds

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CERTIFICATION

CERTIFICATION BY THE ENVIRONMENTAL STEWARDSHIP–REMEDIATION SERVICES (ENV-RS) PROJECT TECHNICAL REPRESENTATIVES

Document Title: **GENERAL FACILITY INFORMATION REPORTS**

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

Name: _____ Date: 3/30/05

David McInroy, Deputy Project Director
Remediation Services
Los Alamos National Laboratory

or

_____ Date: _____

Ken Hargis, Division Leader
Environmental Stewardship Division
Los Alamos National Laboratory

_____ Date: 3/31/05

David Gregory, Federal Project Director
Environmental Restoration Program
Department of Energy/Los Alamos Site Office

or

_____ Date: _____

John Ordaz,
Assistant Area Manager of Environmental Projects
Department of Energy/Los Alamos Site Office

LA-UR-05-1913
March 2005
ER2005-0069

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2005 General Facility Information

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Prepared by
Environmental Stewardship–Remediation Services

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LA-UR-05-1913
ER2005-0069

2005 General Facility Information

March 2005

Responsible project leader:

Printed Name	Signature	Title	Organization	Date
Gabriela Lopez Escobedo		Project Leader	ENV-RS	3/30/05

Responsible UC representative:

Printed Name	Signature	Title	Organization	Date
David McInroy		Deputy Project Director	ENV-RS	3/30/05

Responsible DOE representative:

Printed Name	Signature	Title	Organization	Date
David Gregory		Federal Project Director	DOE-LASO	3/31/05

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1.0 INTRODUCTION

The Los Alamos National Laboratory (the Laboratory) is providing this explanatory document and an unbound set of 55 maps pursuant to Section IV.A.2, General Facility Information (GFI), of the Compliance Order on Consent (the Order).

2.0 SCOPE

Section IV.A.2 of the Order states

> The Respondents shall submit to the Department the following information. These submittals are one-time submittals, unless new information becomes available. In that case, the affected submittals shall be updated and resubmitted annually:
>
> 1. Facility-wide topographic map;
> 2. Facility-wide geologic maps, surface geology, and structure contour maps;
> 3. Maps and tables indicating the surveyed coordinates and locations of all existing springs, wells, and surface water gaging stations;
> 4. Fault and high-fracture density zone maps;
> 5. Maps presenting the discharge points of seeps and springs, with tables indicating estimated flow, associated stratigraphic units, and discharge point elevations;
> 6. Alluvial groundwater maps depicting known saturated aquifer thickness and extent and suspected extent of contamination;
> 7. Perched-intermediate groundwater maps presenting aquifer thickness and flow direction data, and known and suspected vertical and lateral extents of contamination;
> 8. Regional groundwater maps depicting measured groundwater elevations and known flow direction(s);
> 9. The Facility's existing Hydrogeologic Atlas, including water-level contour map of regional aquifer and known radii-of-effects from pumping of municipal supply wells;
> 10. Diagrams using representative data showing groundwater flow regimes as indicated by water chemistry (e.g., Stiff, Piper diagrams) for all groundwater zones; and
> 11. Periodic water level data presented graphically and in tabular format.
>
> The information shall be submitted to the Department, in hardcopy and CD-ROM, beginning 30 days after the effective date of this Consent Order, and no later than March 31 of each subsequent calendar year.

Table 2.0-1 below presents the format the Laboratory will use in responding to each requirement of the request for information in the Order. Table 2.0-2 lists the numbers and the titles of the 55 maps that accompany this report and fulfill the above 11 requirements.

Table 2.0-1
General Facility Information Requirements and Formats

Section IV.A.2 Requirement Number	Description	Format
1	Facility-wide topographic map	See Hydrogeologic Atlas Sheet 1
2	Facility-wide geologic maps, surface geology, and structure contour maps	See Hydrogeologic Atlas Sheets 2, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, and 40
3	Maps and tables indicating the surveyed coordinates and locations of all existing springs, wells, and surface water gaging stations	3 maps (one each for springs, wells, and gaging stations) and Appendices A-1 through A-3
4	Fault and high-fracture density zone maps	1 map
5	Maps presenting the discharge points of seeps and springs, with tables indicating estimated flow, associated stratigraphic units, and discharge point elevations	See Requirement 3 and Appendix A-1
6	Alluvial groundwater maps depicting known saturated aquifer thickness and extent and suspected extent of contamination	2 maps
7	Perched-intermediate groundwater maps presenting aquifer thickness and flow direction data, and known and suspected vertical and lateral extents of contamination	1 map
8	Regional groundwater maps depicting measured groundwater elevations and known flow direction(s)	1 map
9	The Facility's existing Hydrogeologic Atlas, including water-level contour map of regional aquifer and known radii-of-effects from pumping of municipal supply wells	44 maps (see Hydrogeologic Atlas and Appendices B-1 and B-2)
10	Diagrams using representative data showing groundwater flow regimes as indicated by water chemistry (e.g., Stiff, Piper diagrams) for all groundwater zones	2 maps and Appendix C
11	Periodic water level data presented graphically and in tabular format	1 map

Table 2.0-2
General Facility Information Map Titles and Numbers

Section IV.A.2 Requirement Number	Map Title	Map Number
1	*Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas (LA-UR-01-70)*	
	Sheet 1: Topography of the Los Alamos Area	109020
2	*Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas (LA-UR-01-70)*	
	Sheet 2: Bedrock Geology of the Los Alamos Area (limited to units covered by atlas that crop out)	109021
	Sheet 4: Structure on top of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)	109023
	Sheet 7: Structure on top of the Cerro Toledo interval (Qct)	109026
	Sheet 10: Structure on top of the ash flow, Otowi Member, Bandelier Tuff (Qbof)	109029
	Sheet 13: Structure on top of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)	109032
	Sheet 16 Structure on top of the Cerros del Rio basalt (Tb4)	109035
	Sheet 19: Structure on top of the fanglomerate, Puye Formation (Tpf)	109038
	Sheet 22: Structure on top of the Totavi Lentil, Puye Formation (Tpt)	109041
	Sheet 25: Structure on top of the upper flows,Tschicoma Formation (Tt2)	109044
	Sheet 28: Structure on top of the lower flows,Tschicoma Formation (Tt1)	109047
	Sheet 31: Structure on top of the Los Alamos aquifer, Santa Fe Group (Tsfuv)	109050
	Sheet 34: Structure on top of the Santa Fe Group, undivided (Tsfu)	109053
	Sheet 37: Structure on top of the Bayo Canyon basalt (Tb2)	109056
	Sheet 40: Structure on top of the Santa Clara Canyon basalt (Tb1)	109059
3	Locations of Springs at Los Alamos National Laboratory	PMR04048D
	Locations of Monitoring Wells, Water Supply Wells, and Vapor Monitoring Boreholes at Los Alamos National Laboratory	04-0098-01
	Locations of Surface Water Gaging Stations at Los Alamos National Laboratory	04-0098-02
4	Faults at Los Alamos National Laboratory	m201332
5	Locations of Springs at Los Alamos National Laboratory	PMR04048D
6	Known and Suspected Extent of Alluvial Groundwater at Los Alamos National Laboratory	04-0112-02
	Known and Suspected Extent of Alluvial Groundwater Contamination at Los Alamos National Laboratory	04-0112-03
7	Perched-Intermediate Groundwater and Known Contaminants at Los Alamos National Laboratory	m201364
8	From *Groundwater Level Data Submittal to NMED* (LA-UR-05-0455)	
	Elevation of Top of Regional Aquifer for Los Alamos National Laboratory	m201360

Table 2.0-2 (continued)

Section IV.A.2 Requirement Number	Map Title		Map Number
9	*Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas (LA-UR-01-70)*		
	Sheet 1:	Topography of the Los Alamos Area	109020
	Sheet 2:	Bedrock Geology of the Los Alamos Area (limited to units covered by atlas that crop out)	109021
	Sheet 3:	Thickness of the Tshirege Member, Bandelier Tuff (Qbt)	109022
	Sheet 4:	Structure on top of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)	109023
	Sheet 5:	Depth to top of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)	109024
	Sheet 6:	Thickness of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)	109025
	Sheet 7:	Structure on top of the Cerro Toledo interval (Qct)	109026
	Sheet 8:	Depth to top of the Cerro Toledo interval (Qct)	109027
	Sheet 9:	Thickness of the Cerro Toledo interval (Qct)	109028
	Sheet 10:	Structure on top of the ash flow, Otowi Member, Bandelier Tuff (Qbof)	109029
	Sheet 11:	Depth to top of the ash flow, Otowi Member, Bandelier Tuff (Qbof)	109030
	Sheet 12:	Thickness of the ash flow, Otowi Member, Bandelier Tuff (Qbof)	109031
	Sheet 13:	Structure on top of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)	109032
	Sheet 14:	Depth to top of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)	109033
	Sheet 15:	Thickness of the the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)	109034
	Sheet 16:	Structure on top of the Cerros del Rio basalt (Tb4)	109035
	Sheet 17:	Depth to top of the Cerros del Rio basalt (Tb4)	109036
	Sheet 18:	Thickness of the Cerros del Rio basalt (Tb4)	109037
	Sheet 19:	Structure on top of the fanglomerate, Puye Formation (Tpf)	109038
	Sheet 20:	Depth to top of the fanglomerate, Puye Formation (Tpf)	109039
	Sheet 21:	Thickness of the fanglomerate, Puye Formation (Tpf)	109040
	Sheet 22:	Structure on top of the Totavi Lentil, Puye Formation (Tpt)	109041
	Sheet 23:	Depth to top of the Totavi Lentil, Puye Formation (Tpt)	109042
	Sheet 24:	Thickness of the Totavi Lentil, Puye Formation (Tpt)	109043
	Sheet 25:	Structure on top of the upper flows,Tschicoma Formation(Tt2)	109044
	Sheet 26:	Depth to top of the upper flows,Tschicoma Formation (Tt2)	109045
	Sheet 27:	Thickness of the upper flows,Tschicoma Formation (Tt2)	109046
	Sheet 28:	Structure on top of the lower flows,Tschicoma Formation (Tt1)	109047
	Sheet 29:	Depth to top of the lower flows,Tschicoma Formation (Tt1)	109048
	Sheet 30:	Thickness of the lower flows,Tschicoma Formation (Tt1)	109049
	Sheet 31:	Structure on top of the Los Alamos aquifer, Santa Fe Group (Tsfuv)	109050

Table 2.0-2 (continued)

Section IV.A.2 Requirement Number	Map Title	Map Number
9 (continued)	Sheet 32: Depth to top of the Los Alamos aquifer, Santa Fe Group (Tsfuv)	109051
	Sheet 33: Thickness of the Los Alamos aquifer, Santa Fe Group (Tsfuv)	109052
	Sheet 34: Structure on top of the Santa Fe Group, undivided (Tsfu)	109053
	Sheet 35: Depth to top of the Santa Fe Group, undivided (Tsfu)	109054
	Sheet 36: Partial thickness of the Santa Fe Group, undivided (Tsfu)	109055
	Sheet 37: Structure on top of the Bayo Canyon basalt (Tb2)	109056
	Sheet 38: Depth to top of the Bayo Canyon basalt (Tb2)	109057
	Sheet 39: Thickness of the Bayo Canyon basalt (Tb2)	109058
	Sheet 40: Structure on top of the Santa Clara Canyon basalt (Tb1)	109059
	Sheet 41: Depth to top of the Santa Clara Canyon basalt (Tb1)	109060
	Sheet 42: Thickness of the Santa Clara Canyon basalt (Tb1)	109061
	Sheet 43: Regional Piezometric Surface for the Los Alamos Area	109062
	Sheet 44: Geology at the Regional Piezometric Surface for the Los Alamos Area	109063
10	General Hydrochemistry of Intermediate and Regional Groundwater	m201423-IRGWS
	General Hydrochemistry of Alluvial Groundwater	04-0098-04
11	Groundwater Level Data in the Regional Aquifer at Los Alamos National Laboratory	m201423

3.0 DESCRIPTION OF REQUIREMENTS

The following sections describe the submittal for each of the requirements and the information provided in response to the request.

3.1 Requirement 1: Facility-Wide Topographic Map

Map 109020 or Sheet 1 of the 2001 "Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas" (Expanded Atlas) is a topographic map created using 1992 elevation model data. The text for the Expanded Atlas can be found in Appendix B-2. Section 3.9 provides an explanation of the limitations associated with the maps in the Expanded Atlas.

3.2 Requirement 2: Facility-Wide Geologic Maps, Surface Geology, and Structure Contour Maps

Maps 109021, 109023, 109026, 109029, 109032, 109035, 109038, 109041, 109044, 109047, 109050, 109053, 109056, and 109059 or Sheets 2, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, and 40 from the Expanded Atlas are provided to meet this requirement. The text for the Expanded Atlas is provided in Appendix B-2. Section 3.9 provides an explanation of the limitations associated with the maps in the Expanded Atlas.

3.3 Requirement 3: Maps and Tables Indicating the Surveyed Coordinates and Locations of All Existing Springs, Wells, and Surface Water Gaging Stations

Three separate maps—one each for springs, monitoring and water supply wells and boreholes, and gaging stations—and Appendices A-1 through A-3 are provided to meet this requirement.

Springs

Map PMR04048D shows the surveyed locations of springs at the Laboratory. The U.S. Environmental Protection Agency (EPA) defines seepage as "percolation of water through the soil from unlined canals, ditches, laterals, watercourses, or water storage facilities," and it defines a spring as "ground water seeping out of the earth where the water table intersects the ground surface" (available at http://www.epa.gov/OCEPAterms/sterms.html). The collection of horizontal location data for seeps and springs at the Laboratory has historically not distinguished between these features and has classified all water discharge points from the earth or soil as springs. The locations are derived from five feature data sources, one compiled by the U.S. Geological Survey in cooperation with the EPA and four compiled from Laboratory environmental projects.

The five feature data sources were merged into a single theme and reviewed by subject matter experts (including the New Mexico Environment Department [NMED] Department of Energy [DOE] Oversight Bureau) for appropriateness of location survey method, validity of horizontal coordinate values, seep/spring classification, periodic migration of the point of discharge, and consistency for site naming and identification. The point locations were overlain with a Digital Elevation Model to obtain the discharge-point elevation and with publicly available geologic maps to obtain the associated stratigraphic unit. A unique feature identification value is provided to link the feature data to database tables containing such information as spring water flow rate, effluent pH, specific conductance, dissolved oxygen, temperature, oxidation-reduction potential, and chemical constituents.

The seeps and springs feature data found in Appendix A-1 were derived from the following sources:

- AVLIB Springs, Shapefile WQH_avlib_springs_pnt, ArcView Library, Water Quality and Hydrology Group, Environmental Stewardship Division, 1996
- National Hydrography Dataset Program, Medium Resolution, SubBasins 13020101, 13020102, 13020202, and 13020201; US Geological Survey, 08 October 2004
- Springs, MS Excel Spreadsheet, New Mexico Environment Department, Department of Energy Oversight Bureau, Los Alamos, New Mexico, 03 November 2004
- Springs, Shapefile ER_springs_pnt (2002-0593), Information Management, Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico; November 2002
- Water Quality Database, Shapefile WQH_springs_pnt, Water Quality and Hydrology Group, Environmental Stewardship Division, November 2003.

Wells and Boreholes

Map 04-0098-01 depicts the surveyed locations of groundwater monitoring wells, vapor-monitoring boreholes and water-supply wells. The data contain locations and unique descriptive feature attributes for wells and boreholes at the Laboratory. Appendix A-2 contains the data used to develop this map. The data were compiled from various sources, including field survey, global positioning system units, a historical Laboratory document (Purtymun, 1995), and various technical well reports.

Surface Water Gaging Stations

Map 04-0098-02 depicts the surveyed locations of surface water gaging stations. The gaging-station data contain locations and unique descriptive feature attributes for storm water runoff monitoring stations at the Laboratory administered by the Laboratory's Water Quality and Hydrology (WQH) Group. The monitoring stations are associated with regulatory compliance monitoring conducted under the Clean Water Act and the Federal Facility Compliance Act.

To aid in water quality interpretation, the WQH Group has divided stream flow into three types or matrices: base flow, snowmelt, and storm runoff. Each flow type might be collected at a single location within a period of as little as a week, depending on weather conditions. At times, the flow might represent a combination of flow types. The gage station data set contains information only on storm runoff stations.

Source data were collected using global positioning system units and digital elevation model data extracted from the Cerro Grande fire laser-altimetry data set (Carey and Cole, 2002). This information has been stored in Laboratory databases, which is the primary source for this data set (Appendix A-3 of this report). Attribute data include unique identifiers to provide a relationship to water-quality information stored in Laboratory databases.

3.4 Requirement 4: Fault and High-Fracture Density Zone Maps

Fault Traces

Map m201332 depicts fault trace data, acquired from publicly available 1:24,000 scale geologic maps for the Laboratory and immediate vicinity, and fractures derived from facility-wide studies conducted by the Laboratory's Seismic Hazard Program.

The fault traces are categorized as an exposed normal fault, an approximately located normal fault, a concealed normal fault, or a fault with an uncertain trace. The spatial compilation of published fault trace data is intended for regional and site analysis similar in scale to the source publications. Published fault data exist for the Laboratory; however, fault traces for the surrounding area and the region between Los Alamos County and the Fenton Hill site, in many cases, have been investigated but remain in draft format not presently available to the public. These data will be updated and resubmitted as they are released.

The majority of the published fault trace data were digitized from scanned geologic maps that were saved as image files and georectified to Universal Transverse Mercator Zone 13N grid space for the horizontal North American Datum of 1927. The line trace vector data were converted to the State Plane Coordinate System, New Mexico, Central Zone, North American Datum of 1983 (U.S. Geological Survey feet) after the digitized features were merged into a single feature file. In the case of the Puye Quadrangle, the U.S. Geological Survey published the fault traces as vector data in addition to their paper publication. The process of scanning a paper map and digitizing traces was unnecessary for this quadrangle.

The published fault trace data were verified for conformity of digitized traces with the traces on georectified image files. The data were also verified for missing digital representations to features published on maps and for the classification of fault type.

The fault trace data are derived are from the following publications:

- "Geology of White Rock Quadrangle, Los Alamos and Santa Fe Counties, New Mexico," New Mexico Bureau of Mines and Mineral Resources in cooperation with the Los Alamos National Laboratory, Geologic Map 73; D. Dethier; scale 1:24,000; 1997

- "Geologic Map of the Puye Quadrangle, Los Alamos, Rio Arriba, Sandoval, and Santa Fe Counties, New Mexico," U.S. Department of the Interior, U.S. Geological Survey; Miscellaneous Field Studies Map MF-2419 Version 1.0; D. Dethier; scale 1:24,000; 2003
- "Geology of St. Peter's Dome Area, Jemez Mountains, New Mexico," New Mexico Bureau of Mines and Mineral Resources in cooperation with the Los Alamos National Laboratory, Geologic Map 69; F. Goff, J. N. Gardner, and G. Valentine; scale 1:24,000; 1990
- "Preliminary Geologic Map of the Frijoles 7.5-Minute Quadrangle," New Mexico Bureau of Geology and Mineral Resources, Draft Geologic Map NMBGMR OF-GM 42; F. Goff, J. N. Gardner, and S. L. Reneau; scale 1:24,000; June 2002
- "Preliminary Geologic Map of the Guaje Mountain 7.5-Minute Quadrangle, Los Alamos and Sandoval Counties, New Mexico," New Mexico Bureau of Geology and Mineral Resources, Draft Geologic Map NMBGMR OF-GM 55; K. Kempter and S. Kelley; scale 1:24,000; June 2002
- "Preliminary Geologic Map of the Jemez Springs, 7.5-Minute Quadrangle," New Mexico Bureau of Geology and Mineral Resources, Draft Geologic Map NMBGMR OF-GM 73; S. Kelley, K. A. Kempter, F. Goff, M. Ramsey, B. Osborn, and C. A. Ferguson; scale 1:24,000; May 2003

The fault coverage for the area in and surrounding the Laboratory includes fault mapping by the Laboratory's Seismic Hazard Team from 1987 to 2004 using a variety of methods (e.g., conventional geologic mapping, surveying, drilling, and trenching) and different mapping scales (ranging from 1:1200 to 1:62,500). Portions of the data include currently unpublished mapping performed by the Laboratory's Seismic Hazards Geology Team.

The coverage includes faults and related structures such as folds, fissures, and fault zones. Faults are categorized by the level of certainty in the location of the fault or related structure (e.g., well located, approximately located, concealed, or assumed/uncertain). The amount of vertical displacement (offset) on structures was determined at some location(s) along a fault. In places, faults were located by three-dimensional analysis of surveyed points on geologic contacts and were determined to lie between two surveyed points. The orientation and lateral extent of such faults is uncertain, and they are shown on the map as points. Fault zones are shown either as lines or polygons, depending on the width of the zone. The polygons represent the exposed area of the fault zone. The absence of faults in areas outside of the limit of mapping should not be inferred to mean that faults are not present. Additionally, faults are shown only in areas where they are exposed or may be inferred. The end of a fault line on the map does not necessarily indicate the end of the fault but, rather, may indicate of the end of exposure or the lack of evidence of a fault at the location, a common occurrence in urbanized areas or in areas where faults have been buried by younger sediments.

Fault traces were digitized from field geologic maps or incorporated as two-dimensional point data from locations between surveyed points. The scale and method of mapping used to locate faults determines the accuracy in the placement of the faults. These data should be used at an appropriate scale and should not be used for siting of facilities. Members of the Laboratory's Seismic Hazards Geology Team should be contacted for information on interpreting the data.

Faults and related structures included in this map are derived from the following published maps and reports and from unpublished mapping performed by the Laboratory's Seismic Hazards Geology Team.

- Aby, S. B., 1997. "The Terraces of Cochiti Canyon: Soil Development and Relation to Rectonism in the Pajarito Fault Zone," M.S. Thesis, University of New Mexico, Albuquerque, New Mexico, 159 pp.

- Gardner, J. N., and House, L., 1987. "Seismic Hazards Investigations at Los Alamos National Laboratory, 1984 to 1985," Los Alamos National Laboratory report LA-11072-MS, 76 pp.
- Gardner, J. N., Lavine, A., WoldeGabriel, G., Krier, D., Vaniman, D., Caporuscio, F., Lewis, C. J., Reneau, P., Kluk, E., and Snow, M. J., 1999. "Structural Geology of the Northwestern Portion of Los Alamos National Laboratory, Rio Grande Rift, New Mexico: Implications for Seismic Surface Rupture Potential from TA-3 to TA-55," Los Alamos National Laboratory report LA-13589-MS, 112 pp.
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Fracture Density Zones

No facility-wide fracture density zone maps exist for the Laboratory. Based on a conversation with NMED on February 22, 2005, the Laboratory is submitting a list of smaller-scale geologic studies that contain information regarding fracture density in lieu of a map. The following list of references is provided in response to this requirement:

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3.5 Requirement 5: Maps Presenting the Discharge Points of Seeps and Springs, with Tables Indicating Estimated Flow, Associated Stratigraphic Units, and Discharge Point Elevations

See Map PMR04048D and Section 3.3, Springs, for text explaining the locations of springs. Appendix A-1 provides a tabulation of various characteristics of springs to fulfill Requirement 5.

3.6 Requirement 6: Alluvial Groundwater Maps Depicting Known Saturated Aquifer Thickness and Extent and Suspected Extent of Contamination

Maps 04-0112-02 and 04-0112-03 are provided to address this requirement: one depicting the known and suspected extent of saturation and the other showing the known and suspected extent of contamination.

The alluvial system is highly transient throughout the year with spring maximums and autumn/winter minimums. Therefore, saturated thicknesses for most of the reaches are not known with certainty. The extent of saturation in canyon bottoms is shown in Map 04-0112-03 by a line symbol. As more data are obtained, maps depicting the estimated saturated thicknesses will be updated and resubmitted.

Known and Suspected Extent of Alluvial Groundwater

Field observations were used to determine persistent, intermittent, and potential saturation in alluvial groundwater. The zones were delineated through consensus by subject matter experts. Delineations were hand-drawn on a base map and digitized as a separate layer of information.

Points along a reach where persistent saturation was recorded were connected to represent a perched alluvial aquifer. Intermittent saturation is generally seasonal and was delineated by field observations of running water on alluvial sediments. Historical observations and position of alluvial sediment packages

were used to determine potential saturation. This map is considered qualitative in nature and should not be used quantitatively because of the uncertainty associated with the edges of the delineated reaches.

Known and Suspected Extent of Alluvial Groundwater Contamination

The most recent water-quality data from the Laboratory databases were used to identify key contaminants in alluvial groundwater. Results above screening levels are shown for each of the contaminants. The levels of contamination in alluvial groundwater are known only at a limited number of locations where alluvial wells exist. However, in order to depict the expected extent of contamination on a map, subject matter experts used the data from wells and their knowledge of the alluvial systems at the Laboratory to show general areas where contaminant levels are expected to exceed screening levels. These depictions represent the best understanding of contaminant locations available today but are not intended to be exact. The Laboratory's understanding of the extent of contamination is expected to change over time as new data become available.

Adjacent locations along a reach where contamination was observed were connected to represent the extent of contamination in persistent alluvial groundwater. The extent of contamination in alluvial groundwater is transient and generally decreases with time. Although the original chemical data are quantitative, depiction of contamination between and beyond measurement points is speculative, especially at the lateral extent of contamination in alluvial groundwater. This map is considered semiqualitative in nature and should not be used quantitatively.

3.7 Requirement 7: Perched-Intermediate Groundwater Maps Presenting Aquifer Thickness and Flow Direction Data and Known and Suspected Vertical and Lateral Extents of Contamination

Map m201364 is provided to address this requirement. Analytical results used to develop the map were obtained from the Laboratory databases. Hydrologic data and observations, made during drilling and presented in the well completion reports, were used to determine saturated thickness of perched-intermediate groundwater. This point-source information is displayed as text adjacent to each well location. Data required to adequately determine connection between perched zones are not yet available.

The most recent water-quality data from the Laboratory databases were used to identify key contaminants in perched-intermediate groundwater. Results above screening levels are shown for each of the contaminants. The levels of contamination in perched-intermediate groundwater are known only at a limited number of locations where perched-intermediate wells exist.

The data presented for each location on the map should be used to describe groundwater conditions at a single point. Not enough information is available to link the chemistry or lateral extent of perched groundwater from one location to another adjacent location. In addition, the direction of groundwater flow cannot be determined because not enough measurement points are available in a common perched zone (a minimum of three is needed) to provide a flow vector. The Stiff diagrams are considered quantitative; the vertical extent of saturation is considered semiquantitative.

3.8 Requirement 8: Regional Groundwater Maps Depicting Measured Groundwater Elevations and Known Flow Direction(s)

One contour map, Map m201360, representing the groundwater elevation of the top of the regional aquifer was extracted from the *Groundwater Level Data Submittal to NMED* (dated January 27, 2005) and has been reprinted to meet this requirement.

A high degree of uncertainty exists in regard to geologic controls on preferential groundwater flow. As a result of a conversation with NMED on February 22, 2005, the Laboratory is not indicating the direction of flow on Map m201360.

The sources of data used to develop this map include published reports (Koch and Rogers, 2003; Koch et al., 2004), well completion reports, and personal communication from Laboratory staff involved in drilling. Recent R-well water-level data, taken from Laboratory databases, are preliminary and subject to change.

3.9 Requirement 9: The Facility's Existing Hydrogeologic Atlas, Including Water-Level Contour Map of Regional Aquifer and Known Radii-of-Effects from Pumping of Municipal Supply Wells

The Laboratory has completed two of the three planned stages of a hydrogeologic atlas: a preliminary atlas and an expanded atlas. The third stage, annual updates to the atlas, has not been completed.

The text of the 1999 "Documentation for the Preliminary Hydrogeologic Atlas for Los Alamos National Laboratory" defined the overall purpose and scope of the atlas, described the source and quality of data used in its preparation, delineated specifications and assumptions for the various types of maps presented, and discussed the availability of the atlas (Appendix B-1). The text of the 2001 "Documentation for the Expanded Hydrogeologic Atlas for Los Alamos National Laboratory" restated the purpose, scope, and availability of the atlas but focused on new features such as subsurface maps and updates to the preliminary atlas (Appendix B-2). In response to Requirement 9, 44 maps from the 2001 Expanded Atlas are provided with this report.

The sheets of the Expanded Atlas depict all penetrations at the Laboratory as "wells" or "control points" with "well designations" and do not distinguish between wells intersecting groundwater and boreholes.

The requirement to provide the known radii-of-effects from pumping of municipal supply wells was met by a previous submittal to NMED: *Groundwater Level Data Submittal to NMED* (dated January 27, 2005) and has not been resubmitted in this report.

3.10 Requirement 10: Diagrams Using Representative Data Showing Groundwater Flow Regimes as Indicated by Water Chemistry (e.g., Stiff, Piper Diagrams) for All Groundwater Zones

Two maps are provided to address this requirement: Map m201423-IRGWS depicts the hydrochemistry of both the perched-intermediate and regional groundwater flow regimes, and Map 04-0098-04 depicts the alluvial groundwater flow regime.

Analytical results used to develop these maps were obtained from the Laboratory databases. Stiff diagrams were created using AquaChem, a water-quality data analysis, plotting, and modeling computer program. The point-source Stiff diagrams are used to illustrate general water quality in a geometric format and are displayed adjacent to each well location. Since two groundwater flow regimes (perched-intermediate and regional) are included on Map m201423-IRGWS, different colored Stiff diagrams are used to distinguish between the two regimes.

Data displayed for each location on the map are used to describe general groundwater hydrochemistry at a single point in space and time. Although the data used to generate the Stiff diagrams are quantitative, the horizontal axis lacks the resolution necessary to determine precise concentrations. Therefore, the hydrochemical data displayed are considered semiquantitative.

3.11 Requirement 11: Periodic Water-Level Data Presented Graphically and in Tabular Format

Map m201423 is provided to meet this requirement. The map was generated by evaluating automated transducer records and manual measurements to determine peizometric groundwater levels in the regional aquifer. The data have been displayed as time-variant plots and placed on a base map as a single layer. Where intermittent groundwater-level data are available next to locations with regional groundwater records, they are included in the map for reference.

The requirement to submit periodic water level data in a tabular format was met by another recent submittal to NMED (*Groundwater Level Data Submittal to NMED* dated January 27, 2005) and has not been resubmitted in this report.

The data presented in the map are considered point data in space and time. Further interpretation must be considered to delineate equipotentiometric surfaces within the aquifer. The primary purpose of the map is to illustrate the variability of peizometric head with depth over time throughout the Laboratory. Of particular interest are individual locations with multiple screens. Data used to generate the peizometric plots are considered semiqualitative in the plotted form because of the resolution of the scales. The original data are considered semiquantitative.

4.0 REFERENCES

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Koch, R. J., Rogers, D. B., Tapia, N. J., and McLin, S. G., 2004, Manual and transducer groundwater levels from test wells at Los Alamos National Laboratory, 1992–2003: Los Alamos National Laboratory report LA-14132, 36 pp.

Koch, R. J., and Rogers, D. B., 2003, Water supply at Los Alamos, 1998–2001: Los Alamos National Laboratory report LA-13985-PR, 84 pp.

Purtymun, W. D., 1995, Geologic and hydrologic records of observation wells, test holes, test wells, supply wells, springs, and surface water stations in the Los Alamos area, Los Alamos National Laboratory report LA-12883-MS, 339 pp.

Appendix A-1

Data Set for the Springs Location Map

The information presented in the following table has been taken from Los Alamos National Laboratory databases and has not been edited for typographical errors.

Data Set for the Springs Location Map

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Agua Piedra Spring	NMEDDOEOB2004 073	1618238.28	1799902.59	Unknown	8128.90		2.4 ft, average resolution	Ttc, Caballo lavas, Tshicoma Formation (Tertiary)	8–10 (estimated)	6 (estimated)
AL-10.6 Spring	NMEDDOEOB2004 159	1586782.13	1752840.12	±16 ft	8393.40		2.4 ft, average resolution	Qtr, Rabbit Mountain rhyolite, Cerro Toledo rhyolite, Tewa Group (Pleistocene)		
Alamo Spring	GNIS 00903049	1515596.37	1758161.16	±168.5 ft of true position		2292.70	10 meter, resolution	Qcpa		
ALLVSEEP 100E16-2659	NMEDDOEOB2004 076	1616812.08	1765035.06	Unknown	7294.50		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		
American Spring	NMEDDOEOB2004 127	1601080.90	1760073.01	±16 ft	8269.30		2.4 ft, average resolution		6–12 (estimated)	4 (estimated)
Ancha Spring	NMEDDOEOB2004 007	1669351.76	1750112.40	±16 ft	5699.50		4.7 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	0–4 (estimated)	<2 (estimated)
Ancho Spring	NMEDDOEOB2004 037	1647208.26	1737200.30	±16 ft	5656.00		2.4 ft, average resolution	Tcb2, Basalt flows (Pliocene)	150–200 (estimated)	8 (estimated)
Anderson Spring	NMEDDOEOB2004 080	1615965.26	1771449.02	±16 ft	7422.60		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	1.73 (measured)	<2 (estimated)
Antler Spring	NMEDDOEOB2004 154	1591844.45	1756709.11	±16 ft	7919.10		2.4 ft, average resolution		19 (estimated)	10 (estimated)
Apache Spring	NMEDDOEOB2004 140	1598799.05	1755428.59	±16 ft	8247.00		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	17 (estimated)	10 (estimated)
Armstead Spring	NMEDDOEOB2004 136	1599839.29	1762691.49	±16 ft	8210.00		2.4 ft, average resolution		4–8 (estimated)	<2 (estimated)
Barbara Spring	NMEDDOEOB2004 147	1593101.22	1754219.24	±16 ft	7734.40		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)		
Basalt Spring	NMEDDOEOB2004 028	1656440.30	1770853.11	±16 ft	6011.00		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	30–100 (estimated)	30 (estimated)
Bonito Spring	GNIS 00913783	1501534.93	1859399.49	±168.5 ft of true position		2523.70	10 meter, resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Bryan Spring	NMEDDOEOB2004 088	1614096.66	1767940.87	±16 ft	7411.70		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	8–12 (estimated)	8 (estimated)
Buck 1 Spring	NMEDDOEOB2004 009	1669149.68	1750935.42	±16 ft	5709.60		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)		
Buck 2 Spring	NMEDDOEOB2004 008	1669338.09	1750042.56	±16 ft	5710.80		4.7 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)		
Bulldog Spring	NMEDDOEOB2004 083	1614808.72	1767195.69	±16 ft	7394.70		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	40–50 (estimated)	10 (estimated)
Burning Ground Spring	NMEDDOEOB2004 085	1614268.00	1764633.00	Unknown	7417.30		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		
Butterfly Spring	NMEDDOEOB2004 069	1622484.71	1795883.58	±16 ft	7394.30		2.4 ft, average resolution	Qtal, Undifferentiated terrace and alluvium deposits (Quaternary)	< 2 (estimated)	<2 (estimated)
Campground Spring	GNIS 00913825	1501722.92	1856248.64	±168.5 ft of true position		2484.20	10 meter, resolution			
Campsite Springs	NMEDDOEOB2004 111	1603673.95	1796416.85	±16 ft	8601.50		2.4 ft, average resolution	Ttr, Rendija lavas (Tertiary)	150–200 (estimated)	75 (estimated)
Canada Spring	NMEDDOEOB2004 002	1671968.28	1748829.76	±16 ft		1754.80	10 meter, resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	<2 (estimated)	<2 (estimated)
CC-0.04 Spring	NMEDDOEOB2004 110	1603756.06	1796629.43	±16 ft	8603.00		2.4 ft, average resolution	Ttr, Rendija lavas (Tertiary)	8–12 (estimated)	8 (estimated)
CDV-0.8 Spring	NMEDDOEOB2004 071	1621704.00	1760855.00	Unknown	6987.10		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–8 (estimated)	4 (estimated)
CDV-5.0 Spring	NMEDDOEOB2004 120	1601806.34	1767986.45	±16 ft	8406.60		2.4 ft, average resolution		8–12 (estimated)	4 (estimated)
CDV-5.29 Spring	NMEDDOEOB2004 138	1599482.17	1769730.42	±16 ft	8556.80		2.4 ft, average resolution		2–4 (estimated)	<2 (estimated)
CDV-5.76 Spring	NMEDDOEOB2004 141	1597382.87	1771371.03	±16 ft	8806.40		2.4 ft, average resolution		2–4 (estimated)	<2 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
CDV-5.97 Spring	NMEDDOEOB2004 142	1596469.15	1771945.34	±16 ft	8920.80		2.4 ft, average resolution		2–4 (estimated)	<2 (estimated)
CDV-6.05 Spring	NMEDDOEOB2004 143	1596083.34	1772183.15	±16 ft	8966.50		2.4 ft, average resolution		10–16 (estimated)	4 (estimated)
Cebollita Spring	GNIS 00887311	1500180.05	1758386.43	±168.5 ft of true position		2473.40	10 meter, resolution	Qa		
Charlie's Spring	NMEDDOEOB2004 094	1613558.58	1767804.51	±16 ft	7455.80		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	4–5 (estimated)	4 (estimated)
Cochiti Spring	GNIS 00905230	1625790.00	1668388.72	±168.5 ft of true position	5312.10		4.7 ft, average resolution			
Coffman Springs	NMEDDOEOB2004 153	1591864.15	1757508.30	±16 ft	7982.60		2.4 ft, average resolution		85 (estimated)	85 (estimated)
CV Spring 1	ER2002-0593 002	1604144.00	1766462.00	Unknown	8168.70		2.4 ft, average resolution	Tphd, Hornblende dacite of Cerro Grande, Tschicoma Formation (Pliocene)	?	? (estimated)
CV Spring 2	ER2002-0593 003	1604344.00	1766562.00	Unknown	8183.70		2.4 ft, average resolution	Tphd, Hornblende dacite of Cerro Grande, Tschicoma Formation (Pliocene)	?	? (estimated)
Dave Spring	NMEDDOEOB2004 102	1606402.58	1752242.58	±16 ft	7074.30		2.4 ft, average resolution	Tphd, Hornblende dacite of Cerro Grande, Tschicoma Formation (Pliocene)	6 (estimated)	6 (estimated)
DOE Spring	NMEDDOEOB2004 052	1642347.12	1733725.61	±16 ft	5547.90		2.4 ft, average resolution	Tcbm, Basalt and interlayered phreatomagmatic deposits (Pliocene)	4–6 (estimated)	<2 (estimated)
DP Spring	NMEDDOEOB2004 059	1636477.58	1773651.18	Unknown	6896.40		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–15 (estimated)	10 (estimated)
DP-0.0 Spring	NMEDDOEOB2004 058	1637615.31	1772979.79	Unknown	6614.20		2.4 ft, average resolution	Qal, Alluvium (mostly Holocene)	< 2 (estimated)	<2 (estimated)
Dunlap Spring	GNIS 00913804	1512795.98	1829555.31	±168.5 ft of true position		2725.00	10 meter, resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Fish Ladder Spring	NMEDDOEOB2004 075	1616851.00	1763184.00	Unknown	7352.20		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	4–8 (estimated)	<2 (estimated)
Flavjo Spring	GNIS 00937099	1554416.30	1851681.11	±168.5 ft of true position		2901.90	10 meter, resolution			
FR-10.01 Spring	NMEDDOEOB2004 145	1593468.27	1754075.73	±16 ft	7718.00		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	9 (estimated)	4 (estimated)
FR-10.26 Spring	NMEDDOEOB2004 150	1592277.16	1756073.34	±16 ft	7862.90		2.4 ft, average resolution	Tphd, Hornblende dacite, Tschicoma Formation (Pliocene-Miocene)	15 (estimated)	6 (estimated)
FR-10.35 Spring	NMEDDOEOB2004 148	1592690.78	1754962.22	±16 ft	7784.10		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	9 (estimated)	4 (estimated)
FR-10.36 Spring	NMEDDOEOB2004 149	1592484.49	1757701.81	±16 ft	8026.20		2.4 ft, average resolution		6 (estimated)	4 (estimated)
FR-6.6 Spring	NMEDDOEOB2004 097	1611144.24	1749737.36	±16 ft	6839.60		2.4 ft, average resolution	Qal, Alluvium (mostly Holocene)	4 (estimated)	4 (estimated)
FR-7.7 Spring	NMEDDOEOB2004 100	1606915.94	1752186.83	±16 ft	7037.80		2.4 ft, average resolution	Tphd, Hornblende dacite of Cerro Grande, Tschicoma Formation (Pliocene)	15 (estimated)	6 (estimated)
FR-8.1 Spring	NMEDDOEOB2004 112	1603298.46	1752631.10	±16 ft	7213.20		2.4 ft, average resolution	Qbt(?), Upper Bandelier Tuff, Tshirege Member (Pleistocene)	< 2 (estimated)	<2 (estimated)
FR-8.4 Spring	NMEDDOEOB2004 125	1601158.56	1751863.08	±16 ft	7299.50		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	< 2 (estimated)	<2 (estimated)
FR-9.6 Spring	NMEDDOEOB2004 144	1594580.06	1752805.09	±16 ft	7630.20		2.4 ft, average resolution	Qls, Landslide (Quaternary)	< 2 (estimated)	<2 (estimated)
FR-9.9 Spring	NMEDDOEOB2004 146	1593448.86	1753950.80	±16 ft	7704.40		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	3–5 (estimated)	3 (estimated)
Frijoles Spring 1	NMEDDOEOB2004 151	1591940.54	1759584.95	±16 ft	8376.10		2.4 ft, average resolution		300 (estimated)	25 (estimated)
Frijoles Spring 2	NMEDDOEOB2004 157	1589897.53	1758627.20	±16 ft	8298.50		2.4 ft, average resolution		350 (estimated)	30 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
FRWT-0.15 Spring	NMEDDOEOB2004 156	1591161.62	1757591.65	±16 ft	8017.10		2.4 ft, average resolution		15 (estimated)	4 (estimated)
FRWT-0.16 Spring	NMEDDOEOB2004 155	1591813.89	1754772.73	±16 ft	7915.00		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	22 (estimated)	22 (estimated)
FRWT-1.01 Spring	NMEDDOEOB2004 158	1588869.87	1761568.24	±16 ft	8729.80		2.4 ft, average resolution		4 (estimated)	4 (estimated)
GA-0.36 Spring	NMEDDOEOB2004 065	1628646.00	1804264.00	Unknown	7288.50		4.7 ft, average resolution	Qcta, Cerro Toledo interval with younger alluvium and/or colluvium (Quaternary)		
GARVEY Spring	NMEDDOEOB2004 091	1613744.15	1767903.64	±16 ft	7450.70		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	< 2 (estimated)	<2 (estimated)
GU-0.01 Spring	NMEDDOEOB2004 013	1666463.11	1777215.24	±16 ft	5654.80		2.4 ft, average resolution	Qtp, Piedmont alluvium (Holocene)	0–15 (estimated)	6 (estimated)
GU-13.4 Spring	NMEDDOEOB2004 104	1605129.59	1795587.76	±16 ft	8492.20		2.4 ft, average resolution	Ttr, Rendija lavas (Tertiary)	8–12 (estimated)	8 (estimated)
GU-13.6 Spring	NMEDDOEOB2004 106	1604400.87	1796189.73	±16 ft	8564.70		2.4 ft, average resolution	Ttr, Rendija lavas (Tertiary)	< 2 (estimated)	<2 (estimated)
GU-13.8 Spring	NMEDDOEOB2004 117	1602681.33	1796734.16	±16 ft	8673.40		2.4 ft, average resolution		< 2 (estimated)	<2 (estimated)
GU-13.85 Spring	NMEDDOEOB2004 115	1602687.39	1796566.73	±16 ft	8667.80		2.4 ft, average resolution		10–14 (estimated)	10 (estimated)
GU-14.0 Spring	NMEDDOEOB2004 118	1602290.14	1796617.80	±16 ft	8702.20		2.4 ft, average resolution		15–20 (estimated)	4 (estimated)
GUAJE Spring 1	NMEDDOEOB2004 131	1600653.52	1797624.58	±16 ft	8839.00		2.4 ft, average resolution		100 (estimated)	10 (estimated)
GUAJE Spring 2	NMEDDOEOB2004 132	1600495.65	1795990.48	±16 ft	8819.60		2.4 ft, average resolution		150 (estimated)	40 (estimated)
GUARDIA Spring	GNIS 00913814	1507704.14	1838233.36	±168.5 ft of true position		2691.10	10 meter, resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
GUNT-0.20 Spring	NMEDDOEOB2004 122	1601420.23	1797452.94	±16 ft	8798.70		2.4 ft, average resolution		10–14 (estimated)	10 (estimated)
GUNT-0.24 Spring	NMEDDOEOB2004 124	1601249.22	1797626.35	±16 ft	8817.20		2.4 ft, average resolution		< 2 (estimated)	<2 (estimated)
GUSF-0.3 Spring	NMEDDOEOB2004 130	1600706.00	1796071.93	±16 ft	8801.60		2.4 ft, average resolution		< 2 (estimated)	<2 (estimated)
GUSF-0.4 Spring	NMEDDOEOB2004 135	1600236.87	1795912.04	±16 ft	8836.10		2.4 ft, average resolution		3–5 (estimated)	<2 (estimated)
Hamilton Bend Spring	NMEDDOEOB2004 050	1642643.00	1776209.00	±16 ft	6493.40		2.4 ft, average resolution	Qtp5, Piedmont alluvium (Holocene to late Pleistocene(?))	0–8 (estimated)	<2 (estimated)
Hanlon Spring	NMEDDOEOB2004 081	1615437.49	1771631.48	±16 ft	7481.90		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–2 (estimated)	<2 (estimated)
Hollow Spring	NMEDDOEOB2004 070	1622326.00	1762412.00	Unknown	7156.80		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	<2 (estimated)	<2 (estimated)
Homestead Spring	NMEDDOEOB2004 087	1614176.32	1768659.27	±16 ft	7440.10		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	10–30 (estimated)	6 (estimated)
Indian Spring	NMEDDOEOB2004 011	1667390.37	1777251.42	Unknown	5660.60		2.4 ft, average resolution	Qtp5, Piedmont alluvium (Holocene to late Pleistocene(?))	2–6 (estimated)	4 (estimated)
Jemez Canyon Hot Spring	NMEDDOEOB2004 165	1522544.00	1757562.00	±328 ft		2083.50	10 meter, resolution	IPm		
Jemez Hot Spring ORIG	GNIS 00914428	1510033.05	1737214.69	±168.5 ft of true position		1895.30	10 meter, resolution	Qal		
Jemez Village Spring JS2/3	NMEDDOEOB2004 169	1509544.00	1735762.00	±328 ft		1896.50	10 meter, resolution	Qal		
Jemez Village Spring JS4/5	NMEDDOEOB2004 167	1511044.00	1741162.00	±328 ft		1923.00	10 meter, resolution	Qc		
Josie Spring	NMEDDOEOB2004 086	1614227.03	1767981.42	±16 ft	7411.60		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–4 (estimated)	4 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Kieling Spring	NMEDDOEOB2004 084	1614502.26	1767223.06	±16 ft	7417.40		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	8–20 (estimated)	8 (estimated)
La Cueva Spring	NMEDDOEOB2004 162	1523844.00	1772862.00	±328 ft		2336.60	10 meter, resolution	Qal		
La Jara Spring	GNIS 00937103	1557180.81	1851078.39	±168.5 ft of true position		2908.70	10 meter, resolution			
La Mesita Spring	NMEDDOEOB2004 003	1671887.79	1772266.86	±16 ft	5549.60		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	30–50 (estimated)	8 (estimated)
LA-12.6 Spring	NMEDDOEOB2004 103	1606240.73	1780669.97	±16 ft	7966.50		2.4 ft, average resolution	Qal, Alluvium (Quaternary)	8–12 (estimated)	6 (estimated)
LA-13.8 Spring	NMEDDOEOB2004 137	1599734.37	1781437.13	Unknown	8876.70		2.4 ft, average resolution		12–18 (estimated)	<2 (estimated)
LA-5.19 Spring	NMEDDOEOB2004 045	1643975.75	1771875.76	±16 ft	6471.10		2.4 ft, average resolution	Qa3(?), Alluvial deposit (Holocene)	0–18 (estimated)	4 (estimated)
Las Vegitas Spring	GNIS 00918230	1509979.61	1693095.11	±168.5 ft of true position		1791.20	10 meter, resolution			
Leche Spring	GNIS 00937104	1539445.31	1824735.76	±168.5 ft of true position		2791.70	10 meter, resolution			
Los Alamos Spring	NMEDDOEOB2004 024	1657368.09	1771080.46	±16 ft	5976.80		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	2–4 (estimated)	<2 (estimated)
Madrid Spring	GNIS 00937107	1546491.19	1840918.36	±168.5 ft of true position		2978.00	10 meter, resolution			
Martin Spring	NMEDDOEOB2004 082	1614837.00	1761965.00	Unknown	7442.70		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–20 (measured)	<2 (estimated)
Mccauley Spring	GNIS 00914324	1528522.58	1753944.98	±168.5 ft of true position		2241.90	10 meter, resolution	Qls		
Ojito Palo Duro	GNIS 00909273	1557439.60	1857728.07	±168.5 ft of true position		2849.20	10 meter, resolution			
Ojo Chamisa	GNIS 00915871	1522132.96	1667248.31	±168.5 ft of true position		1866.00	10 meter, resolution			
Otowi Spring	NMEDDOEOB2004 001	1672317.50	1773647.96	±16 ft	5492.20		2.4 ft, average resolution	Qa3, Alluvial deposit (Holocene)	4–10 (estimated)	4 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Pajarito Ski Chair	NMEDDOEOB2004 116	1602684.31	1779176.59	±16 ft	8982.90		2.4 ft, average resolution			
Pajarito Ski Shop	NMEDDOEOB2004 139	1599397.34	1780625.40	±16 ft	9221.30		2.4 ft, average resolution			
PBTR-0.71 Spring	NMEDDOEOB2004 079	1616088.78	1781785.31	Unknown	7529.20		2.4 ft, average resolution	Qbt, Upper Bandelier, Tshirege Member (Quaternary)	< 2 (estimated)	<2 (estimated)
PC Spring	NMEDDOEOB2004 128	1601022.14	1772943.43	±16 ft	8789.60		2.4 ft, average resolution		20–40 (estimated)	10 (estimated)
PC1 Spring	NMEDDOEOB2004 121	1601495.89	1773149.00	±16 ft	8699.40		2.4 ft, average resolution		2–4 (estimated)	<2 (estimated)
PC2 Spring	NMEDDOEOB2004 123	1601397.36	1773142.24	±16 ft	8716.20		2.4 ft, average resolution		2–4 (estimated)	<2 (estimated)
Pedro Spring	GNIS 00913805	1519919.95	1827044.22	±168.5 ft of true position		2758.40	10 meter, resolution			
Perkins Spring	NMEDDOEOB2004 092	1613734.08	1767897.77	±16 ft	7446.40		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–4 (estimated)	<2 (estimated)
Peter Spring	NMEDDOEOB2004 093	1613674.00	1764863.00	Unknown	7439.50		2.4 ft, average resolution	Qbt(?), Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–10 (estimated)	<2 (estimated)
Pine Spring (SRC)	NMEDDOEOB2004 068	1624150.31	1804195.49	Unknown	7726.90		4.7 ft, average resolution	Ttc, Caballo lavas, Tshicoma Formation (Tertiary)		
Pine Spring Cabin	NMEDDOEOB2004 064	1630080.15	1803405.72	Unknown	7248.10		4.7 ft, average resolution	Tkv, Keres volcanic rocks (Miocene)		
QMZ-1.7 Spring	NMEDDOEOB2004 119	1601940.76	1789459.25	±16 ft	8815.30		2.4 ft, average resolution		< 2 (estimated)	<2 (estimated)
Quemazon Spring	NMEDDOEOB2004 114	1602713.14	1788722.77	±16 ft	8693.60		2.4 ft, average resolution		30–35 (estimated)	12 (estimated)
Reservoir Spring	NMEDDOEOB2004 101	1606859.97	1779056.92	±16 ft	7844.00		2.4 ft, average resolution	Qal, Alluvium (Quaternary)	80–100 (estimated)	10 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Rincon Spring	GNIS 00913784	1496937.42	1864442.27	±168.5 ft of true position		2543.10	10 meter, resolution			
RN-0.9 Spring	NMEDDOEOB2004 096	1612410.00	1787236.41	±16 ft	8061.30		2.4 ft, average resolution	Ttr, Rendija lavas (Tertiary)	< 2 (estimated)	<2 (estimated)
Sacred Spring	NMEDDOEOB2004 006	1669915.44	1780252.86	Unknown	5634.20		4.7 ft, average resolution	Qtp5, Piedmont alluvium (Holocene to late Pleistocene(?))	30–50 (estimated)	6 (estimated)
San Antonio Hot Spring	GNIS 00910605	1523218.26	1796917.48	±168.5 ft of true position		2549.70	10 meter, resolution			
San Antonio Warm Spring	GNIS 00902625	1548348.63	1809040.62	±168.5 ft of true position		2575.20	10 meter, resolution			
San Lorenzo Spring	GNIS 00910653	1627986.10	1834319.02	±168.5 ft of true position		2216.80	10 meter, resolution			
Sandia Spring	NMEDDOEOB2004 015	1663153.54	1761836.20	±16 ft	5682.80		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	60 (estimated)	<2 (estimated)
Sino Spring	GNIS 00911091	1513174.04	1754503.54	±168.5 ft of true position		2326.80	10 meter, resolution	Qcbt		
Skate Spring	NMEDDOEOB2004 074	1617127.82	1776078.03	Unknown	7312.90		2.4 ft, average resolution	Qbt, Upper Bandelier, Tshirege Member (Quaternary)	3–5 (estimated)	4 (estimated)
Skull Spring	NMEDDOEOB2004 152	1591938.39	1754352.71	±16 ft	7879.90		2.4 ft, average resolution	Qbo, Lower Bandelier Tuff, Otowi Member (Pleistocene)	65 (estimated)	20 (estimated)
SM-30 Spring	ER2002-0593 045	1616519.89	1773124.03	Unknown	7411.20		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–2 (estimated)	<2 (estimated)
SM-30A Spring	ER2002-0593 046	1616498.11	1772856.12	Unknown	7389.10		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–2 (estimated)	<2 (estimated)
Soda Dam Hot Spring JF5	NMEDDOEOB2004 168	1510844.00	1743662.00	±328 ft		1956.80	10 meter, resolution	Qt(?)		
Spence Hot Spring	GNIS 00914429	1528054.96	1764672.83	±168.5 ft of true position		2240.70	10 meter, resolution	Pa		
SPET-1.7 Spring	NMEDDOEOB2004 160	1584650.35	1751892.29	±16 ft	8651.80		4.7 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Spring 1	NMEDDOEOB2004 010	1667772.28	1767986.08	±16 ft	5622.00		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	40 (estimated)	<2 (estimated)
Spring 10	NMEDDOEOB2004 057	1638008.43	1728240.08	±16 ft	5368.80		4.7 ft, average resolution		<2 (estimated)	<2 (estimated)
Spring 2	NMEDDOEOB2004 012	1667216.96	1766472.82	±16 ft	5585.00		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	20 (estimated)	<2 (estimated)
Spring 2A	NMEDDOEOB2004 016	1662644.00	1754862.00	±328 ft	5517.20		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	?	? (estimated)
Spring 2B	WQH SPR ULI 14111	1661936.00	1754700.00	±0 ft	5432.90		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	<2 (estimated)	<2 (estimated)
Spring 3	NMEDDOEOB2004 020	1661216.24	1753718.34	±16 ft	5534.60		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	60–80 (estimated)	6 (estimated)
Spring 3A	NMEDDOEOB2004 019	1661229.50	1753534.16	±16 ft	5511.60		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	131–133 (measured)	100 (estimated)
Spring 3AA	NMEDDOEOB2004 021	1660966.80	1751344.95	±16 ft	5459.70		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	<2 (estimated)	<2 (estimated)
Spring 3B	NMEDDOEOB2004 018	1661354.00	1749814.00	±328 ft	5457.80		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	0–10 (estimated)	8 (estimated)
Spring 3C	NMEDDOEOB2004 022	1658441.84	1748762.52	±16 ft	5421.80		2.4 ft, average resolution	Qls(?), Landslide deposit (Holocene to late Pliocene)	16–20 (estimated)	18 (estimated)
Spring 4	NMEDDOEOB2004 023	1657414.67	1748291.71	±16 ft	5426.60		2.4 ft, average resolution	Qls(?), Landslide deposit (Holocene to late Pliocene)	184 (measured)	180 (estimated)
Spring 4A	NMEDDOEOB2004 030	1656064.01	1748068.89	±16 ft	5617.10		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	924 (measured)	50 (estimated)
Spring 4AA	NMEDDOEOB2004 029	1656115.51	1748461.51	±16 ft	5634.20		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	15–20 (estimated)	10 (estimated)
Spring 4B	NMEDDOEOB2004 026	1656962.59	1748270.68	±16 ft	5506.20		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	10 (estimated)	<2 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Spring 4C	NMEDDOEOB2004 025	1657251.15	1748374.13	±16 ft	5463.80		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	80 (estimated)	60 (estimated)
Spring 4D	NMEDDOEOB2004 027	1656650.06	1746334.82	±16 ft	5416.40		2.4 ft, average resolution	Qls(?), Landslide deposit (Holocene to late Pliocene)	<2 (estimated)	<2 (estimated)
Spring 5	NMEDDOEOB2004 033	1655026.92	1743190.17	±16 ft	5554.40		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	44 (measured)	20 (estimated)
Spring 5A	NMEDDOEOB2004 032	1655489.13	1741920.45	±16 ft	5414.60		2.4 ft, average resolution	Qls(?), Landslide deposit (Holocene to late Pliocene)	10 (estimated)	<2 (estimated)
Spring 5AA	NMEDDOEOB2004 035	1651144.00	1742562.00	±328 ft	5787.40		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	?	0 (pooled)(estimated)
Spring 5B	NMEDDOEOB2004 034	1651802.90	1738172.63	±16 ft	5393.20		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	25–35 (estimated)	15 (estimated)
Spring 5C	NMEDDOEOB2004 031	1655911.94	1742125.49	±16 ft	5411.30		2.4 ft, average resolution	Qa2(?), Alluvial and lacustrine deposit (Holocene and late Pleistocene)	<2 (estimated)	<2 (estimated)
Spring 6	WQH SPR ULI 2941	1648882.00	1735517.00	±300 ft	5380.90		2.4 ft, average resolution	Qls(?), Landslide deposit (Holocene to late Pliocene)	40–50 (estimated)	20 (estimated)
Spring 6A	NMEDDOEOB2004 038	1647047.11	1734368.47	±16 ft	5370.70		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	50–70 (estimated)	18 (estimated)
Spring 6AA	NMEDDOEOB2004 040	1646733.02	1734352.82	±16 ft	5368.90		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	120–180 (estimated)	120 (estimated)
Spring 6AAA	NMEDDOEOB2004 041	1646632.75	1734336.37	±16 ft	5374.70		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	10–100 (estimated)	50 (estimated)
Spring 7	WQH SPR ULI 2961	1645317.00	1733782.00	±15 ft	5366.70		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	6–10 (estimated)	<2 (estimated)
Spring 8	NMEDDOEOB2004 044	1644664.00	1733615.96	±16 ft	5366.40		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	6–10 (estimated)	<2 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
Spring 8A	NMEDDOEOB2004 046	1643802.22	1734004.86	Unknown	5472.40		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	20–30 (estimated)	4 (estimated)
Spring 8B	NMEDDOEOB2004 048	1643464.95	1733751.99	Unknown	5458.70		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	<2 (estimated)	< (estimated)
Spring 9	WQH SPR ULI 3011	1643134.73	1733631.21	Unknown	5460.30		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	30–40 (estimated)	8 (estimated)
Spring 9A	NMEDDOEOB2004 051	1642542.55	1733606.12	±16 ft	5563.10		2.4 ft, average resolution	Qls, Landslide deposit (Holocene to late Pliocene)	30–50 (estimated)	12 (estimated)
Spring 9B	NMEDDOEOB2004 054	1642129.00	1732281.00	±16 ft	5500.40		2.4 ft, average resolution	Tcm, Phreatomagmatic deposit (Pliocene)	<2 (estimated)	<2 (estimated)
Spring 9BB	NMEDDOEOB2004 056	1641424.91	1732332.73	Unknown	6139.40		2.4 ft, average resolution	Tcba, Basaltic andesite and related flows (Pliocene)	?	? (estimated)
Spring 9C	NMEDDOEOB2004 053	1642164.24	1731520.07	±16 ft	5403.40		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	<2 (estimated)	<2 (estimated)
Spring 9D	NMEDDOEOB2004 055	1642082.00	1731021.00	Unknown	5363.60		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)	<2 (estimated)	<2 (estimated)
Starmer Spring	NMEDDOEOB2004 090	1613806.09	1767878.80	±16 ft	7446.50		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	20–50 (estimated)	10 (estimated)
Stone Spring	NMEDDOEOB2004 105	1604647.36	1760047.17	±16 ft	7793.30		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	4–12 (estimated)	4 (estimated)
SWSC Spring	ER2002-0593 036	1613900.59	1764757.19	Unknown	7433.60		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–65 (measured)	<2 (estimated)
TA-18 Spring	NMEDDOEOB2004 060	1634124.18	1760670.04	Unknown	6757.90		2.4 ft, average resolution	Qal, Alluvium (mostly Holocene)	6–22 (measured)	4 (estimated)
Threemile Spring	ER2002-0593 029	1631998.17	1761588.94	Unknown	6797.00		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–29 (measured)	6 (estimated)
TS-1.42 Spring	NMEDDOEOB2004 066	1626815.00	1768810.00	Unknown	7173.90		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	< 2 (estimated)	<2 (estimated)

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
TW 1.72 Spring	ER2002-0593 047	1619003.18	1771044.19	Unknown	7256.40		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		
Upper Starmer Spring	NMEDDOEOB2004 095	1613443.63	1767779.07	±16 ft	7467.10		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	0–15 (estimated)	4 (estimated)
WA-6.25 Spring	NMEDDOEOB2004 067	1624989.87	1757503.12	Unknown	6796.20		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)	2–6 (estimated)	4 (estimated)
Warner Spring	NMEDDOEOB2004 004	1670018.00	1775728.00	±3280 ft	5562.10		2.4 ft, average resolution	Qc, Colluvium (Holocene to middle Pleistocene)	?	? (estimated)
Water Canyon Gallery	NMEDDOEOB2004 108	1604172.61	1762507.18	±16 ft	7948.20		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		
WC Seeps Belw SR501	NMEDDOEOB2004 098	1608230.20	1760269.42	±16 ft	7500.00		2.4 ft, average resolution	Qbt, Upper Bandelier Tuff, Tshirege Member (Pleistocene)		
Yak Spring	NMEDDOEOB2004 113	1602884.28	1788491.76	±16 ft	8674.10		2.4 ft, average resolution		8–12 (estimated)	6 (estimated)
Young Spring	NMEDDOEOB2004 099	1608157.39	1777653.32	±16 ft	7731.80		2.4 ft, average resolution	Ttp, Pajarito lavas, Tshicoma Formation (Tertiary)	8–12 (estimated)	4 (estimated)
	NHD20157 002	1540748.90	1858266.76	±168.5 ft of true position		2620.50	10 meter, resolution			
	NHD20157 004	1539919.79	1857211.46	±168.5 ft of true position		2666.40	10 meter, resolution			
	NHD20157 008	1511885.02	1835392.23	±168.5 ft of true position		2633.90	10 meter, resolution			
	NHD20157 011	1564411.48	1824164.77	±168.5 ft of true position		2964.50	10 meter, resolution			
	NHD20157 012	1523354.52	1815418.15	±168.5 ft of true position		2574.50	10 meter, resolution			
	NHD20157 013	1538276.45	1814403.79	±168.5 ft of true position		2575.10	10 meter, resolution			
	NHD20157 014	1595293.81	1813793.86	±168.5 ft of true position	8844.90		4.7 ft, average resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
	NHD20157 015	1609958.64	1810784.23	±168.5 ft of true position	8229.40		4.7 ft, average resolution	Ttu, Tshicoma Formation lavas, undifferentiated (Tertiary)		
	NHD20157 016	1518636.97	1806360.42	±168.5 ft of true position		2531.80	10 meter, resolution			
	NHD20157 017	1506008.02	1798782.53	±168.5 ft of true position		2481.10	10 meter, resolution			
	NHD20157 018	1578707.94	1792470.00	±168.5 ft of true position		2695.10	10 meter, resolution			
	NHD20157 019	1549345.70	1783926.59	±168.5 ft of true position		2856.90	10 meter, resolution			
	NHD20157 020	1552953.53	1783721.30	±168.5 ft of true position		2780.50	10 meter, resolution			
	NHD20157 021	1551264.48	1782227.55	±168.5 ft of true position		2843.60	10 meter, resolution			
	NHD20157 022	1567951.01	1780815.41	±168.5 ft of true position		2628.30	10 meter, resolution			
	NHD20157 023	1492608.75	1774773.96	±168.5 ft of true position		2340.80	10 meter, resolution			
	NHD20157 024	1594671.12	1774740.28	±168.5 ft of true position	9381.30		2.4 ft, average resolution			
	NHD20157 025	1582050.56	1772638.97	±168.5 ft of true position	8524.50		4.7 ft, average resolution			
	NHD20157 026	1510289.79	1765264.96	±168.5 ft of true position		2573.40	10 meter, resolution	Qa		
	NHD20157 031	1564493.85	1752341.55	±168.5 ft of true position		2659.60	10 meter, resolution			
	NHD20157 032	1518257.41	1743516.97	±168.5 ft of true position		2341.90	10 meter, resolution	Tba		
	NHD20157 033	1535270.97	1738110.15	±168.5 ft of true position		2495.30	10 meter, resolution			
	NHD20157 035	1607227.82	1722017.83	±168.5 ft of true position	6542.70		4.7 ft, average resolution	Tsf, Middle Santa Fe Group (Miocene)		
	NHD20157 036	1550073.58	1719896.53	±168.5 ft of true position		2525.90	10 meter, resolution			
	NHD20157 037	1555339.07	1715001.50	±168.5 ft of true position		2593.60	10 meter, resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
	NHD20157 038	1540665.93	1702380.55	±168.5 ft of true position		2187.00	10 meter, resolution			
	NHD20157 040	1508079.60	1686443.69	±168.5 ft of true position		1742.80	10 meter, resolution			
	NHD20157 041	1503947.80	1684667.49	±168.5 ft of true position		1739.90	10 meter, resolution			
	NHD20157 042	1523702.95	1674751.08	±168.5 ft of true position		2193.70	10 meter, resolution			
	NHD20157 043	1522477.04	1667880.38	±168.5 ft of true position		1878.70	10 meter, resolution			
	NHD20157 044	1624699.22	1669165.48	±168.5 ft of true position	5314.40		4.7 ft, average resolution			
	NHD20157 046	1493178.55	1859972.84	±168.5 ft of true position		2737.80	10 meter, resolution			
	NHD20157 049	1539241.66	1854205.41	±168.5 ft of true position		2707.30	10 meter, resolution			
	NHD20157 053	1548907.48	1829924.54	±168.5 ft of true position		2936.60	10 meter, resolution			
	NHD20157 054	1503626.21	1819141.96	±168.5 ft of true position		2579.00	10 meter, resolution			
	NHD20157 055	1502620.09	1817529.49	±168.5 ft of true position		2554.20	10 meter, resolution			
	NHD20157 056	1501072.59	1816001.91	±168.5 ft of true position		2533.90	10 meter, resolution			
	NHD20157 058	1666917.66	1810489.35	±168.5 ft of true position	6084.00		4.7 ft, average resolution	Qaf, Tributary alluvial fan deposit (Holocene to late Pleistocene)		
	NHD20157 059	1573431.43	1805435.96	±168.5 ft of true position		2630.20	10 meter, resolution			
	NHD20157 062	1532185.55	1785907.92	±168.5 ft of true position		2500.60	10 meter, resolution			
	NHD20157 063	1574774.17	1778781.92	±168.5 ft of true position		2661.20	10 meter, resolution			
	NHD20157 064	1566580.26	1777575.35	±168.5 ft of true position		2662.50	10 meter, resolution			
	NHD20157 065	1519844.01	1775071.15	±168.5 ft of true position		2425.10	10 meter, resolution			
	NHD20157 066	1494024.32	1774485.00	±168.5 ft of true position		2330.20	10 meter, resolution			

Data Set for the Springs Location Map (continued)

Label	Label1	Easting (ft)	Northing (ft)	Positional Accuracy (ft)	Elev (ft; Ngvd29)	Elev (M; Navd88)	Elev Accuracy	Geology	Total Flow (Lpm)	Flow At Sample Pt (Lpm)
	NHD20157 068	1522666.04	1772068.02	±168.5 ft of true position		2363.00	10 meter, resolution	Qt		
	NHD20157 069	1582383.29	1772163.84	±168.5 ft of true position	8527.20		4.7 ft, average resolution			
	NHD20157 070	1577895.74	1769085.11	±168.5 ft of true position		2592.60	10 meter, resolution			
	NHD20157 071	1582609.79	1766612.92	±168.5 ft of true position	8592.80		4.7 ft, average resolution			
	NHD20157 072	1581517.83	1766388.98	±168.5 ft of true position		2626.40	10 meter, resolution			
	NHD20157 073	1580192.30	1766148.87	±168.5 ft of true position		2626.80	10 meter, resolution			
	NHD20157 075	1547006.90	1760509.02	±168.5 ft of true position		2669.00	10 meter, resolution			
	NHD20157 076	1546202.58	1759378.18	±168.5 ft of true position		2647.60	10 meter, resolution			
	NHD20157 079	1507282.30	1750158.70	±168.5 ft of true position		2269.10	10 meter, resolution	Tpa		
	NHD20157 080	1507371.21	1749450.29	±168.5 ft of true position		2254.60	10 meter, resolution	Tpa		
	NHD20157 081	1561650.48	1749752.00	±168.5 ft of true position		2679.80	10 meter, resolution			
	NHD20157 082	1670029.55	1750974.22	±168.5 ft of true position	5681.10		2.4 ft, average resolution	Qc, Colluvial deposit (Holocene to middle Pleistocene)		
	NHD20157 083	1590776.57	1722421.16	±168.5 ft of true position		1996.00	10 meter, resolution	Tkpt, Peralta tuff, Bearhead rhyolite, Keres Group (Miocene)		
	NHD20157 084	1513172.35	1693333.54	±168.5 ft of true position		1809.20	10 meter, resolution			

Appendix A-2

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map

The information presented in the following table has been taken from Los Alamos National Laboratory databases and has not been edited for typographical errors.

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
16-P-1		TA-16 MDA-P	7/29/1987	35.00	35.00	Well	Monitor Well	LANL	Alluvial	1616000.00	1764707.00	7344.00		Putymun 1995	Good	
16-P-5		TA-16 MDA-P	7/29/1987	35.00	35.00	Well	Monitor Well	LANL	Alluvial	1615764.00	1764594.00	7353.00		Putymun 1995	Good	
16-P-7		TA-16 MDA-P	7/29/1987	35.00	35.00	Well	Monitor Well	LANL	Alluvial	1615625.00	1764553.00	7356.00		Putymun 1995	Good	
16-P-9		TA-16 MDA-P	7/29/1987	35.00	35.00	Well	Monitor Well	LANL	Alluvial	1615427.00	1764443.00	7376.00		Putymun 1995	Good	
18-BG-1	18-01060	Pajarito Canyon W of TA-18	8/1/1994	37.00	35.00	Well	Monitor Well	LANL ER	Alluvial	1634152.90	1762575.36	6776.45	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1060
18-BG-4	18-10024	Threemile Canyon	2/18/1998	25.00	6.80	Well	Monitor Well	LANL ER	Alluvial	1633600.00	1760750.00	6725.00	Shallow Alluvial Well	RJK Estimate	Moderate	Not Surveyed Gray 01, Est from FIMAD Map
18-MW-1	18-02013	Pajarito Canyon at TA-18	7/8/1990	25.60	25.60	Well	Monitor Well	LANL ER	Alluvial	1634843.70	1761930.30	6758.80	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-10	18-01255	Pajarito Canyon at TA-18	8/10/1994	22.00	20.00	Well	Monitor Well	LANL ER	Alluvial	1635610.25	1761063.57	6735.90	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-11	18-01275	Pajarito Canyon at TA-18	8/11/1994	49.00	47.00	Well	Monitor Well	LANL ER	Alluvial	1636001.69	1761139.83	6740.13	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-12	18-10010	Pajarito Canyon at TA-18	11/6/1996	43.80	41.00	Well	Monitor Well	LANL ER	Alluvial	1636139.90	1760607.80	6725.70	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-13	18-10011	Pajarito Canyon at TA-18	11/14/1996	40.10	40.00	Well	Monitor Well	LANL ER	Alluvial	1636092.80	1760626.10	6727.30	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-14	18-10012	Pajarito Canyon at TA-18	11/8/1996	45.00	43.00	Well	Monitor Well	LANL ER	Alluvial	1636093.90	1760676.80	6725.80	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-15	18-10013	Pajarito Canyon at TA-18	11/12/1996	48.00	39.00	Well	Monitor Well	LANL ER	Alluvial	1635995.70	1760669.40	6727.90	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-16	18-10014	Pajarito Canyon at TA-18	11/4/1996	37.00	30.50	Well	Monitor Well	LANL ER	Alluvial	1636040.80	1760580.70	6727.00	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-17	18-01684	Lower Pajarito Canyon	8/1/1995	23.80	22.00	Well	Monitor Well	LANL ER	Alluvial	1637778.20	1759717.10	6695.20	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1684
18-MW-18	18-01685	Lower Pajarito Canyon	7/31/1995	24.00	23.00	Well	Monitor Well	LANL ER	Alluvial	1639925.00	1758247.20	6654.70	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1685
18-MW-2	18-02014	Pajarito Canyon at TA-18	7/8/1990	27.60	27.60	Well	Monitor Well	LANL ER	Alluvial	1634878.40	1761868.10	6758.50	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2014
18-MW-3	18-02015	Pajarito Canyon at TA-18	7/8/1990	27.00	23.40	Well	Monitor Well	LANL ER	Alluvial	1634893.60	1761864.10	6758.30	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2015
18-MW-4	18-02016	Pajarito Canyon at TA-18	7/8/1990	26.20	26.20	Well	Monitor Well	LANL ER	Alluvial	1634904.50	1761878.60	6758.30	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2016
18-MW-5	18-02023	Pajarito Canyon at TA-18	3/7/1994	30.00	28.00	Well	Monitor Well	LANL ER	Alluvial	1635883.20	1761021.00	6736.70	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2023
18-MW-6	18-02024	Pajarito Canyon at TA-18	3/9/1994	27.00	25.00	Well	Monitor Well	LANL ER	Alluvial	1635899.60	1760916.30	6730.10	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2024
18-MW-7	18-01135	Pajarito Canyon at TA-18	7/6/1994	32.00	30.00	Well	Monitor Well	LANL ER	Alluvial	1634846.28	1761791.52	6755.50	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1135

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
18-MW-8	18-01166	Three Mile Canyon TA-18	8/4/1994	40.00	37.90	Well	Monitor Well	LANL ER	Alluvial	1634714.26	1760658.14	6747.79	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1166
18-MW-9	18-01234	Pajarito Canyon at TA-18	7/21/1994	23.00	21.00	Well	Monitor Well	LANL ER	Alluvial	1635949.81	1760893.56	6732.91	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1234
39-DM-2	39-01121	Ancho Canyon North Fork	6/15/1994	40.00	40.00	Well	Monitor Well	LANL ER	Alluvial	1639912.00	1743157.00	6277.18	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-4	39-01133	Ancho Canyon North Fork	6/15/1994	17.50	17.50	Well	Monitor Well	LANL ER	Alluvial	1639844.00	1743548.00	6285.96	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-6	39-01135	Ancho Canyon North Fork	8/15/1994	60.00	60.00	Well	Monitor Well	LANL ER	Alluvial	1637094.00	1747228.00	6384.57	MDA-Y Monitor Well	ER Locations	Good	ER Locations from ENV
39-UM-3	39-01120	Ancho Canyon North Fork	8/15/1994	55.00	54.00	Well	Monitor Well	LANL ER	Alluvial	1637032.00	1747663.00	6394.20	TA-39 OU-1132 MDA Y Well	ER Locations	Good	ER Locations from ENV
APCO-1		Pueblo Canyon	8/15/1990	20.00	19.70	Well	Monitor Well	LANL	Alluvial	1649210.00	1773020.00	6368.00		Putymun 1995		
BCO-1	10-01277	Bayo Canyon	11/23/1994	79.00	68.00	Well	Monitor Well	LANL ER	Alluvial	1640648.74	1778914.70	6642.00		ER Survey	Good	
CDBO-1		South Fork CDB	4/17/1985	15.00	13.00	Well	Monitor Well	LANL	Alluvial	1637968.59	1760943.96	6757.60	Purtymun has 1 and 2 reversed	FIMAD	Good	BH-1045
CDBO-2		South Fork CDB	4/18/1985	18.00	18.00	Well	Monitor Well	LANL	Alluvial	1638119.02	1761103.11	6748.20	Downstream of MDAs J, K	FIMAD	Good	BH-1046
CDBO-3		South Fork CDB	4/18/1985	12.00	12.00	Well	Monitor Well	LANL	Alluvial	1640677.11	1759611.02	6670.20	Downstream of MDA L	FIMAD	Good	BH-1047
CDBO-4		Lower CDB	4/18/1985	12.00	12.00	Well	Monitor Well	LANL	Alluvial	1645474.96	1758546.95	6564.50	Downstream of MDA G	FIMAD	Good	BH-1048
CDBO-5		Upper CDB	1/1/1992	17.50	17.00	Well	Monitor Well	LANL	Alluvial	1633583.38	1765818.38	6879.01	West of TA-46 Drainage	FIMAD	Good	BH-1049
CDBO-6		Middle CDB	1/1/1992	49.00	44.00	Well	Monitor Well	LANL	Alluvial	1636209.19	1764759.78	6817.20	Near PM-4, Downstream of TA-46	FIMAD	Good	BH-1050
CDBO-7		Middle CDB	1/1/1992	44.00	39.00	Well	Monitor Well	LANL	Alluvial	1637399.97	1763301.02	6771.81	Adjacent to MDAs J, K	FIMAD	Good	BH-1051
CDBO-8		Middle CDB	1/1/1992	23.00	13.00	Well	Monitor Well	LANL	Alluvial	1639293.94	1762365.98	6722.47	Upgradient of MDA L	FIMAD	Good	BH-1052
CDBO-9		Middle CDB	1/1/1992	34.00	29.00	Well	Monitor Well	LANL	Alluvial	1642126.00	1759697.00	6633.00	Downgradient of MDA L	FIMAD	Good	BH-1053 Switched FIMAD coord with CDBM-2
CDV-MW-1	16-02655	Cañon de Valle	9/27/1997	12.00	7.60	Well	Monitor Well	LANL ER	Alluvial	1611299.50	1764152.90	7583.70		Gray 01		
CDV-MW-2	16-02656	Cañon de Valle	11/5/1997	9.20	8.20	Well	Monitor Well	LANL ER	Alluvial	1613634.45	1764932.80	7443.20		Gray 01		
CDV-MW-3	16-02657	Cañon de Valle	10/10/1997	9.10	5.70	Well	Monitor Well	LANL ER	Alluvial	1613813.20	1764850.60	7433.25		Gray 01		
CDV-MW-4	16-02658	Cañon de Valle	9/16/1997	12.00	7.20	Well	Monitor Well	LANL ER	Alluvial	1615071.40	1764469.60	7375.60		Gray 01		
CDV-MW-5	16-02659	Cañon de Valle	9/8/1997	10.00	7.00	Well	Monitor Well	LANL ER	Alluvial	1616712.10	1765035.10	7300.50		Gray 01		
CDV-MW-6	16-02660	Cañon de Valle	9/22/1997	7.00	6.90	Well	Monitor Well	LANL ER	Alluvial	1616693.20	1765036.30	7301.30		Gray 01		
FCO-1		Fence Canyon	8/22/1989	29.00	12.40	Well	Monitor Well	LANL	Alluvial	1642412.00	1751182.00	6509.00	Dry when installed	Putymun 1995		
GC-TH-1		Guaje Canyon	10/1/1966	23.00	23.00	Well	Unknown	LANL	Alluvial	1626844.00	1795762.00	7180.00	TH-1	Putymun 1995		Test Hole 1

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
GC-TH-2		Guaje Canyon	10/1/1966	103.00	102.00	Well	Unknown	LANL	Alluvial	1629800.00	1794800.00	7060.00	TH-2, Loc revised per PMO	Putymun 1995		Test Hole 2
LAO-0.3	41-01003	Los Alamos Canyon	5/27/1994	12.00	11.25	Well	Monitor Well	LANL ER	Alluvial	1624799.00	1774512.00	6968.10		Gray 01	Good	
LAO-0.6		Los Alamos Canyon	5/6/1994	17.50	13.35	Well	Monitor Well	LANL ER	Alluvial	1626748.10	1774332.90	6910.70		Gray 01	Good	
LAO-0.7		Los Alamos Canyon	6/16/2005	0.00	0.00	Well	Monitor Well	LANL	Alluvial	1627212.30	1774260.40	6900.00		WQDB		
LAO-0.8		Los Alamos Canyon	5/11/1994	17.50	12.85	Well	Monitor Well	LANL ER	Alluvial	1627699.70	1774274.70	6887.60		Gray 01	Good	
LAO-0.91	02-01022	Los Alamos Canyon	5/12/1994	15.50	14.85	Well	Monitor Well	LANL ER	Alluvial	1628654.30	1774207.00	6861.70		Gray 01	Good	
LAO-1	02-01076	Los Alamos Canyon	2/1/1966	32.00	28.00	Well	Monitor Well	LANL	Alluvial	1629395.00	1773956.00	6836.00		Putymun 1995		
LAO-1.2		Los Alamos Canyon	4/1/1969	38.00	0.00	Well	Monitor Well	LANL	Alluvial	1632644.00	1773362.00	6720.00		Putymun 1995		
LAO-1.6g		Los Alamos Canyon	3/20/1996	36.00	30.80	Well	Monitor Well	LANL ER	Alluvial	1636083.42	1772557.63	6658.01		Gray 2001	Good	
LAO-1.8		Los Alamos Canyon	4/1/1969	48.00	18.00	Well	Monitor Well	LANL	Alluvial	1635444.00	1772723.00	6680.00		Putymun 1995		
LAO-2		DP Canyon	2/1/1966	32.00	32.00	Well	Monitor Well	LANL	Alluvial	1637608.00	1773096.00	6593.00		Putymun 1995		
LAO-3		Los Alamos Canyon	2/1/1966	32.00	24.00	Well	Monitor Well	LANL	Alluvial	1638011.00	1773098.00	6578.00		Putymun 1995		
LAO-3A		Los Alamos Canyon	9/1/1989	18.00	14.70	Well	Monitor Well	LANL	Alluvial	1637980.90	1773099.80	6579.00		Putymun 1995		
LAO-4		Los Alamos Canyon	2/1/1966	31.00	24.00	Well	Monitor Well	LANL	Alluvial	1640752.00	1772730.00	6519.00		Putymun 1995		
LAO-4.5		Los Alamos Canyon	4/1/1969	62.00	40.00	Well	Monitor Well	LANL	Alluvial	1643659.00	1772088.00	6452.00		Putymun 1995		
LAO-4.5A		Los Alamos Canyon	9/1/1989	20.00	18.50	Well	Monitor Well	LANL	Alluvial	1643500.00	1772052.00	6460.00		Putymun 1995		
LAO-4.5B		Los Alamos Canyon	9/1/1989	35.00	34.90	Well	Monitor Well	LANL	Alluvial	1643512.00	1772055.00	6459.00		Putymun 1995		
LAO-4.5C		Los Alamos Canyon	11/1/1989	25.00	23.30	Well	Monitor Well	LANL	Alluvial	1643547.00	1772077.00	6458.00		Putymun 1995		
16-P-1		TA-16 MDA-P	7/29/1987	26.55	19.05	Well	Monitor Well	LANL	Alluvial	1635117.51	1773766.43	6715.02		Putymun 1995	Good	
16-P-5		TA-16 MDA-P	7/29/1987	26.43	18.83	Well	Monitor Well	LANL	Alluvial	1635176.93	1774024.08	6712.56		Putymun 1995	Good	
16-P-7		TA-16 MDA-P	7/29/1987	26.31	18.61	Well	Monitor Well	LANL	Alluvial	1635236.35	1774281.73	6710.10		Putymun 1995	Good	
16-P-9		TA-16 MDA-P	7/29/1987	26.20	18.39	Well	Monitor Well	LANL	Alluvial	1635295.77	1774539.39	6707.64		Putymun 1995	Good	
18-BG-7	18-01060	Pajarito Canyon W of TA-19	8/1/1994	26.08	18.17	Well	Monitor Well	LANL ER	Alluvial	1635355.19	1774797.04	6705.18	Shallow Alluvial Well	LANL 1995, 54616	Good	ER SITE 18-1061
18-BG-10	18-10024	Threemile Canyon	2/18/1998	25.97	17.95	Well	Monitor Well	LANL ER	Alluvial	1635414.61	1775054.69	6702.73	Shallow Alluvial Well	RJK Estimate	Moderate	Not Surveyed Gray 01, Est from FIMAD Map
18-MW-1	18-02013	Pajarito Canyon at TA-18	7/8/1990	25.85	17.73	Well	Monitor Well	LANL ER	Alluvial	1635474.03	1775312.35	6700.27	Shallow Alluvial Well	LANL 1995, 54615	Good	
~~18-MW-10~~	~~18-01255~~	~~Pajarito Canyon at TA-18~~	~~8/10/1994~~	~~25.73~~	~~17.51~~	~~Well~~	~~Monitor Well~~	~~LANL ER~~	~~Alluvial~~	~~1635533.45~~	~~1775570.00~~	~~6697.81~~	~~Shallow Alluvial Well~~	~~LANL 1995, 54615~~	~~Good~~	

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
18-MW-11	18-01275	Pajarito Canyon at TA-18	8/11/1994	25.62	17.29	Well	Monitor Well	LANL ER	Alluvial	1635592.87	1775827.65	6695.35	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-12	18-10010	Pajarito Canyon at TA-18	11/6/1996	25.50	17.07	Well	Monitor Well	LANL ER	Alluvial	1635652.29	1776085.30	6692.89	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-13	18-10011	Pajarito Canyon at TA-18	11/14/1996	25.38	16.85	Well	Monitor Well	LANL ER	Alluvial	1635711.71	1776342.96	6690.43	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-14	18-10012	Pajarito Canyon at TA-18	11/8/1996	25.27	16.63	Well	Monitor Well	LANL ER	Alluvial	1635771.13	1776600.61	6687.98	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-15	18-10013	Pajarito Canyon at TA-18	11/12/1996	25.15	16.41	Well	Monitor Well	LANL ER	Alluvial	1635830.55	1776858.26	6685.52	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-16	18-10014	Pajarito Canyon at TA-18	11/4/1996	25.04	16.19	Well	Monitor Well	LANL ER	Alluvial	1635889.97	1777115.91	6683.06	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-17	18-01684	Lower Pajarito Canyon	8/1/1995	24.92	15.97	Well	Monitor Well	LANL ER	Alluvial	1635949.39	1777373.57	6680.60	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1684
18-MW-18	18-01685	Lower Pajarito Canyon	7/31/1995	24.80	15.76	Well	Monitor Well	LANL ER	Alluvial	1636008.81	1777631.22	6678.14	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1685
18-MW-2	18-02014	Pajarito Canyon at TA-18	7/8/1990	24.69	15.54	Well	Monitor Well	LANL ER	Alluvial	1636068.23	1777888.87	6675.68	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2014
18-MW-3	18-02015	Pajarito Canyon at TA-18	7/8/1990	24.57	15.32	Well	Monitor Well	LANL ER	Alluvial	1636127.65	1778146.52	6673.23	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2015
18-MW-4	18-02016	Pajarito Canyon at TA-18	7/8/1990	24.45	15.10	Well	Monitor Well	LANL ER	Alluvial	1636187.07	1778404.18	6670.77	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2016
18-MW-5	18-02023	Pajarito Canyon at TA-18	3/7/1994	24.34	14.88	Well	Monitor Well	LANL ER	Alluvial	1636246.49	1778661.83	6668.31	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2023
18-MW-6	18-02024	Pajarito Canyon at TA-18	3/9/1994	24.22	14.66	Well	Monitor Well	LANL ER	Alluvial	1636305.91	1778919.48	6665.85	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2024
18-MW-7	18-01135	Pajarito Canyon at TA-18	7/6/1994	24.11	14.44	Well	Monitor Well	LANL ER	Alluvial	1636365.33	1779177.13	6663.39	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1135
18-MW-8	18-01166	Three Mile Canyon TA-19	8/4/1994	23.99	14.22	Well	Monitor Well	LANL ER	Alluvial	1636424.75	1779434.79	6660.93	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1166
18-MW-9	18-01234	Pajarito Canyon at TA-19	7/21/1994	23.87	14.00	Well	Monitor Well	LANL ER	Alluvial	1636484.17	1779692.44	6658.47	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1234
39-DM-8	39-01121	Ancho Canyon North Fork	6/15/1994	23.76	13.78	Well	Monitor Well	LANL ER	Alluvial	1636543.59	1779950.09	6656.02	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-10	39-01133	Ancho Canyon North Fork	6/15/1994	23.64	13.56	Well	Monitor Well	LANL ER	Alluvial	1636603.01	1780207.74	6653.56	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-12	39-01135	Ancho Canyon North Fork	8/15/1994	23.52	13.34	Well	Monitor Well	LANL ER	Alluvial	1636662.43	1780465.40	6651.10	MDA-Y Monitor Well	ER Locations	Good	ER Locations from ENV
39-UM-4	39-01120	Ancho Canyon North Fork	8/15/1994	23.41	13.12	Well	Monitor Well	LANL ER	Alluvial	1636721.85	1780723.05	6648.64	TA-39 OU-1132 MDA Y Well	ER Locations	Good	ER Locations from ENV
APCO-2		Pueblo Canyon	8/15/1990	23.29	12.90	Well	Monitor Well	LANL	Alluvial	1636781.27	1780980.70	6646.18		Putymun 1996		
BCO-2	10-01278	Bayo Canyon	11/23/1994	23.18	12.68	Well	Monitor Well	LANL ER	Alluvial	1636840.69	1781238.35	6643.72		ER Survey	Good	
CDBO-10		South Fork CDB	4/17/1985	23.06	12.46	Well	Monitor Well	LANL	Alluvial	1636900.11	1781496.01	6641.27	Purtymun has 1 and 2 reversed	FIMAD	Good	BH-1053

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
CDBO-11		South Fork CDB	4/18/1985	22.94	12.24	Well	Monitor Well	LANL	Alluvial	1636959.53	1781753.66	6638.81	Downstream of MDAs J, K	FIMAD	Good	BH-1054
CDBO-12		South Fork CDB	4/18/1985	22.83	12.03	Well	Monitor Well	LANL	Alluvial	1637018.95	1782011.31	6636.35	Downstream of MDA L	FIMAD	Good	BH-1055
CDBO-13		Lower CDB	4/18/1985	22.71	11.81	Well	Monitor Well	LANL	Alluvial	1637078.37	1782268.97	6633.89	Downstream of MDA G	FIMAD	Good	BH-1056
CDBO-14		Upper CDB	1/1/1992	22.59	11.59	Well	Monitor Well	LANL	Alluvial	1637137.79	1782526.62	6631.43	West of TA-46 Drainage	FIMAD	Good	BH-1057
CDBO-15		Middle CDB	1/1/1992	22.48	11.37	Well	Monitor Well	LANL	Alluvial	1637197.21	1782784.27	6628.97	Near PM-4, Downstream of TA-47	FIMAD	Good	BH-1058
CDBO-16		Middle CDB	1/1/1992	22.36	11.15	Well	Monitor Well	LANL	Alluvial	1637256.63	1783041.92	6626.52	Adjacent to MDAs J, K	FIMAD	Good	BH-1059
CDBO-17		Middle CDB	1/1/1992	22.24	10.93	Well	Monitor Well	LANL	Alluvial	1637316.05	1783299.58	6624.06	Upgradient of MDA L	FIMAD	Good	BH-1060
CDBO-18		Middle CDB	1/1/1992	22.13	10.71	Well	Monitor Well	LANL	Alluvial	1637375.47	1783557.23	6621.60	Downgradient of MDA L	FIMAD	Good	BH-1053 Switched FIMAD coord with CDBM-3
CDV-MW-7	16-02661	Ca±on de Valle	9/27/1997	22.01	10.49	Well	Monitor Well	LANL ER	Alluvial	1637434.89	1783814.88	6619.14		Gray 01		
CDV-MW-8	16-02662	Ca±on de Valle	11/5/1997	21.90	10.27	Well	Monitor Well	LANL ER	Alluvial	1637494.31	1784072.53	6616.68		Gray 01		
CDV-MW-9	16-02663	Ca±on de Valle	10/10/1997	21.78	10.05	Well	Monitor Well	LANL ER	Alluvial	1637553.73	1784330.19	6614.22		Gray 01		
CDV-MW-10	16-02664	Ca±on de Valle	9/16/1997	21.66	9.83	Well	Monitor Well	LANL ER	Alluvial	1637613.15	1784587.84	6611.76		Gray 01		
CDV-MW-11	16-02665	Ca±on de Valle	9/8/1997	21.55	9.61	Well	Monitor Well	LANL ER	Alluvial	1637672.57	1784845.49	6609.31		Gray 01		
CDV-MW-12	16-02666	Ca±on de Valle	9/22/1997	21.43	9.39	Well	Monitor Well	LANL ER	Alluvial	1637731.98	1785103.14	6606.85		Gray 01		
FCO-2		Fence Canyon	8/22/1989	21.31	9.17	Well	Monitor Well	LANL	Alluvial	1637791.40	1785360.80	6604.39	Dry when installed	Putymun 1995		
GC-TH-3		Guaje Canyon	10/1/1966	21.20	8.95	Well	Unknown	LANL	Alluvial	1637850.82	1785618.45	6601.93	TH-2	Putymun 1995		Test Hole 3
GC-TH-4		Guaje Canyon	10/1/1966	21.08	8.73	Well	Unknown	LANL	Alluvial	1637910.24	1785876.10	6599.47	TH-2, Loc revised per PMO	Putymun 1995		Test Hole 4
LAO-0.3	41-01004	Los Alamos Canyon	5/27/1994	20.97	8.51	Well	Monitor Well	LANL ER	Alluvial	1637969.66	1786133.75	6597.01		Gray 01	Good	
LAO-0.6		Los Alamos Canyon	5/6/1994	20.85	8.29	Well	Monitor Well	LANL ER	Alluvial	1638029.08	1786391.41	6594.56		Gray 01	Good	
LAO-0.7		Los Alamos Canyon	6/16/2005	20.73	8.08	Well	Monitor Well	LANL	Alluvial	1638088.50	1786649.06	6592.10		WQDB		
LAO-0.8		Los Alamos Canyon	5/11/1994	20.62	7.86	Well	Monitor Well	LANL ER	Alluvial	1638147.92	1786906.71	6589.64		Gray 01	Good	
LAO-0.91	02-01130	Los Alamos Canyon	5/12/1994	20.50	7.64	Well	Monitor Well	LANL ER	Alluvial	1638207.34	1787164.36	6587.18		Gray 01	Good	
LAO-2	02-01184	Los Alamos Canyon	2/1/1966	20.38	7.42	Well	Monitor Well	LANL	Alluvial	1638266.76	1787422.02	6584.72		Putymun 1995		
LAO-1.3		Los Alamos Canyon	4/1/1969	20.27	7.20	Well	Monitor Well	LANL	Alluvial	1638326.18	1787679.67	6582.26		Putymun 1995		
LAO-1.6g		Los Alamos Canyon	3/20/1996	20.15	6.98	Well	Monitor Well	LANL ER	Alluvial	1638385.60	1787937.32	6579.80		Gray 2002	~~Good~~	

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
LAO-1.9		Los Alamos Canyon	4/1/1969	20.04	6.76	Well	Monitor Well	LANL	Alluvial	1638445.02	1788194.97	6577.35		Putymun 1995		
LAO-4		DP Canyon	2/1/1966	19.92	6.54	Well	Monitor Well	LANL	Alluvial	1638504.44	1788452.63	6574.89		Putymun 1995		
LAO-5		Los Alamos Canyon	2/1/1966	19.80	6.32	Well	Monitor Well	LANL	Alluvial	1638563.86	1788710.28	6572.43		Putymun 1995		
LAO-3A		Los Alamos Canyon	9/1/1989	19.69	6.10	Well	Monitor Well	LANL	Alluvial	1638623.28	1788967.93	6569.97		Putymun 1995		
LAO-5		Los Alamos Canyon	2/1/1966	19.57	5.88	Well	Monitor Well	LANL	Alluvial	1638682.70	1789225.59	6567.51		Putymun 1995		
LAO-4.6		Los Alamos Canyon	4/1/1969	19.45	5.66	Well	Monitor Well	LANL	Alluvial	1638742.12	1789483.24	6565.05		Putymun 1995		
LAO-4.5A		Los Alamos Canyon	9/1/1989	19.34	5.44	Well	Monitor Well	LANL	Alluvial	1638801.54	1789740.89	6562.60		Putymun 1995		
LAO-4.5B		Los Alamos Canyon	9/1/1989	19.22	5.22	Well	Monitor Well	LANL	Alluvial	1638860.96	1789998.54	6560.14		Putymun 1995		
LAO-4.5C		Los Alamos Canyon	11/1/1989	19.11	5.00	Well	Monitor Well	LANL	Alluvial	1638920.38	1790256.20	6557.68		Putymun 1995		
16-P-1		TA-16 MDA-P	7/29/1987	18.99	4.78	Well	Monitor Well	LANL	Alluvial	1638979.80	1790513.85	6555.22		Putymun 1995	Good	
16-P-5		TA-16 MDA-P	7/29/1987	18.87	4.56	Well	Monitor Well	LANL	Alluvial	1639039.22	1790771.50	6552.76		Putymun 1995	Good	
16-P-7		TA-16 MDA-P	7/29/1987	18.76	4.35	Well	Monitor Well	LANL	Alluvial	1639098.64	1791029.15	6550.30		Putymun 1995	Good	
16-P-9		TA-16 MDA-P	7/29/1987	18.64	4.13	Well	Monitor Well	LANL	Alluvial	1639158.06	1791286.81	6547.85		Putymun 1995	Good	
18-BG-13	18-01060	Pajarito Canyon W of TA-20	8/1/1994	18.52	3.91	Well	Monitor Well	LANL ER	Alluvial	1639217.48	1791544.46	6545.39	Shallow Alluvial Well	LANL 1995, 54617	Good	ER SITE 18-1062
18-BG-16	18-10024	Threemile Canyon	2/18/1998	18.41	3.69	Well	Monitor Well	LANL ER	Alluvial	1639276.90	1791802.11	6542.93	Shallow Alluvial Well	RJK Estimate	Moderate	Not Surveyed Gray 01, Est from FIMAD Map
18-MW-1	18-02013	Pajarito Canyon at TA-18	7/8/1990	18.29	3.47	Well	Monitor Well	LANL ER	Alluvial	1639336.32	1792059.76	6540.47	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-10	18-01255	Pajarito Canyon at TA-18	8/10/1994	18.18	3.25	Well	Monitor Well	LANL ER	Alluvial	1639395.74	1792317.42	6538.01	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-11	18-01275	Pajarito Canyon at TA-18	8/11/1994	18.06	3.03	Well	Monitor Well	LANL ER	Alluvial	1639455.16	1792575.07	6535.55	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-12	18-10010	Pajarito Canyon at TA-18	11/6/1996	17.94	2.81	Well	Monitor Well	LANL ER	Alluvial	1639514.58	1792832.72	6533.09	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-13	18-10011	Pajarito Canyon at TA-18	11/14/1996	17.83	2.59	Well	Monitor Well	LANL ER	Alluvial	1639574.00	1793090.37	6530.64	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-14	18-10012	Pajarito Canyon at TA-18	11/8/1996	17.71	2.37	Well	Monitor Well	LANL ER	Alluvial	1639633.42	1793348.03	6528.18	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-15	18-10013	Pajarito Canyon at TA-18	11/12/1996	17.59	2.15	Well	Monitor Well	LANL ER	Alluvial	1639692.84	1793605.68	6525.72	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-16	18-10014	Pajarito Canyon at TA-18	11/4/1996	17.48	1.93	Well	Monitor Well	LANL ER	Alluvial	1639752.26	1793863.33	6523.26	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-17	18-01684	Lower Pajarito Canyon	8/1/1995	17.36	1.71	Well	Monitor Well	LANL ER	Alluvial	1639811.68	1794120.98	6520.80	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1684

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
18-MW-18	18-01685	Lower Pajarito Canyon	7/31/1995	17.25	1.49	Well	Monitor Well	LANL ER	Alluvial	1639871.10	1794378.64	6518.34	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1685
18-MW-2	18-02014	Pajarito Canyon at TA-18	7/8/1990	17.13	1.27	Well	Monitor Well	LANL ER	Alluvial	1639930.52	1794636.29	6515.89	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2014
18-MW-3	18-02015	Pajarito Canyon at TA-18	7/8/1990	17.01	1.05	Well	Monitor Well	LANL ER	Alluvial	1639989.94	1794893.94	6513.43	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2015
18-MW-4	18-02016	Pajarito Canyon at TA-18	7/8/1990	16.90	0.83	Well	Monitor Well	LANL ER	Alluvial	1640049.36	1795151.60	6510.97	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2016
18-MW-5	18-02023	Pajarito Canyon at TA-18	3/7/1994	16.78	0.62	Well	Monitor Well	LANL ER	Alluvial	1640108.78	1795409.25	6508.51	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2023
18-MW-6	18-02024	Pajarito Canyon at TA-18	3/9/1994	16.66	0.40	Well	Monitor Well	LANL ER	Alluvial	1640168.20	1795666.90	6506.05	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2024
18-MW-7	18-01135	Pajarito Canyon at TA-18	7/6/1994	16.55	0.18	Well	Monitor Well	LANL ER	Alluvial	1640227.62	1795924.55	6503.59	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1135
18-MW-8	18-01166	Three Mile Canyon TA-20	8/4/1994	16.43	-0.04	Well	Monitor Well	LANL ER	Alluvial	1640287.04	1796182.21	6501.14	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1166
18-MW-9	18-01234	Pajarito Canyon at TA-20	7/21/1994	16.32	-0.26	Well	Monitor Well	LANL ER	Alluvial	1640346.46	1796439.86	6498.68	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1234
39-DM-14	39-01121	Ancho Canyon North Fork	6/15/1994	16.20	-0.48	Well	Monitor Well	LANL ER	Alluvial	1640405.88	1796697.51	6496.22	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-16	39-01133	Ancho Canyon North Fork	6/15/1994	16.08	-0.70	Well	Monitor Well	LANL ER	Alluvial	1640465.30	1796955.16	6493.76	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-18	39-01135	Ancho Canyon North Fork	8/15/1994	15.97	-0.92	Well	Monitor Well	LANL ER	Alluvial	1640524.72	1797212.82	6491.30	MDA-Y Monitor Well	ER Locations	Good	ER Locations from ENV
39-UM-5	39-01120	Ancho Canyon North Fork	8/15/1994	15.85	-1.14	Well	Monitor Well	LANL ER	Alluvial	1640584.13	1797470.47	6488.84	TA-39 OU-1132 MDA Y Well	ER Locations	Good	ER Locations from ENV
APCO-3		Pueblo Canyon	8/15/1990	15.73	-1.36	Well	Monitor Well	LANL	Alluvial	1640643.55	1797728.12	6486.38		Putymun 1997		
BCO-3	10-01279	Bayo Canyon	11/23/1994	15.62	-1.58	Well	Monitor Well	LANL ER	Alluvial	1640702.97	1797985.77	6483.93		ER Survey	Good	
CDBO-19		South Fork CDB	4/17/1985	15.50	-1.80	Well	Monitor Well	LANL	Alluvial	1640762.39	1798243.43	6481.47	Purtymun has 1 and 2 reversed	FIMAD	Good	BH-1061
CDBO-20		South Fork CDB	4/18/1985	15.39	-2.02	Well	Monitor Well	LANL	Alluvial	1640821.81	1798501.08	6479.01	Downstream of MDAs J, K	FIMAD	Good	BH-1062
CDBO-21		South Fork CDB	4/18/1985	15.27	-2.24	Well	Monitor Well	LANL	Alluvial	1640881.23	1798758.73	6476.55	Downstream of MDA L	FIMAD	Good	BH-1063
CDBO-22		Lower CDB	4/18/1985	15.15	-2.46	Well	Monitor Well	LANL	Alluvial	1640940.65	1799016.38	6474.09	Downstream of MDA G	FIMAD	Good	BH-1064
CDBO-23		Upper CDB	1/1/1992	15.04	-2.68	Well	Monitor Well	LANL	Alluvial	1641000.07	1799274.04	6471.63	West of TA-46 Drainage	FIMAD	Good	BH-1065
CDBO-24		Middle CDB	1/1/1992	14.92	-2.90	Well	Monitor Well	LANL	Alluvial	1641059.49	1799531.69	6469.18	Near PM-4, Downstream of TA-48	FIMAD	Good	BH-1066
CDBO-25		Middle CDB	1/1/1992	14.80	-3.12	Well	Monitor Well	LANL	Alluvial	1641118.91	1799789.34	6466.72	Adjacent to MDAs J, K	FIMAD	Good	BH-1067
CDBO-26		Middle CDB	1/1/1992	14.69	-3.33	Well	Monitor Well	LANL	Alluvial	1641178.33	1800046.99	6464.26	Upgradient of MDA L	FIMAD	Good	BH-1068

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
CDBO-27		Middle CDB	1/1/1992	14.57	-3.55	Well	Monitor Well	LANL	Alluvial	1641237.75	1800304.65	6461.80	Downgradient of MDA L	FIMAD	Good	BH-1053 Switched FIMAD coord with CDBM-4
CDV-MW-13	16-02667	Ca±on de Valle	9/27/1997	14.46	-3.77	Well	Monitor Well	LANL ER	Alluvial	1641297.17	1800562.30	6459.34		Gray 01		
CDV-MW-14	16-02668	Ca±on de Valle	11/5/1997	14.34	-3.99	Well	Monitor Well	LANL ER	Alluvial	1641356.59	1800819.95	6456.88		Gray 01		
CDV-MW-15	16-02669	Ca±on de Valle	10/10/1997	14.22	-4.21	Well	Monitor Well	LANL ER	Alluvial	1641416.01	1801077.60	6454.42		Gray 01		
CDV-MW-16	16-02670	Ca±on de Valle	9/16/1997	14.11	-4.43	Well	Monitor Well	LANL ER	Alluvial	1641475.43	1801335.26	6451.97		Gray 01		
CDV-MW-17	16-02671	Ca±on de Valle	9/8/1997	13.99	-4.65	Well	Monitor Well	LANL ER	Alluvial	1641534.85	1801592.91	6449.51		Gray 01		
CDV-MW-18	16-02672	Ca±on de Valle	9/22/1997	13.87	-4.87	Well	Monitor Well	LANL ER	Alluvial	1641594.27	1801850.56	6447.05		Gray 01		
FCO-3		Fence Canyon	8/22/1989	13.76	-5.09	Well	Monitor Well	LANL	Alluvial	1641653.69	1802108.22	6444.59	Dry when installed	Putymun 1995		
GC-TH-5		Guaje Canyon	10/1/1966	13.64	-5.31	Well	Unknown	LANL	Alluvial	1641713.11	1802365.87	6442.13	TH-3	Putymun 1995		Test Hole 5
GC-TH-6		Guaje Canyon	10/1/1966	13.53	-5.53	Well	Unknown	LANL	Alluvial	1641772.53	1802623.52	6439.67	TH-2, Loc revised per PMO	Putymun 1995		Test Hole 6
LAO-0.3	41-01005	Los Alamos Canyon	5/27/1994	13.41	-5.75	Well	Monitor Well	LANL ER	Alluvial	1641831.95	1802881.17	6437.22		Gray 01	Good	
LAO-0.6		Los Alamos Canyon	5/6/1994	13.29	-5.97	Well	Monitor Well	LANL ER	Alluvial	1641891.37	1803138.83	6434.76		Gray 01	Good	
LAO-0.7		Los Alamos Canyon	6/16/2005	13.18	-6.19	Well	Monitor Well	LANL	Alluvial	1641950.79	1803396.48	6432.30		WQDB		
LAO-0.8		Los Alamos Canyon	5/11/1994	13.06	-6.41	Well	Monitor Well	LANL ER	Alluvial	1642010.21	1803654.13	6429.84		Gray 01	Good	
LAO-0.91	02-01238	Los Alamos Canyon	5/12/1994	12.94	-6.63	Well	Monitor Well	LANL ER	Alluvial	1642069.63	1803911.78	6427.38		Gray 01	Good	
LAO-3	02-01292	Los Alamos Canyon	2/1/1966	12.83	-6.85	Well	Monitor Well	LANL	Alluvial	1642129.05	1804169.44	6424.92		Putymun 1995		
LAO-1.4		Los Alamos Canyon	4/1/1969	12.71	-7.06	Well	Monitor Well	LANL	Alluvial	1642188.47	1804427.09	6422.47		Putymun 1995		
LAO-1.6g		Los Alamos Canyon	3/20/1996	12.60	-7.28	Well	Monitor Well	LANL ER	Alluvial	1642247.89	1804684.74	6420.01		Gray 2003	Good	
LAO-1.10		Los Alamos Canyon	4/1/1969	12.48	-7.50	Well	Monitor Well	LANL	Alluvial	1642307.31	1804942.39	6417.55		Putymun 1995		
LAO-6		DP Canyon	2/1/1966	12.36	-7.72	Well	Monitor Well	LANL	Alluvial	1642366.73	1805200.05	6415.09		Putymun 1995		
LAO-7		Los Alamos Canyon	2/1/1966	12.25	-7.94	Well	Monitor Well	LANL	Alluvial	1642426.15	1805457.70	6412.63		Putymun 1995		
LAO-3A		Los Alamos Canyon	9/1/1989	12.13	-8.16	Well	Monitor Well	LANL	Alluvial	1642485.57	1805715.35	6410.17		Putymun 1995		
LAO-6		Los Alamos Canyon	2/1/1966	12.01	-8.38	Well	Monitor Well	LANL	Alluvial	1642544.99	1805973.00	6407.71		Putymun 1995		
LAO-4.7		Los Alamos Canyon	4/1/1969	11.90	-8.60	Well	Monitor Well	LANL	Alluvial	1642604.41	1806230.66	6405.26		Putymun 1995		
LAO-4.5A		Los Alamos Canyon	9/1/1989	11.78	-8.82	Well	Monitor Well	LANL	Alluvial	1642663.83	1806488.31	6402.80		Putymun 1995		

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
LAO-4.5B		Los Alamos Canyon	9/1/1989	11.67	-9.04	Well	Monitor Well	LANL	Alluvial	1642723.25	1806745.96	6400.34		Putymun 1995		
LAO-4.5C		Los Alamos Canyon	11/1/1989	11.55	-9.26	Well	Monitor Well	LANL	Alluvial	1642782.67	1807003.61	6397.88		Putymun 1995		
16-P-1		TA-16 MDA-P	7/29/1987	11.43	-9.48	Well	Monitor Well	LANL	Alluvial	1642842.09	1807261.27	6395.42		Putymun 1995	Good	
16-P-5		TA-16 MDA-P	7/29/1987	11.32	-9.70	Well	Monitor Well	LANL	Alluvial	1642901.51	1807518.92	6392.96		Putymun 1995	Good	
16-P-7		TA-16 MDA-P	7/29/1987	11.20	-9.92	Well	Monitor Well	LANL	Alluvial	1642960.93	1807776.57	6390.51		Putymun 1995	Good	
16-P-9		TA-16 MDA-P	7/29/1987	11.08	-10.14	Well	Monitor Well	LANL	Alluvial	1643020.35	1808034.22	6388.05		Putymun 1995	Good	
18-BG-19	18-01060	Pajarito Canyon W of TA-21	8/1/1994	10.97	-10.36	Well	Monitor Well	LANL ER	Alluvial	1643079.77	1808291.88	6385.59	Shallow Alluvial Well	LANL 1995, 54618	Good	ER SITE 18-1063
18-BG-22	18-10024	Threemile Canyon	2/18/1998	10.85	-10.58	Well	Monitor Well	LANL ER	Alluvial	1643139.19	1808549.53	6383.13	Shallow Alluvial Well	RJK Estimate	Moderate	Not Surveyed Gray 01, Est from FIMAD Map
18-MW-1	18-02013	Pajarito Canyon at TA-18	7/8/1990	10.74	-10.79	Well	Monitor Well	LANL ER	Alluvial	1643198.61	1808807.18	6380.67	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-10	18-01255	Pajarito Canyon at TA-18	8/10/1994	10.62	-11.01	Well	Monitor Well	LANL ER	Alluvial	1643258.03	1809064.84	6378.21	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-11	18-01275	Pajarito Canyon at TA-18	8/11/1994	10.50	-11.23	Well	Monitor Well	LANL ER	Alluvial	1643317.45	1809322.49	6375.76	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-12	18-10010	Pajarito Canyon at TA-18	11/6/1996	10.39	-11.45	Well	Monitor Well	LANL ER	Alluvial	1643376.87	1809580.14	6373.30	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-13	18-10011	Pajarito Canyon at TA-18	11/14/1996	10.27	-11.67	Well	Monitor Well	LANL ER	Alluvial	1643436.28	1809837.79	6370.84	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-14	18-10012	Pajarito Canyon at TA-18	11/8/1996	10.15	-11.89	Well	Monitor Well	LANL ER	Alluvial	1643495.70	1810095.45	6368.38	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-15	18-10013	Pajarito Canyon at TA-18	11/12/1996	10.04	-12.11	Well	Monitor Well	LANL ER	Alluvial	1643555.12	1810353.10	6365.92	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-16	18-10014	Pajarito Canyon at TA-18	11/4/1996	9.92	-12.33	Well	Monitor Well	LANL ER	Alluvial	1643614.54	1810610.75	6363.46	Shallow Alluvial Well	LANL 1997	Good	Kaiser Data
18-MW-17	18-01684	Lower Pajarito Canyon	8/1/1995	9.81	-12.55	Well	Monitor Well	LANL ER	Alluvial	1643673.96	1810868.40	6361.00	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1684
18-MW-18	18-01685	Lower Pajarito Canyon	7/31/1995	9.69	-12.77	Well	Monitor Well	LANL ER	Alluvial	1643733.38	1811126.06	6358.55	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1685
18-MW-2	18-02014	Pajarito Canyon at TA-18	7/8/1990	9.57	-12.99	Well	Monitor Well	LANL ER	Alluvial	1643792.80	1811383.71	6356.09	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2014
18-MW-3	18-02015	Pajarito Canyon at TA-18	7/8/1990	9.46	-13.21	Well	Monitor Well	LANL ER	Alluvial	1643852.22	1811641.36	6353.63	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2015
18-MW-4	18-02016	Pajarito Canyon at TA-18	7/8/1990	9.34	-13.43	Well	Monitor Well	LANL ER	Alluvial	1643911.64	1811899.01	6351.17	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2016
18-MW-5	18-02023	Pajarito Canyon at TA-18	3/7/1994	9.22	-13.65	Well	Monitor Well	LANL ER	Alluvial	1643971.06	1812156.67	6348.71	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2023
18-MW-6	18-02024	Pajarito Canyon at TA-18	3/9/1994	9.11	-13.87	Well	Monitor Well	LANL ER	Alluvial	1644030.48	1812414.32	6346.25	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2024

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
18-MW-7	18-01135	Pajarito Canyon at TA-18	7/6/1994	8.99	-14.09	Well	Monitor Well	LANL ER	Alluvial	1644089.90	1812671.97	6343.80	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1135
18-MW-8	18-01166	Three Mile Canyon TA-21	8/4/1994	8.88	-14.31	Well	Monitor Well	LANL ER	Alluvial	1644149.32	1812929.62	6341.34	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1166
18-MW-9	18-01234	Pajarito Canyon at TA-21	7/21/1994	8.76	-14.53	Well	Monitor Well	LANL ER	Alluvial	1644208.74	1813187.28	6338.88	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1234
39-DM-20	39-01121	Ancho Canyon North Fork	6/15/1994	8.64	-14.74	Well	Monitor Well	LANL ER	Alluvial	1644268.16	1813444.93	6336.42	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-22	39-01133	Ancho Canyon North Fork	6/15/1994	8.53	-14.96	Well	Monitor Well	LANL ER	Alluvial	1644327.58	1813702.58	6333.96	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-24	39-01135	Ancho Canyon North Fork	8/15/1994	8.41	-15.18	Well	Monitor Well	LANL ER	Alluvial	1644387.00	1813960.23	6331.50	MDA-Y Monitor Well	ER Locations	Good	ER Locations from ENV
39-UM-6	39-01120	Ancho Canyon North Fork	8/15/1994	8.29	-15.40	Well	Monitor Well	LANL ER	Alluvial	1644446.42	1814217.89	6329.04	TA-39 OU-1132 MDA Y Well	ER Locations	Good	ER Locations from ENV
APCO-4		Pueblo Canyon	8/15/1990	8.18	-15.62	Well	Monitor Well	LANL	Alluvial	1644505.84	1814475.54	6326.59		Putymun 1998		
BCO-4	10-01280	Bayo Canyon	11/23/1994	8.06	-15.84	Well	Monitor Well	LANL ER	Alluvial	1644565.26	1814733.19	6324.13		ER Survey	Good	
CDBO-28		South Fork CDB	4/17/1985	7.95	-16.06	Well	Monitor Well	LANL	Alluvial	1644624.68	1814990.84	6321.67	Purtymun has 1 and 2 reversed	FIMAD	Good	BH-1069
CDBO-29		South Fork CDB	4/18/1985	7.83	-16.28	Well	Monitor Well	LANL	Alluvial	1644684.10	1815248.50	6319.21	Downstream of MDAs J, K	FIMAD	Good	BH-1070
CDBO-30		South Fork CDB	4/18/1985	7.71	-16.50	Well	Monitor Well	LANL	Alluvial	1644743.52	1815506.15	6316.75	Downstream of MDA L	FIMAD	Good	BH-1071
CDBO-31		Lower CDB	4/18/1985	7.60	-16.72	Well	Monitor Well	LANL	Alluvial	1644802.94	1815763.80	6314.29	Downstream of MDA G	FIMAD	Good	BH-1072
CDBO-32		Upper CDB	1/1/1992	7.48	-16.94	Well	Monitor Well	LANL	Alluvial	1644862.36	1816021.46	6311.84	West of TA-46 Drainage	FIMAD	Good	BH-1073
CDBO-33		Middle CDB	1/1/1992	7.36	-17.16	Well	Monitor Well	LANL	Alluvial	1644921.78	1816279.11	6309.38	Near PM-4, Downstream of TA-49	FIMAD	Good	BH-1074
CDBO-34		Middle CDB	1/1/1992	7.25	-17.38	Well	Monitor Well	LANL	Alluvial	1644981.20	1816536.76	6306.92	Adjacent to MDAs J, K	FIMAD	Good	BH-1075
CDBO-35		Middle CDB	1/1/1992	7.13	-17.60	Well	Monitor Well	LANL	Alluvial	1645040.62	1816794.41	6304.46	Upgradient of MDA L	FIMAD	Good	BH-1076
CDBO-36		Middle CDB	1/1/1992	7.02	-17.82	Well	Monitor Well	LANL	Alluvial	1645100.04	1817052.07	6302.00	Downgradient of MDA L	FIMAD	Good	BH-1053 Switched FIMAD coord with CDBM-5
CDV-MW-19	16-02673	Ca±on de Valle	9/27/1997	6.90	-18.04	Well	Monitor Well	LANL ER	Alluvial	1645159.46	1817309.72	6299.54		Gray 01		
CDV-MW-20	16-02674	Ca±on de Valle	11/5/1997	6.78	-18.26	Well	Monitor Well	LANL ER	Alluvial	1645218.88	1817567.37	6297.09		Gray 01		
CDV-MW-21	16-02675	Ca±on de Valle	10/10/1997	6.67	-18.47	Well	Monitor Well	LANL ER	Alluvial	1645278.30	1817825.02	6294.63		Gray 01		
CDV-MW-22	16-02676	Ca±on de Valle	9/16/1997	6.55	-18.69	Well	Monitor Well	LANL ER	Alluvial	1645337.72	1818082.68	6292.17		Gray 01		
CDV-MW-23	16-02677	Ca±on de Valle	9/8/1997	6.43	-18.91	Well	Monitor Well	LANL ER	Alluvial	1645397.14	1818340.33	6289.71		Gray 01		

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
CDV-MW-24	16-02678	Ca±on de Valle	9/22/1997	6.32	-19.13	Well	Monitor Well	LANL ER	Alluvial	1645456.56	1818597.98	6287.25		Gray 01		
FCO-4		Fence Canyon	8/22/1989	6.20	-19.35	Well	Monitor Well	LANL	Alluvial	1645515.98	1818855.63	6284.79	Dry when installed	Putymun 1995		
GC-TH-7		Guaje Canyon	10/1/1966	6.09	-19.57	Well	Unknown	LANL	Alluvial	1645575.40	1819113.29	6282.33	TH-4	Putymun 1995		Test Hole 7
GC-TH-8		Guaje Canyon	10/1/1966	5.97	-19.79	Well	Unknown	LANL	Alluvial	1645634.82	1819370.94	6279.88	TH-2, Loc revised per PMO	Putymun 1995		Test Hole 8
LAO-0.3	41-01006	Los Alamos Canyon	5/27/1994	5.85	-20.01	Well	Monitor Well	LANL ER	Alluvial	1645694.24	1819628.59	6277.42		Gray 01	Good	
LAO-0.6		Los Alamos Canyon	5/6/1994	5.74	-20.23	Well	Monitor Well	LANL ER	Alluvial	1645753.66	1819886.24	6274.96		Gray 01	Good	
LAO-0.7		Los Alamos Canyon	6/16/2005	5.62	-20.45	Well	Monitor Well	LANL	Alluvial	1645813.08	1820143.90	6272.50		WQDB		
LAO-0.8		Los Alamos Canyon	5/11/1994	5.50	-20.67	Well	Monitor Well	LANL ER	Alluvial	1645872.50	1820401.55	6270.04		Gray 01	Good	
LAO-0.91	02-01346	Los Alamos Canyon	5/12/1994	5.39	-20.89	Well	Monitor Well	LANL ER	Alluvial	1645931.92	1820659.20	6267.58		Gray 01	Good	
LAO-4	02-01400	Los Alamos Canyon	2/1/1966	5.27	-21.11	Well	Monitor Well	LANL	Alluvial	1645991.34	1820916.85	6265.13		Putymun 1995		
LAO-1.5		Los Alamos Canyon	4/1/1969	5.15	-21.33	Well	Monitor Well	LANL	Alluvial	1646050.76	1821174.51	6262.67		Putymun 1995		
LAO-1.6g		Los Alamos Canyon	3/20/1996	5.04	-21.55	Well	Monitor Well	LANL ER	Alluvial	1646110.18	1821432.16	6260.21		Gray 2004	Good	
LAO-1.11		Los Alamos Canyon	4/1/1969	4.92	-21.77	Well	Monitor Well	LANL	Alluvial	1646169.60	1821689.81	6257.75		Putymun 1995		
LAO-8		DP Canyon	2/1/1966	4.81	-21.99	Well	Monitor Well	LANL	Alluvial	1646229.02	1821947.46	6255.29		Putymun 1995		
LAO-9		Los Alamos Canyon	2/1/1966	4.69	-22.20	Well	Monitor Well	LANL	Alluvial	1646288.43	1822205.12	6252.83		Putymun 1995		
LAO-3A		Los Alamos Canyon	9/1/1989	4.57	-22.42	Well	Monitor Well	LANL	Alluvial	1646347.85	1822462.77	6250.38		Putymun 1995		
LAO-7		Los Alamos Canyon	2/1/1966	4.46	-22.64	Well	Monitor Well	LANL	Alluvial	1646407.27	1822720.42	6247.92		Putymun 1995		
LAO-4.8		Los Alamos Canyon	4/1/1969	4.34	-22.86	Well	Monitor Well	LANL	Alluvial	1646466.69	1822978.08	6245.46		Putymun 1995		
LAO-4.5A		Los Alamos Canyon	9/1/1989	4.22	-23.08	Well	Monitor Well	LANL	Alluvial	1646526.11	1823235.73	6243.00		Putymun 1995		
LAO-4.5B		Los Alamos Canyon	9/1/1989	4.11	-23.30	Well	Monitor Well	LANL	Alluvial	1646585.53	1823493.38	6240.54		Putymun 1995		
LAO-4.5C		Los Alamos Canyon	11/1/1989	3.99	-23.52	Well	Monitor Well	LANL	Alluvial	1646644.95	1823751.03	6238.08		Putymun 1995		
16-P-1		TA-16 MDA-P	7/29/1987	3.88	-23.74	Well	Monitor Well	LANL	Alluvial	1646704.37	1824008.69	6235.62		Putymun 1995	Good	
16-P-5		TA-16 MDA-P	7/29/1987	3.76	-23.96	Well	Monitor Well	LANL	Alluvial	1646763.79	1824266.34	6233.17		Putymun 1995	Good	
16-P-7		TA-16 MDA-P	7/29/1987	3.64	-24.18	Well	Monitor Well	LANL	Alluvial	1646823.21	1824523.99	6230.71		Putymun 1995	Good	
16-P-9		TA-16 MDA-P	7/29/1987	3.53	-24.40	Well	Monitor Well	LANL	Alluvial	1646882.63	1824781.64	6228.25		Putymun 1995	Good	
18-BG-25	18-01060	Pajarito Canyon W of TA-22	8/1/1994	3.41	-24.62	Well	Monitor Well	LANL ER	Alluvial	1646942.05	1825039.30	6225.79	Shallow Alluvial Well	LANL 1995, 54619	Good	ER SITE 18-1064

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
18-BG-28	18-10024	Threemile Canyon	2/18/1998	3.29	-24.84	Well	Monitor Well	LANL ER	Alluvial	1647001.47	1825296.95	6223.33	Shallow Alluvial Well	RJK Estimate	Moderate	Not Surveyed Gray 01, Est from FIMAD Map
18-MW-1	18-02013	Pajarito Canyon at TA-18	7/8/1990	3.18	-25.06	Well	Monitor Well	LANL ER	Alluvial	1647060.89	1825554.60	6220.87	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-10	18-01255	Pajarito Canyon at TA-18	8/10/1994	3.06	-25.28	Well	Monitor Well	LANL ER	Alluvial	1647120.31	1825812.25	6218.42	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-11	18-01275	Pajarito Canyon at TA-18	8/11/1994	2.95	-25.50	Well	Monitor Well	LANL ER	Alluvial	1647179.73	1826069.91	6215.96	Shallow Alluvial Well	LANL 1995, 54615	Good	
18-MW-12	18-10010	Pajarito Canyon at TA-18	11/6/1996	2.83	-25.72	Well	Monitor Well	LANL ER	Alluvial	1647239.15	1826327.56	6213.50	Shallow Alluvial Well	LANL 1997,	Good	Kaiser Data
18-MW-13	18-10011	Pajarito Canyon at TA-18	11/14/1996	2.71	-25.94	Well	Monitor Well	LANL ER	Alluvial	1647298.57	1826585.21	6211.04	Shallow Alluvial Well	LANL 1997,	Good	Kaiser Data
18-MW-14	18-10012	Pajarito Canyon at TA-18	11/8/1996	2.60	-26.15	Well	Monitor Well	LANL ER	Alluvial	1647357.99	1826842.86	6208.58	Shallow Alluvial Well	LANL 1997,	Good	Kaiser Data
18-MW-15	18-10013	Pajarito Canyon at TA-18	11/12/1996	2.48	-26.37	Well	Monitor Well	LANL ER	Alluvial	1647417.41	1827100.52	6206.12	Shallow Alluvial Well	LANL 1997,	Good	Kaiser Data
18-MW-16	18-10014	Pajarito Canyon at TA-18	11/4/1996	2.36	-26.59	Well	Monitor Well	LANL ER	Alluvial	1647476.83	1827358.17	6203.66	Shallow Alluvial Well	LANL 1997,	Good	Kaiser Data
18-MW-17	18-01684	Lower Pajarito Canyon	8/1/1995	2.25	-26.81	Well	Monitor Well	LANL ER	Alluvial	1647536.25	1827615.82	6201.21	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1684
18-MW-18	18-01685	Lower Pajarito Canyon	7/31/1995	2.13	-27.03	Well	Monitor Well	LANL ER	Alluvial	1647595.67	1827873.47	6198.75	Shallow Alluvial Well	FIMAD	Good	ER Site 18-1685
18-MW-2	18-02014	Pajarito Canyon at TA-18	7/8/1990	2.02	-27.25	Well	Monitor Well	LANL ER	Alluvial	1647655.09	1828131.13	6196.29	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2014
18-MW-3	18-02015	Pajarito Canyon at TA-18	7/8/1990	1.90	-27.47	Well	Monitor Well	LANL ER	Alluvial	1647714.51	1828388.78	6193.83	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2015
18-MW-4	18-02016	Pajarito Canyon at TA-18	7/8/1990	1.78	-27.69	Well	Monitor Well	LANL ER	Alluvial	1647773.93	1828646.43	6191.37	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2016
18-MW-5	18-02023	Pajarito Canyon at TA-18	3/7/1994	1.67	-27.91	Well	Monitor Well	LANL ER	Alluvial	1647833.35	1828904.09	6188.91	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2023
18-MW-6	18-02024	Pajarito Canyon at TA-18	3/9/1994	1.55	-28.13	Well	Monitor Well	LANL ER	Alluvial	1647892.77	1829161.74	6186.46	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-2024
18-MW-7	18-01135	Pajarito Canyon at TA-18	7/6/1994	1.43	-28.35	Well	Monitor Well	LANL ER	Alluvial	1647952.19	1829419.39	6184.00	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1135
18-MW-8	18-01166	Three Mile Canyon TA-22	8/4/1994	1.32	-28.57	Well	Monitor Well	LANL ER	Alluvial	1648011.61	1829677.04	6181.54	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1166
18-MW-9	18-01234	Pajarito Canyon at TA-22	7/21/1994	1.20	-28.79	Well	Monitor Well	LANL ER	Alluvial	1648071.03	1829934.70	6179.08	Shallow Alluvial Well	LANL 1995, 54615	Good	ER SITE 18-1234
39-DM-26	39-01121	Ancho Canyon North Fork	6/15/1994	1.09	-29.01	Well	Monitor Well	LANL ER	Alluvial	1648130.45	1830192.35	6176.62	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-28	39-01133	Ancho Canyon North Fork	6/15/1994	0.97	-29.23	Well	Monitor Well	LANL ER	Alluvial	1648189.87	1830450.00	6174.16	Dry when installed	ER Locations	Good	ER Locations from ENV
39-DM-30	39-01135	Ancho Canyon North Fork	8/15/1994	0.85	-29.45	Well	Monitor Well	LANL ER	Alluvial	1648249.29	1830707.65	6171.71	MDA-Y Monitor Well	ER Locations	Good	ER Locations from ENV

Data Set for the Monitoring Wells, Supply Wells, and Vapor Monitoring Boreholes Location Map (continued)

Well Name	ER ID	Location Description	Date Completed	Total Depth	Completion Depth	Type	Current Status	Owner	Completion	East	North	Elevation	Comments	Coordinate Source	Coordinate Confidence	Coordinate Comment
39-UM-7	39-01120	Ancho Canyon North Fork	8/15/1994	0.74	-29.67	Well	Monitor Well	LANL ER	Alluvial	1648308.71	1830965.31	6169.25	TA-39 OU-1132 MDA Y Well	ER Locations	Good	ER Locations from ENV
APCO-5		Pueblo Canyon	8/15/1990	0.62	-29.88	Well	Monitor Well	LANL	Alluvial	1648368.13	1831222.96	6166.79		Putymun 1999		
BCO-5	10-01281	Bayo Canyon	11/23/1994	0.50	-30.10	Well	Monitor Well	LANL ER	Alluvial	1648427.55	1831480.61	6164.33		ER Survey	Good	
CDBO-37		South Fork CDB	4/17/1985	0.39	-30.32	Well	Monitor Well	LANL	Alluvial	1648486.97	1831738.26	6161.87	Purtymun has 1 and 2 reversed	FIMAD	Good	BH-1077
CDBO-38		South Fork CDB	4/18/1985	0.27	-30.54	Well	Monitor Well	LANL	Alluvial	1648546.39	1831995.92	6159.41	Downstream of MDAs J, K	FIMAD	Good	BH-1078
CDBO-39		South Fork CDB	4/18/1985	0.16	-30.76	Well	Monitor Well	LANL	Alluvial	1648605.81	1832253.57	6156.95	Downstream of MDA L	FIMAD	Good	BH-1079
CDBO-40		Lower CDB	4/18/1985	0.04	-30.98	Well	Monitor Well	LANL	Alluvial	1648665.23	1832511.22	6154.50	Downstream of MDA G	FIMAD	Good	BH-1080
CDBO-41		Upper CDB	1/1/1992	-0.08	-31.20	Well	Monitor Well	LANL	Alluvial	1648724.65	1832768.87	6152.04	West of TA-46 Drainage	FIMAD	Good	BH-1081
CDBO-42		Middle CDB	1/1/1992	-0.19	-31.42	Well	Monitor Well	LANL	Alluvial	1648784.07	1833026.53	6149.58	Near PM-4, Downstream of TA-50	FIMAD	Good	BH-1082
CDBO-43		Middle CDB	1/1/1992	-0.31	-31.64	Well	Monitor Well	LANL	Alluvial	1648843.49	1833284.18	6147.12	Adjacent to MDAs J, K	FIMAD	Good	BH-1083
CDBO-44		Middle CDB	1/1/1992	-0.43	-31.86	Well	Monitor Well	LANL	Alluvial	1648902.91	1833541.83	6144.66	Upgradient of MDA L	FIMAD	Good	BH-1084

Appendix A-3

Data Set for the Surface Water Gaging Stations Location Map

The information presented in the following table has been taken from Los Alamos National Laboratory databases and has not been edited for typographical errors.

Data Set for the Surface Water Gaging Stations Location Map

ULI	Name	Synonym	Easting (ft)	Northing (ft)	Coordinate Accuracy	Coordinate Method	Coordinate Source	Elevation (ft)	Elevation Accuracy	Elevation Method	Elevation Source	Latitude	Longitude	Latitude/Longitude Method	Latitude/Longitude Source	Steward	Technical Area	Canyon
14131	Garcia Canyon	2929	1642910.267	1803458.753	100.0	DGPS	K. Buckley	6820.0	100.0	E	Woodward	35.956577703	-106.241574094	GISAI	Woodward	Z102267	TA-00	Garcia Canyon
4871	Los Alamos below Ice Rink	E026	1618177.800	1775650.100	100.0	DGPS	Woodward	7756.0	20.0	DEM	Woodward	35.880156431	-106.325073136	GISAI	Woodward	Z102267	TA-43	Los Alamos Canyon
11	Los Alamos above DP Canyon	E030	1637439.700	1772888.200	100.0	DGPS	K. Buckley, K.Mullen	7639.0	20.0	DEM	Woodward	35.872591708	-106.260048578	GISAI	Woodward	Z117151	TA-53	Los Alamos Canyon
21	DP above TA-21	E038	1630695.700	1775656.000	100.0	DGPS	K. Buckley, K.Mullen	7237.0	20.0	DEM	Woodward	35.880191617	-106.282815694	GISAI	Woodward	Z117151	TA-21	DP Canyon
31	DP below Meadow at TA-21	E039	1633202.774	1774874.304	100.0	DGPS	K. Buckley, K.Mullen	7183.0	20.0	DEM	Woodward	35.878046081	-106.274351747	GISAI	Woodward	Z117151	TA-21	DP Canyon
41	DP above Los Alamos Canyon	E040	1637562.600	1773153.300	100.0	DGPS	K. Buckley, K.Mullen	6621.0	20.0	DEM	Woodward	35.873320053	-106.259633825	GISAI	Woodward	Z117151	TA-73	DP Canyon
51	Los Alamos above SR-4	E042	1648153.800	1770881.800	100.0	DGPS	K. Buckley, K.Mullen	7086.0	20.0	DEM	Woodward	35.867077108	-106.223885564	GISAI	Woodward	Z117151	TA-72	Los Alamos Canyon
4891	Los Alamos Canyon Weir above SR-4	E049	1649764.300	1770912.000	100.0	DGPS	Woodward	6755.0	20.0	DEM	Woodward	35.867158772	-106.218449758	GISAI	Woodward	Z102267	TA-72	Los Alamos Canyon
4901	Los Alamos below LA Weir	E050	1650066.300	1770912.000	100.0	DGPS	Woodward	6626.0	20.0	DEM	Woodward	35.867158500	-106.217430444	GISAI	Woodward	Z102267	TA-72	Los Alamos Canyon
4921	Pueblo above Acid	E055	1624408.800	1778875.100	100.0	DGPS	Woodward	6940.0	20.0	DEM	Woodward	35.889027753	-106.304044789	GISAI	Woodward	Z102267	TA-00	Pueblo Canyon
4821	Acid above Pueblo	E056	1624436.100	1778804.100	100.0	DGPS	Woodward	6945.9	20.0	DEM	Woodward	35.888832736	-106.303952489	GISAI	Woodward	Z102267	TA-00	Acid Canyon
61	Pueblo above SR-502	E060	1650231.800	1772264.000	100.0	DGPS	K. Buckley, K.Mullen	7037.0	20.0	DEM	Woodward	35.870872697	-106.216870303	GISAI	Woodward	Z117151	TA-74	Pueblo Canyon
12471	Bayo below TA-10	E070	1642542.854	1778106.460	100.0	DGPS	Woodward	6577.1	20.0	DEM	Woodward	35.886928019	-106.242821883	GISAI	Woodward	Z112801	TA-00	Los Alamos Canyon
4931	Guaje above Rendija	E089	1646407.700	1788368.800	100.0	DGPS	Woodward	6419.0	20.0	DEM	Woodward	35.915120114	-106.229766794	GISAI	Woodward	Z102267	TA-00	Guaje Canyon
4851	Rendija above Guaje	E090	1647297.300	1786979.800	100.0	DGPS	Woodward	6622.0	20.0	DEM	Woodward	35.911303597	-106.226763511	GISAI	Woodward	Z102267	TA-00	Rendija Canyon
4861	Guaje at SR-502	E099	1665991.500	1777388.500	100.0	DGPS	K. Buckley, K.Mullen	6603.0	20.0	DEM	Woodward	35.884924756	-106.163660258	GISAI	Woodward	Z102267	TA-00	Guaje Canyon
14121	Los Alamos Canyon near Otowi Bridge	E110	1669985.190	1776709.303	100.0	DGPS	Woodward	5582.6	20.0	DEM	Woodward	35.883048358	-106.150180058	GISAI	Woodward	Z102267	TA-00	Los Alamos Canyon
71	Sandia right fork at Power Plant	E121	1620151.600	1773793.700	100.0	DGPS	Woodward	6602.0	20.0	DEM	Woodward	35.875060333	-106.318405675	GISAI	Woodward	Z117151	TA-03	Sandia Canyon
81	Sandia left fork at Asphalt Plant	E122	1620114.100	1773924.500	100.0	DGPS	K. Buckley, K.Mullen	6633.0	20.0	DEM	Woodward	35.875419606	-106.318532569	GISAI	Woodward	Z117151	TA-03	Sandia Canyon
11731	Sandia tributary at Sigma	E122.2	1620253.000	1774101.000	100.0	DGPS	K. Buckley, K.Mullen	6244.0	20.0	DEM	Woodward	35.875924692	-106.319736400	GISAI	Woodward	Z117151	TA-03	Sandia Canyon
12491	Sandia Tributary below Sigma	E122.3	1620385.300	1772964.100	100.0	DGPS	Woodward	6529.0	20.0	DEM	Woodward	35.872781622	-106.317614875	GISAI	Woodward	Z112801	TA-03	Ten-Site Canyon
14631	Sandia Tributary behind MRF	E122.35	1621695.618	1773405.122	100.0	UNK	K.Buckley	0.0	0.0			0.000000000	0.000000000			Z112801		
4951	Sandia tributary at Heavy Equipment	E122.5	1621760.000	1772997.800	100.0	DGPS	K. Buckley, K.Mullen	7706.0	20.0	DEM	Woodward	35.872876728	-106.312974719	GISAI	Woodward	Z102267	TA-60	Sandia Canyon
91	Sandia below Wetlands	E123	1622680.000	1773064.000	100.0	DGPS	Woodward	6619.0	20.0	DEM	Woodward	35.873060186	-106.309869442	GISAI	Woodward	Z117151	TA-60	Sandia Canyon

Data Set for the Surface Water Gaging Stations Location Map (continued)

ULI	Name	Synonym	Easting (ft)	Northing (ft)	Coordinate Accuracy	Coordinate Method	Coordinate Source	Elevation (ft)	Elevation Accuracy	Elevation Method	Elevation Source	Latitude	Longitude	Latitude/Longitude Method	Latitude/Longitude Source	Steward	Technical Area	Canyon
101	Sandia above Firing Range	E124	1637136.600	1769931.300	100.0	DGPS	Woodward	6381.0	20.0	DEM	Woodward	35.864468125	-106.261070544	GISAI	Woodward	Z117151	TA-53	Sandia Canyon
111	Sandia above SR-4	E125	1647470.500	1767968.000	100.0	DGPS	Woodward	6349.0	20.0	DEM	Woodward	35.859072494	-106.226194239	GISAI	Woodward	Z117151	TA-72	Sandia Canyon
121	TA-55 NW above Effluent Canyon	E196	1624491.000	1770021.000	100.0	DGPS	Woodward	7329.0	20.0	DEM	Woodward	35.864703044	-106.303750836	GISAI	Woodward	Z117151	TA-55	Mortanda Canyon
131	Mortandad below Effluent Canyon	E200	1626746.700	1770272.000	100.0	DGPS	Woodward	6345.0	20.0	DEM	Woodward	35.865395781	-106.296138008	GISAI	Woodward	Z117151	TA-00	Mortanda Canyon
141	Mortandad above Ten Site	E201	1633072.300	1769387.500	100.0	DGPS	Woodward	6945.0	20.0	DEM	Woodward	35.862972094	-106.274787489	GISAI	Woodward	Z117151	TA-05	Mortanda Canyon
12501	Ten Site at TA-50	E201.1	1626375.000	1768871.800	100.0	DGPS	Woodward	7220.0	20.0	DEM	Woodward	35.861548519	-106.297390256	GISAI	Woodward	Z112801	TA-50	Ten-Site Canyon
12511	Ten Site below MDA C	E201.3	1626468.100	1768864.800	100.0	DGPS	Woodward	6190.0	20.0	DEM	Woodward	35.861529414	-106.297076033	GISAI	Woodward	Z112801	TA-50	Ten-Site Canyon
151	Ten Site above Mortandad	E201.5	1633029.500	1768474.500	100.0	DGPS	Woodward	6946.0	20.0	DEM	Woodward	35.860463775	-106.274931156	GISAI	Woodward	Z117151	TA-05	Ten-Site Canyon
161	Mortandad above Sediment Traps	E202	1634249.500	1768620.000	100.0	DGPS	Woodward	6341.0	20.0	DEM	Woodward	35.860864292	-106.270813847	GISAI	Woodward	Z117151	TA-05	Mortanda Canyon
171	Mortandad below Sediment Traps	E203	1634969.700	1768628.000	100.0	DGPS	Woodward	6817.4	20.0	DEM	Woodward	35.860886667	-106.268383217	GISAI	Woodward	Z117151	TA-05	Mortanda Canyon
181	Mortandad at LANL Boundary	E204	1641813.600	1766790.200	100.0	DGPS	Woodward	6293.0	20.0	DEM	Woodward	35.855838983	-106.245285725	GISAI	Woodward	Z117151	TA-05	Mortanda Canyon
191	Canada del Buey near TA-46	E218	1631931.800	1766736.000	100.0	DGPS	CM	5665.0	20.0	DEM	Woodward	35.855686758	-106.278634094	GISAI	Woodward	Z117151	TA-46	Canada del Buey
11741	TA-54 RANT	E220	1636115.700	1762807.100	100.0	DGPS	K. Buckley, K.Mullen	7360.0	20.0	DEM	Woodward	35.844895392	-106.264512614	GISAI	Woodward	Z117151	TA-54	Canada del Buey
14611	Area J West	E220.5	1636528.786	1762497.438	100.0	DGPS	KBuckley	6878.3	20.0	DEM	Woodward	35.844044814	-106.263118611	GISAI	Woodward	Z097762	TA-54	Canada del Buey
14621	Area J East	E220.7	1636948.172	1762112.158	100.0	DGPS	KBuckley	6873.9	20.0	DEM	Woodward	35.842986475	-106.261703350	GISAI	Woodward	Z097762	TA-54	Canada del Buey
211	MDA L	E223	1640180.100	1759476.600	100.0	DGPS	K. Buckley, K.Mullen	6839.0	20.0	DEM	Woodward	35.835746336	-106.250798147	GISAI	Woodward	Z117151	TA-54	Canada del Buey
221	Canada del Buey near MDA G	E225	1643550.700	1758721.200	100.0	DGPS	Woodward	7299.0	20.0	DEM	Woodward	35.833670550	-106.239426419	GISAI	Woodward	Z117151	TA-54	Canada del Buey
231	MDA G-13	E227	1643540.000	1758433.300	100.0	DGPS	Consuelo Montoya	6812.0	20.0	DEM	Woodward	35.832879600	-106.239462625	GISAI	Woodward	Z117151	TA-54	Canada del Buey
241	Canada del Buey above SR-4	E230	1651676.700	1756415.200	100.0	DGPS	K. Buckley, K.Mullen	7292.0	20.0	DEM	Woodward	35.827329697	-106.212014003	GISAI	Woodward	Z117151	TA-54	Canada del Buey
251	Pajarito below SR-501	E240	1610031.600	1771216.300	100.0	DGPS	K. Buckley, K.Mullen	7379.0	20.0	DEM	Woodward	35.867955144	-106.352557042	GISAI	Woodward	Z117151	TA-69	Pajarito Canyon
261	Pajarito above Starmers	E241	1614684.000	1768076.800	100.0	DGPS	K. Buckley, K.Mullen	7378.5	20.0	DEM	Woodward	35.859342375	-106.336844661	GISAI	Woodward	Z117151	TA-09	Pajarito Canyon
271	Starmers above Pajarito	E242	1614661.800	1767989.800	100.0	DGPS	K. Buckley, K.Mullen	7377.4	20.0	DEM	Woodward	35.859103306	-106.336919322	GISAI	Woodward	Z117151	TA-09	Starmers Canyon
281	La Delfe above Pajarito	E242.5	1616053.500	1767184.000	100.0	DGPS	K. Buckley, K.Mullen	7311.3	20.0	DEM	Woodward	35.856892833	-106.332220233	GISAI	Woodward	Z117151	TA-09	Pajarito Canyon
291	Pajarito above Twomile	E243	1626607.700	1766072.000	100.0	DGPS	Woodward	6942.6	20.0	DEM	Woodward	35.853856922	-106.296600397	GISAI	Woodward	Z117151	TA-40	Pajarito Canyon
11751	Twomile tributary at TA-3	E243.5	1618917.100	1771476.800	100.0	DGPS	K. Buckley, K.Mullen	6666.0	20.0	DEM	Woodward	35.868692672	-106.322566981	GISAI	Woodward	Z117151	TA-03	Two Mile Canyon

Data Set for the Surface Water Gaging Stations Location Map (continued)

ULI	Name	Synonym	Easting (ft)	Northing (ft)	Coordinate Accuracy	Coordinate Method	Coordinate Source	Elevation (ft)	Elevation Accuracy	Elevation Method	Elevation Source	Latitude	Longitude	Latitude/Longitude Method	Latitude/Longitude Source	Steward	Technical Area	Canyon
301	Twomile above Pajarito	E244	1626724.000	1766194.300	100.0	DGPS	Woodward	7204.0	20.0	DEM	Woodward	35.854193069	-106.296208122	GISAI	Woodward	Z117151	TA-66	Two Mile Canyon
311	Pajarito above TA-18	E245	1629599.100	1765095.800	100.0	DGPS	Woodward	6272.0	20.0	DEM	Woodward	35.851178492	-106.286504250	GISAI	Woodward	Z117151	TA-46	Pajarito Canyon
321	Pajarito above Threemile	E245.5	1633087.700	1763184.000	100.0	DGPS	Woodward	6495.0	20.0	DEM	Woodward	35.845929183	-106.274730219	GISAI	Woodward	Z117151	TA-18	Pajarito Canyon
331	Threemile above Pajarito	E246	1634074.300	1760712.000	100.0	DGPS	Woodward	6755.5	20.0	DEM	Woodward	35.839138467	-106.271399300	GISAI	Woodward	Z117151	TA-18	Three Mile Canyon
341	MDA G-1	E247	1641915.700	1757780.600	100.0	DGPS	Consuelo Montoya	6365.0	20.0	DGPS	Woodward	35.831086781	-106.244942736	GISAI	Woodward	Z117151	TA-36	Pajarito Canyon
351	MDA G-2	E248	1642589.300	1757438.700	100.0	DGPS	Consuelo Montoya	6365.0	20.0	DEM	Woodward	35.830147356	-106.242670308	GISAI	Woodward	Z117151	TA-36	Pajarito Canyon
361	MDA G-6U	E248.5	1644328.000	1757117.500	100.0	DGPS	Consuelo Montoya	6309.0	20.0	DEM	Woodward	35.829264417	-106.236804700	GISAI	Woodward	Z117151	TA-54	Pajarito Canyon
371	MDA G-4	E249	1643944.300	1756821.300	100.0	DGPS	Consuelo Montoya	6640.0	20.0	DEM	Woodward	35.828450794	-106.238099275	GISAI	Woodward	Z117151	TA-36	Pajarito Canyon
381	MDA G-7	E249.5	1644964.000	1757291.700	100.0	DGPS	Consuelo Montoya	6454.0	20.0	DEM	Woodward	35.829742744	-106.234658994	GISAI	Woodward	Z117151	TA-54	Pajarito Canyon
391	Pajarito above SR-4	E250	1646954.700	1755232.000	100.0	DGPS	Woodward	6528.9	20.0	DEM	Woodward	35.824083044	-106.227944683	GISAI	Woodward	Z117151	TA-00	Pajarito Canyon
401	Water above SR-501	E252	1607260.100	1760443.800	100.0	DGPS	K. Buckley, K.Mullen	7377.0	20.0	DEM	Woodward	35.838351475	-106.361869936	GISAI	Woodward	Z117151	TA-36	Water Canyon
411	Canon de Valle above SR-501	E253	1609413.700	1765328.000	100.0	DGPS	K. Buckley, K.Mullen	7311.0	20.0	DEM	Woodward	35.851776417	-106.354621342	GISAI	Woodward	Z117151	TA-00	Canon de Valle
421	Canon de Valle below MDA P	E256	1616000.100	1764764.100	100.0	DGPS	K. Buckley, K.Mullen	7071.0	20.0	DEM	Woodward	35.850244506	-106.332393567	GISAI	Woodward	Z117151	TA-16	Canon de Valle
4841	Canon de Valle tributary at Burn Grounds	E257	1616474.800	1763409.100	100.0	DGPS	K. Buckley, K.Mullen	6941.0	20.0	DEM	Woodward	35.846522992	-106.330787922	GISAI	Woodward	Z102267	TA-16	Canon de Valle
431	Water above S Site Canyon	E260	1623395.500	1757679.500	100.0	DGPS	K. Buckley, K.Mullen	6865.0	20.0	DEM	Woodward	35.830795417	-106.307423817	GISAI	Woodward	Z117151	TA-37	Water Canyon
441	S Site Canyon above Water	E261	1623337.800	1757740.000	100.0	DGPS	Woodward	6839.5	20.0	DEM	Woodward	35.830961536	-106.307618597	GISAI	Woodward	Z117151	TA-37	S-Site Canyon
451	Canon de Valle above Water	E262	1624410.000	1757742.000	100.0	DGPS	K. Buckley, K.Mullen	6811.7	20.0	DEM	Woodward	35.830968711	-106.304001344	GISAI	Woodward	Z117151	TA-37	Canon de Valle
12481	Water tributary below DARHT	E262.3	1625206.356	1758500.317	100.0	DGPS	Woodward	7138.3	20.0	DEM	Woodward	35.825123639	-106.284184350	GISAI	Woodward	Z112801	TA-36	Water Canyon
461	Water below MDA AB	E262.5	1630275.200	1755616.700	100.0	DGPS	K. Buckley, K.Mullen	6858.0	20.0	DEM	Woodward	35.825137094	-106.284211544	GISAI	Woodward	Z117151	TA-36	Water Canyon
471	Water at SR-4	E263	1641088.000	1748487.700	100.0	DGPS	K. Buckley, K.Mullen	6833.0	20.0	DEM	Woodward	35.805556258	-106.247735858	GISAI	Woodward	Z117151	TA-71	Water Canyon
481	Indio at SR-4	E264	1641139.000	1748299.000	100.0	DGPS	Woodward	6817.0	20.0	DEM	Woodward	35.805037833	-106.247563872	GISAI	Woodward	Z117151	TA-71	Indio Canyon
491	Water below SR-4	E265	1642757.200	1748249.200	100.0	DGPS	Woodward	6651.0	20.0	DEM	Woodward	35.804900783	-106.242106375	GISAI	Woodward	Z117151	TA-71	Water Canyon
501	Potrillo at Lower Slobbovia	E266	1637658.600	1757281.300	100.0	DGPS	K. Buckley, K.Mullen	6936.0	20.0	DEM	Woodward	35.829714792	-106.259304683	GISAI	Woodward	Z117151	TA-36	Potrillo Canyon
511	Potrillo above SR-4	E267	1645342.800	1751325.000	100.0	DGPS	K. Buckley, K.Mullen	6454.0	20.0	DEM	Woodward	35.813350125	-106.233384483	GISAI	Woodward	Z117151	TA-36	Potrillo Canyon
11931	Fence below Meenie	E267.5	1638623.700	1753779.800	100.0	DGPS	Woodward	6224.0	20.0	DEM	Woodward	35.820095256	-106.256048069	GISAI	Woodward	Z116217	TA-68	Fence Canyon

Data Set for the Surface Water Gaging Stations Location Map (continued)

ULI	Name	Synonym	Easting (ft)	Northing (ft)	Coordinate Accuracy	Coordinate Method	Coordinate Source	Elevation (ft)	Elevation Accuracy	Elevation Method	Elevation Source	Latitude	Longitude	Latitude/Longitude Method	Latitude/Longitude Source	Steward	Technical Area	Canyon
521	Ancho above north fork Ancho	E273	1639913.000	1741436.000	100.0	DGPS	K. Buckley, K.Mullen	6241.1	20.0	DEM	Woodward	35.786182889	-106.251698256	GISAI	Woodward	Z117151	TA-33	Ancho Canyon
531	Ancho north fork below SR-4	E274	1639984.000	1741640.700	100.0	DGPS	Woodward	6243.8	20.0	DEM	Woodward	35.786745272	-106.251458869	GISAI	Woodward	Z117151	TA-33	Ancho Canyon
541	Ancho below SR-4	E275	1641917.800	1739822.100	100.0	DGPS	K. Buckley, K.Mullen	6598.0	20.0	DEM	Woodward	35.781748864	-106.244938783	GISAI	Woodward	Z117151	TA-70	Ancho Canyon
4831	Ancho Canyon spring tributary below SR-4	E300	1640957.900	1745036.940	100.0	DGPS	Woodward	6507.8	20.0	DEM	Woodward	35.796075883	-106.248174853	GISAI	Woodward	Z102267	TA-70	Ancho Canyon
551	Chaquehui at TA-33	E338	1639793.300	1735450.600	100.0	DGPS	K. Buckley, K.Mullen	6615.0	20.0	DEM	Woodward	35.769738939	-106.252101425	GISAI	Woodward	Z117151	TA-33	Chaquehui Canyon
561	Chaquehui tributary at TA-33	E340	1640308.000	1739044.700	100.0	DGPS	K. Buckley, K.Mullen	6404.0	20.0	DEM	Woodward	35.779613186	-106.250366369	GISAI	Woodward	Z117151	TA-33	Chaquehui Canyon
571	Rio de los Frijoles at Bandelier	E350	1634678.600	1738080.200	100.0	DGPS	Woodward	6241.0	20.0	DEM	Woodward	35.776961819	-106.269345292	GISAI	Woodward	Z117151	TA-00	Frijoles Canyon
0	South Fork of Acid Canyon	E055.5	1623484.000	1777838.660	100.0	DGPS	K. Buckley	7100.4	20.0	DEM	Woodward	35.886178906	106.307164994	GISAI	Woodward		TA-00	Pueblo Canyon

Appendix B-1

Documentation for the Preliminary Hydrogeologic Atlas for Los Alamos National Laboratory

LA-UR-99-4619
September 1999

Documentation for the Preliminary Hydrogeologic Atlas for Los Alamos National Laboratory

Environmental Restoration Project
A Department of Energy Environmental Cleanup Program
ER19990091

Los Alamos
NATIONAL LABORATORY
Los Alamos, NM 87545

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Produced by the Canyons Focus Area for the
Analysis and Assessment Focus Area

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1.0 INTRODUCTION

Los Alamos National Laboratory (the Laboratory) is located approximately 35 mi northwest of Santa Fe, New Mexico, on the Pajarito Plateau, the expanse of deeply dissected Bandelier Tuff lying between the Jemez Mountains on the west and the Rio Grande on the east (see Figure 1.0-1). The preliminary hydrogeologic atlas for the Laboratory area comprises an unbound set of 25 maps and this report documenting the decisions made in their design and construction. More specifically, this documentation describes the intended purpose and scope of the atlas, describes the data used in its preparation, gives the specifications for the various maps included in the preliminary version, and discusses its availability.

1.1 Purpose of the Atlas

"Hydrogeology" has been defined as "the science that applies geologic methods to the understanding of hydrologic phenomena" (May 1976, 63988). Hydrogeologic studies are critical to the environmental restoration (ER) efforts at the Laboratory; therefore, hydrologists, modelers, and environmental scientists at the Laboratory need various kinds of geologic information for their work. Maps showing the subsurface geology are especially useful in predicting drilling conditions, describing hydrostratigraphic units, formulating conceptual hydrogeologic models, and discretizing numerical models.

At least three types of subsurface maps are needed to minimally characterize the geologic setting of an area: one each showing structure (elevation) at the top, depth to the top, and thickness of major units (Stone 1999, 63990). Additionally, maps showing water levels and the geology at the regional piezometric surface help the user conceptualize the hydrologic system and identify data gaps. Both geologic and hydrologic maps support groundwater-modeling efforts.

The purpose of the hydrogeologic atlas is twofold. First, the amount of previous geologic work done at the Laboratory is considerable, but the results are scattered in numerous reports. A preliminary three-dimensional (3-D) sitewide geologic model for the Laboratory area was constructed in 1996 (Vaniman et al. 1996, 63991) to evaluate and integrate the available data, as well as support visualization and modeling activities. Although the 3-D model is available in electronic form and thus is compatible with modeling needs, it is difficult to provide hard-copy 3-D visualizations; therefore, traditional two-dimensional (2-D) paper maps are needed. Second, many ER activities at the Laboratory require the formulation of a sound conceptual hydrogeologic model. The hydrogeologic atlas was developed to serve as the basis for a single, consistent conceptual hydrogeologic model for the Pajarito Plateau.

1.2 Scope of the Atlas

The preliminary atlas includes a topographic map of the Laboratory area; a thickness map for the Tshirege Member of the Bandelier Tuff; a series of three maps (structure, depth, and thickness) for each of seven underlying geologic units (see Figure 1.2-1); a regional piezometric surface map; and a geologic map drawn at the regional piezometric surface. (There is only one map for the Tshirege Member of the Bandelier Tuff because that stratigraphic unit lies at or very near the surface; therefore, structure would be the same as topography and depth would be essentially zero.)

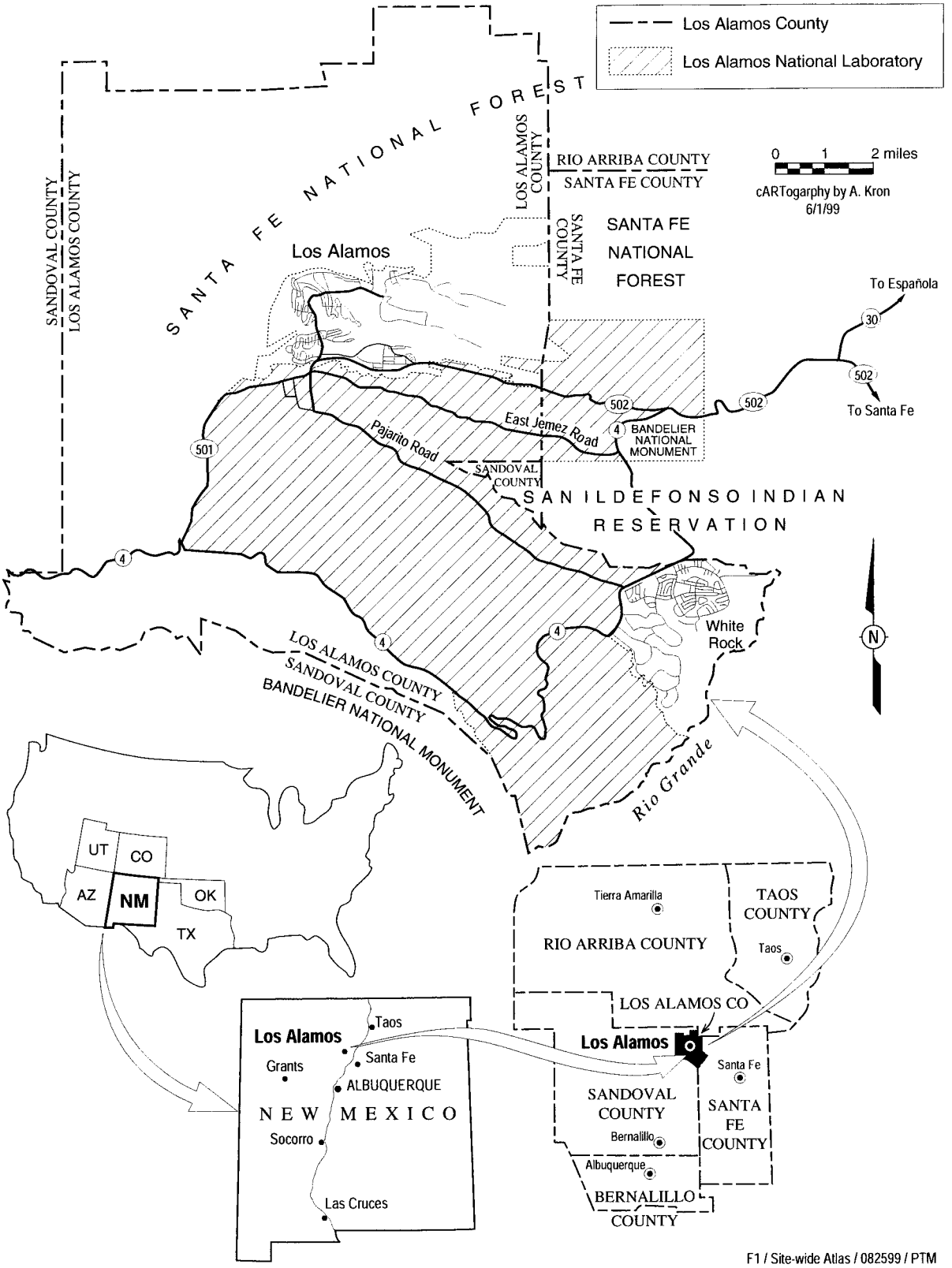


Figure 1.0-1. Location of Los Alamos National Laboratory

Preparation of such an atlas requires that limits be set on space, time, and detail. In terms of limiting space, there must be geographic boundaries. Because the subsurface geologic maps are based on data in the 3-D geologic model, the model boundaries become the atlas boundaries. The atlas is thus limited to the Laboratory and its immediate vicinity. In terms of limiting time, only data already in the Laboratory's 3-D geologic model (1998 version) were used. Thus, geologic and regional water-level data for characterization wells R-9 and R-12 are included, but data for R-15 and R-25 are not (except water level for R-25). However, like the geologic model, the atlas is in electronic form, and the maps will be updated annually as new data warrant and become available. In terms of limiting detail, the initial atlas includes maps for only the basic geologic units (see Figure 1.2-1). That is, the formal members of the Bandelier Tuff are included, but not the various subunits within those members as recognized at the Laboratory. Plans to expand the atlas to incorporate such additional information are discussed in Section 5.0, Further Work.

2.0 GEOLOGIC DATA USED

Modeling stratigraphic units at the Laboratory is difficult because the geologic framework of the Pajarito Plateau is complex. A given stratigraphic unit may contain other stratigraphic units or subunits. For example, the Puye Formation includes the Totavi Lentil and intertongues with both the Tschicoma Formation and Cerros del Rio basalt.

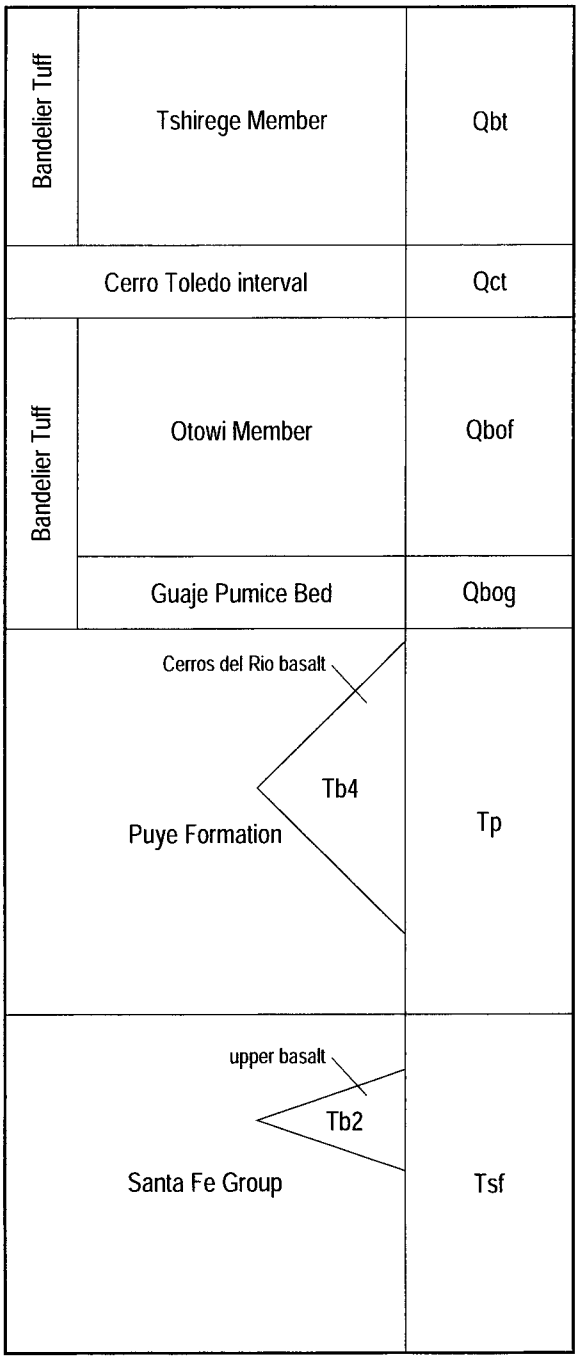
Stratigraphic units covered by this preliminary atlas include the Tshirege Member of the Bandelier Tuff; the Cerro Toledo interval; the ash flow unit in the Otowi Member of the Bandelier Tuff; the Guaje Pumice Bed in the Otowi Member; the Cerros del Rio basalt; the Puye Formation (including the Tschicoma Formation and Cerros del Rio basalt); the upper basalt of the Santa Fe Group; and the Santa Fe Group proper (see Figure 1.2-1).

2.1 Source

A considerable amount of geologic information for the Laboratory area has been collected over the years from outcrops as well as from various observation, test, and water-supply boreholes. Geologic maps exist for different areas at different scales. Purtymun (1995, 45344) compiled most of the subsurface data from Laboratory boreholes and wells.

Laboratory geologists have reviewed and synthesized existing information into the 3-D sitewide geologic model (Vaniman et al. 1996, 63991). The model is the result of integrated analysis of field mapping and borehole logging over the past 40 years. The 1998 version of the sitewide geologic model (Cole et al. 1998, 63987) provides the information that is contoured on the subsurface geologic maps in the preliminary atlas. That reference should be consulted for geologic data associated with specific wells shown on the subsurface maps in the atlas.

The geologic model consists of stratigraphic surfaces (bases or lower contacts) of volcanic and sedimentary units and subunits of regional extent as well as geologic surfaces (tops and bottoms) of localized volcanic flows or sedimentary packages of limited extent. The preliminary atlas portrays 8 of more than 20 modeled surfaces, focusing on major stratigraphic units, especially those of potential hydrologic significance.



F2 / Site-wide Atlas / 082799 / PTM

Figure 1.2-1. Geologic units used in the preliminary hydrogeologic atlas

2.2 Quality

The sitewide model has evolved and improved over the past four years, reflecting the enlarged information base as well as improved data-analysis techniques. The current model exhibits the application of a mix of computer-modeling methods, with knowledge-based bias and intervention supplied by the geologic staff, where appropriate. Additional information about the 3-D geologic model is available in internal Laboratory reports by Cole et al. (1997, 59974; 1998, 63987).

The quality of the geologic data used in the atlas is dependent upon the available geologic control. For some areas, densely spaced, high-quality data allow for a very accurate rendition of geologic conditions. For other areas, data are sparse and of lower quality so that the model is more schematic. In addition to the wells shown as control points on the subsurface maps, there are surface control points (outcrops) that are not shown in the atlas. However, these are clearly used and available in the sitewide model.

3.0 HYDROLOGIC DATA USED

Various kinds of hydrologic observations have also been made at the Laboratory over the years. Some of these are included in the report by Purtymun (1995, 45344). Other observations were published in various reports by the US Geological Survey.

3.1 Source

The only hydrologic parameter presented in this initial version of the atlas is water level. Most of the data used are from the Laboratory's Water Quality and Hydrology Group's (ESH-18's) water-level network for 1996. The source of other water-level data used is discussed in Section 4.6, Map of the Regional Piezometric Surface. Efforts are under way to construct a database for hydrogeologic information from the Laboratory area, and as other types of data are compiled into the database, they will be incorporated in updates of atlas maps.

3.2 Quality

The 1996 water-level data used were collected using transducers in accordance with the ESH-18 standard operating procedure, Pressure Transducer Installation, Removal and Maintenance (December 1998). The measurement intervals range from yearly to hourly, depending on the well. The 1991 data (used for the LA series wells) were collected by means of a steel tape or electric sounder using standard methods.

4.0 MAP SPECIFICATIONS

Several design decisions were made to facilitate the usefulness of the atlas:

1. All the maps are presented on the same base, thus eliminating the need for the user to adjust to different scales or reference information for the different parameters.

2. Each of the three types of subsurface geology maps is contoured in its own unique color so the user can readily identify the kind of map being viewed. That is, the contours on all the structure maps are purple, those on all the depth maps are green, those on all the thickness maps are red, and those on the water-level map are blue.

3. Labels for the wells from which information was used on a particular map, as well as that information, are printed in the same color as the contours so they may be readily located.

The jagged or angular nature of the contours in places is an artifact of the technique used to develop the geologic surfaces in the sitewide geologic model. Some surfaces are represented by triangular irregular networks (TINs) rather than by interpolated surfaces generated through techniques such as kriging or inverse-distance weighting. The TIN model provides a faceted (multi-planar) surface. Contours of such surfaces are composed of straight-line segments, each representing the crossing of an inclined triangular surface (i.e. linear interpolation of the triangular vertices). The TIN model is useful if there are discontinuities in the surface, such as faults or paleocanyons, because internal breaklines for the surface can be specified.

4.1 Base Map

The design of the base map involved considerations of convenient map size and inclusion of sufficient familiar features to ensure that users can readily orient themselves. A convenient map size was assumed to be one that would fit on an ordinary desk yet be large enough to present available data and be easily read. The scale selected,1:36,000, provides for such a map size. To permit easy orientation, major roads, townsites (residential streets), drainages (canyons), major faults, and the wells for which data exist in the 3-D geologic model are shown. The state-plane-coordinate system is also provided for reference.

Data from two basic sets of wells were used in constructing various maps in the atlas. One set includes the wells from the 3-D geologic model used for the subsurface maps. The other set includes the wells for which there are regional water levels as used for maps of the piezometric surface and of the geology at the piezometric surface. Both sets are also shown on the topographic map for reference. The legends of these maps show how the two types of wells are denoted.

4.2 Topographic Map

A topographic map of the Laboratory is included for three reasons. First, it shows the familiar geomorphic features and thus facilitates orienting the user on the plateau. Second, it is the best way to determine whether a given well of interest is on a mesa or in a canyon. Third, it complements all the other maps that strictly show characteristics of geologic units lying some distance below the ground surface. Data that are used come from the 1-ft digital elevation model, created by Greg Cole from the digital contour results of the ER aerial survey conducted in 1991 by Merrick and Company. The contour interval is 50 ft.

Comparing a given subsurface map with the topographic map enables the user to locate outcrop areas. For example, if elevations on the structure map for a given geologic unit are the same as those on the topographic map in the same area, the unit is cropping out there.

4.3 Structure Maps

The structure maps show contours for the elevation of the top of the major rock units, based on the best information available as of the date of the atlas. Data for the structure maps come from the elevations of geologic contacts in the 3-D geologic model. The contour interval is 100 ft for all of the structure maps.

Most of the maps show a general easterly decline in elevation of the top of the subject unit. This is generally a reflection of deposition on an east-sloping surface rather than tectonic dip. Structure contours are closely spaced in some areas because of faulting or paleotopography. Where this occurs in the western part of the map, it is a reflection of the Pajarito fault scarp. In the southeast, closely spaced structure contours represent the presence of a paleocanyon.

4.4 Depth Maps

The depth maps show the contours for the distance below the ground surface to the top of the major rock units, based on the best information available as of the date of the atlas. Data for the depth maps come from subtracting the elevation of the top of the unit from the ground-surface elevation at the well site. The contour interval is 200 ft for all depth maps.

Because depth depends on topography (units are deeper beneath mesas and shallower beneath canyons), the contours mimic those on the topographic map.

4.5 Thickness Maps

The thickness maps show contours of the drilled thickness of major rock units, based on the best information available as of the date of the atlas. Tectonic dip is presumed to be minimal, and no attempt was made to correct for it. Data for the thickness maps come from subtracting the elevation of the top of the underlying unit from the elevation of the top of the target unit. Thickness varies from unit to unit; therefore, the contour interval varies from map to map.

Thickness shown is a result of original depositional thickness, minus any removal of the unit by post-depositional erosion. Thus, areas of greater thickness are places where either more material was originally deposited or less material was removed by erosion before deposition of the overlying unit.

As would be expected, wells do not fully penetrate the deepest geologic unit covered by the atlas (the Santa Fe Group), and contouring thickness is inappropriate. Nonetheless, the partial thicknesses observed are minimum values and provide useful information. Thus, values are given for this unit on Map 23 but they are not contoured.

4.6 Map of the Regional Piezometric Surface

The water-level map shows contours for the approximate elevation of the top of the regional saturated zone (the piezometric surface). Such water levels were determined in wells tapping the deep regional aquifer in the Laboratory area, based on the best information available as of the date of the atlas. The map is essentially a modification of as-yet-unpublished mapping by W.D. Purtymun and S.G. Mclin in 1998 for Los Alamos County water-resource purposes. The main modifications include the extension of their contours to the Guaje Canyon wells; the use of 1991 data for the LA series wells to permit contouring in that area; the use of river elevations to control contouring there; and the addition of the R-9, R-12 and R-25 (1998) data.

Data from the White Rock Canyon springs were not used in the water-level mapping because the springs are elevated above the Rio Grande and are believed to yield water that has become perched above the regional zone of saturation. This may be due to some upgradient splitting of the regional groundwater flow around the Cerros del Rio basalt resulting in discharge at both spring and river positions (Stone 1996, 63989).

Ideally, a regional water-table map depicts the elevation of the top of the unconfined saturated zone, and a potentiometric surface map depicts the elevation to which water will rise in wells tapping a confined zone of saturation. Where the saturated zone is unconfined in one part of the area and confined in another, the more general terms “water-level” or ”piezometric surface” are applied. In practice, however, water levels measured in wells do not precisely represent either the top of the saturated zone or the potentiometric surface but vary from them because of well depth and screen length.

Water level varies with well depth because of vertical hydraulic gradient. Groundwater moves from positions characterized by high hydraulic head to those of low hydraulic head. In groundwater-recharge areas, where the vertical gradient is downward, values of isopotentials (contours of equal hydraulic head) intersected by the well decrease with depth. Thus, the deeper the well, the deeper the water level. The reverse is true in groundwater-discharge areas, where vertical gradient is upward. In that case, the value of isopotentials penetrated by the well increase with depth: the deeper the well, the shallower the water level. Only in areas characterized by neither recharge nor discharge (i.e., isopotentials are vertical and thus parallel to the wells) is the same water level obtained regardless of well depth.

Water level varies with screen length because the screen length determines how many isopotentials the well is open to. The best water-level data are obtained in tubes open only at the bottom (piezometers) because they interrogate head at only a single point. In contrast, the water level obtained from any well with a screen is a composite of all the heads in the interval the well is open to. Although water-level data from wells with short screens are better than those from wells with long screens, they are still composites. The wells used for the piezometric surface map are those tapping the deep aquifer. Most such wells are part of the water-supply system and have very long screens to optimize production. Thus, water levels obtained in them are composite values.

As groundwater moves generally perpendicular to water-table or potentiometric contours, water-level maps are commonly used to evaluate flow direction. However, in view of the inadequacies discussed above, it should be obvious that such maps are only approximations. Therefore, decisions or calculations based on water-level maps can be misleading, and they should be used with caution. Nonetheless, the water-level map presented gives a general picture of the piezometric surface and of groundwater flow direction as conceptualized for the Laboratory area. Interestingly, it differs little from the often-cited map compiled by Purtymun (1984, 6513), except near the Rio Grande, because he used the White Rock Canyon springs to control placement of contours on the east edge of the map.

4.7 Map of the Geology at the Piezometric Surface

The map of the geology at the piezometric surface shows what stratigraphic unit is present at the top of the regional saturated zone or potentiometric surface at various places across the area, based on the best information available as of the date of the atlas. It was constructed by progressively intersecting surfaces for the top and bottom of each geologic unit covered in this preliminary atlas with the regional piezometric surface. The standard colors assigned to geologic units in the 3-D model are used on this map for consistency.

When the water table or potentiometric surface has a different slope than that of the associated geologic units, different units lie within the saturated zone at different places. As the slope of the water table beneath the Pajarito Plateau is steeper than the dip of most geologic units, saturated units are geologically older (deeper) in a downgradient direction. Knowing what material is saturated in an area facilitates the assignment of hydraulic properties to cells during groundwater modeling.

5.0 FURTHER WORK

The development of this atlas is scheduled to proceed in three phases:

1. construction of a preliminary version (documented here),
2. expansion of that version in FY 2000, and
3. annual updates thereafter.

Although the preliminary version has been described in previous sections of this documentation, a brief summary of the planned expansion and updates may also be of interest to atlas users.

The expansion will consist of the addition of things that could not readily be incorporated in this preliminary atlas, in view of data, time, or funding constraints. For example, the subsurface maps will be redrawn using the 1999 sitewide geologic model. Furthermore, subsurface maps were constructed only for the major geologic units, as they are the ones most frequently used in hydrogeologic work at the Laboratory. However, data also exist in the 3-D geologic model for many of the smaller subdivisions of these units. For completeness, structure, depth, and thickness maps should be constructed for them as well. A surface geologic map of the entire Laboratory area would be useful, but its construction necessarily awaits release of recent mapping of the Puye Quadrangle. Cross sections in selected areas would provide another perspective on the subsurface geology. Also, it would be useful to show the existing hydraulic property data, but this was deferred until these data have been compiled. Such compilation will be necessary for their input to the hydrogeologic database, and mapping should be easier once that has occurred. Addition of a stippled pattern to the piezometric surface map to indicate areas of known perched groundwater would also be useful. Such data are currently being compiled. Finally, the expansion will include the tasks necessary to make the atlas available on-line.

The 3-D geologic model and the atlas will be updated annually as necessary to incorporate data from new wells, especially those installed under the Hydrogeologic Workplan (LANL 1998, 59599). For example, if the new data change the 3-D geologic model, the subsurface maps must be modified. Similarly, the water-level map should be revised as new data points are added. Whenever the atlas is updated, the documentation will be revised as well. Only this version will carry the qualifier "Preliminary." Subsequent versions can be identified by the dates on the maps and revised documentation.

Obviously any improvements in the sitewide geologic model also improve the atlas. For the 1999 geologic model, the TIN surfaces are being reanalyzed in order to present more-realistic and visually appealing maps.

6.0 AVAILABILITY OF THE ATLAS

Hard copies of the preliminary atlas are being distributed only to those persons most actively involved in hydrogeologic work at the Laboratory (drilling wells, interpreting hydrologic data, modeling groundwater systems, overseeing environmental activities, etc.). Additional copies are available through the Laboratory's Facility for Information Management, Analysis, and Display (FIMAD).

To eliminate the need for FIMAD to plot large numbers of copies of the maps, the authors expect to eventually provide updated versions of the atlas through a web site. Use of a web site will allow for the presentation of additional data about the sitewide model, including the data set, visual presentations of the degree of fit for the data and model, geologic cross sections, and other information of interest.

The maps included in this preliminary atlas are listed below by map number, abbreviated title, and FIMAD plot identification number:

1. Topography (G107954)
2. Thickness of the Tshirege Member (G107955)
3. Structure on top of the Cerro Toledo interval (G107956)
4. Depth to top of the Cerro Toledo interval (G107957)

5. Thickness of the Cerro Toledo interval (G107958)
6. Structure on top of the ash flow unit, Otowi Member (G107959)
7. Depth to top of the ash flow unit, Otowi Member (G107960)
8. Thickness of the ash flow unit, Otowi Member (G107961)
9. Structure on top of the Guaje Pumice Bed, Otowi Member (G107962)
10. Depth to top of the Guaje Pumice Bed, Otowi Member (G107963)
11. Thickness of the Guaje Pumice Bed, Otowi Member (G107964)
12. Structure on top of the Cerros del Rio basalt (G107965)
13. Depth to top of the Cerros del Rio basalt (G107966)
14. Thickness of the Cerros del Rio basalt (G107967)
15. Structure on top of the Puye Formation (G107968)
16. Depth to top of the Puye Formation (G107969)
17. Thickness of the Puye Formation (G107970)
18. Structure on top of the upper basalt, Santa Fe Group (G107971)
19. Depth to top of the upper basalt, Santa Fe Group (G107972)
20. Thickness of the upper basalt, Santa Fe Group (G107973)
21. Structure on top of the Santa Fe Group (G107974)
22. Depth to top of the Santa Fe Group (G107975)
23. Partial thickness of the Santa Fe Group (G107976)
24. Regional Piezometric Surface (G107977)
25. Geology at the Piezometric Surface (G107978)

7.0 DISCUSSION

The paucity and scattered distribution of data are limiting factors in the preparation of both the 3-D geologic model and any 2-D maps derived from it. Thus, it should be recognized that the maps presented in the atlas are necessarily schematic. As the title of this document clearly states, this atlas is preliminary. However, the maps it contains provide an excellent opportunity to review the sitewide geologic model for the ultimate benefit of both 3-D and 2-D presentations.

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Appendix B-2

Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas

environmental restoration project

A Department of Energy
Environmental Cleanup Program

LA-UR-01-70
February 2001
ER2000-0562

Documentation for the Los Alamos National Laboratory Expanded Hydrogeologic Atlas

Los Alamos
NATIONAL LABORATORY
Los Alamos, NM 87545

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Produced by the Groundwater Investigations Focus Area for the Analysis and Assessment Focus Area

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Acronyms

2-D	two dimensional
3-D	three-dimensional
ER	environmental restoration
FIMAD	Facility for Information Management, Analysis and Display
FY	fiscal year
TA	technical area
TD	total depth
USGS	US Geological Survey

1.0 INTRODUCTION

Hydrogeologic studies seek to understand the relationship of the hydrologic systems of an area to its geologic framework, or the geologic controls of the hydrologic phenomena there (Stone 1999, 63990). Such studies are critical to the Los Alamos National Laboratory's (the Laboratory's) Environmental Restoration (ER) Project's efforts, but require adequate geologic and hydrologic maps. The Laboratory's three-dimensional (3-D) sitewide geologic model (Carey et al. 1999, 66782) compiles available geologic data in electronic form but is difficult to use in hard copy. Thus, a project was undertaken to produce a hydrogeologic atlas for the Laboratory area. Development was planned to occur in three stages: (1) construction of a preliminary atlas in 1999, (2) expansion of that version in 2000, and (3) annual updates (on request) thereafter.

The preliminary hydrogeologic atlas, consisting of 25 maps, was prepared in 1999 (Stone et al. 1999, 64039). The documentation for that version gave the overall purpose and scope of the atlas, described the source and quality of data used in its preparation, gave specifications and assumptions for the various types of maps presented, and discussed the availability of the atlas. Although much of that information applies to the expanded atlas as well, not all of it is repeated here. While those who already have the preliminary atlas may discard the maps from that version, they are advised to keep the original documentation for future reference. New atlas users are encouraged to refer to the original documentation for an introduction to the atlas, especially if they have not seen it previously.

This expanded version of the atlas consists of 45 sheets plus this documentation. (The illustrations that make up the new atlas maps are labeled as "sheets" rather than "maps," as in the preliminary version, because the final sheet is not a map; it gives a series of cross sections.) This updated documentation restates the purpose, scope, and availability of the atlas, but focuses on new features that were suggested in the peer review of the preliminary atlas or were deemed useful but could not readily be incorporated in that version, such as new subsurface maps, other new sheets, and changes to some of the maps in the preliminary atlas.

NB: Users of this atlas are urged to keep this documentation (as well as that of the preliminary version) with the atlas sheets for ready reference.

1.1 Purpose

Hydrologists, modelers, and environmental scientists at the Laboratory need various kinds of hydrogeologic information to perform their work. Maps that show the subsurface geology (structure, depth, and thickness of major units) are especially useful in predicting drilling conditions, describing hydrostratigraphic units, formulating conceptual hydrogeologic models, and discretizing numerical models. Maps that show water levels, areas of perched groundwater, and the geology at the regional piezometric surface help workers conceptualize the hydrologic system and identify data gaps. A geologic map and cross sections further characterize the geology of the Laboratory area.

The purpose of the atlas is threefold: (1) to synthesize (graphically, in one place) the considerable amount of previous hydrogeologic work available, (2) to present the information available in the 3-D sitewide geologic model (Carey et al. 1999, 66782) on traditional two-dimensional (2-D) paper sheets of a manageable size, and (3) to provide the basis for a single, sound hydrogeologic conceptual model for the Pajarito Plateau.

1.2 Scope

As was the case for the preliminary atlas, the scope of the expanded version is somewhat narrow. For one thing, this expanded version is restricted to the area covered by the Laboratory (Figure 1.2-1). Furthermore, it covers only the Tertiary and Quaternary geologic units normally encountered by drilling at the Laboratory. More specifically, it includes maps for only the major geologic units beneath the Pajarito Plateau (Figure 1.2-2). That is, while it includes maps for members of the Bandelier Tuff, it does not (with one exception) include maps for the various subunits within these members that are informally recognized at the Laboratory.

An effort was made to utilize only published data, supplemented where appropriate by the most recent unpublished data available. Geologic data used are those in the Laboratory's 1999 3-D sitewide geologic model (Carey et al. 1999, 66782). The sources of hydrologic data used include Purtymun (1995, 45344), the Laboratory's annual water-supply reports, and completion reports for the regional wells being installed under the Laboratory's hydrogeologic work plan (LANL 1998, 59599).

1.3 FY1999 Sitewide Geologic Model

The sitewide geologic model underwent a major revision in fiscal year (FY) 1999. This was done to better characterize deeper (pre-Bandelier) units, which could influence groundwater flow. More specifically, the revised model includes the two Tschicoma dacite/latite flows, whose source is north of the Laboratory, and three distinct sets of basalt flows, which interfinger with the Puye Formation and Santa Fe Group. In updating the Bandelier Tuff portion of the model, a new informal subunit (the unit 3/4 transition in the Tshirege Member) was added, as recent information suggests that this interval may play an important role in localizing saturation in the western portion of the Laboratory (LANL 1998, 59891).

Data from several sources were used to revise the model:

- new age dates for the basalts;
- drill-hole stratigraphy from new wells being installed under the hydrogeologic work plan (LANL 1998, 59599) and at Technical Area (TA) 16 (LANL 1998, 59891);
- new petrographic studies of sediments of the upper Santa Fe Group and Totavi Lentil;
- geologic map for the White Rock quadrangle (Dethier 1997, 49843);
- geologic map for the St. Peter's Dome area (Goff et al. 1990, 21574);
- geologic-mapping data for the Tschicoma Formation (Griggs 1964, 65649); and
- new high-precision geologic-mapping data (Gardner et al. 1998, 63496; 1999, 63492).

New contact surfaces were developed for all units in the model. The new age and petrographic data help support a preliminary pre-Puye paleogeographic model in which a major drainage system passes from north-northeast to south-southwest through the center of the Laboratory. The trend of the pre-Puye surface and of the base of the Los Alamos aquifer (within the upper Santa Fe Group) align with trends of the axial gravels of the Totavi Lentil and probably reflect the evolution of the ancestral Rio Grande (WoldeGabriel et al., in preparation). As data for these deeper units are limited, atlas-project geologists utilized this paleogeographic model to extrapolate contact surfaces between control points.

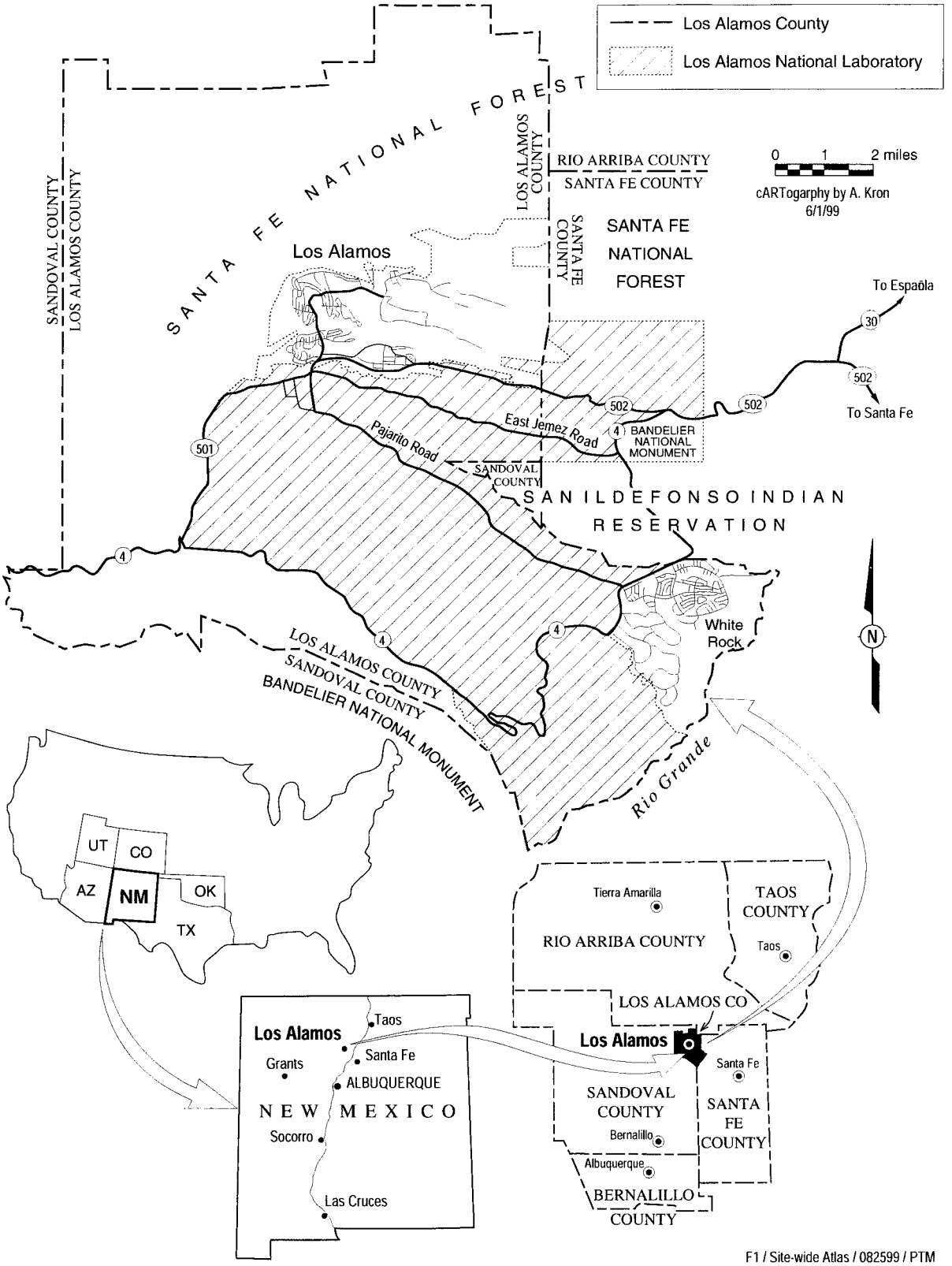
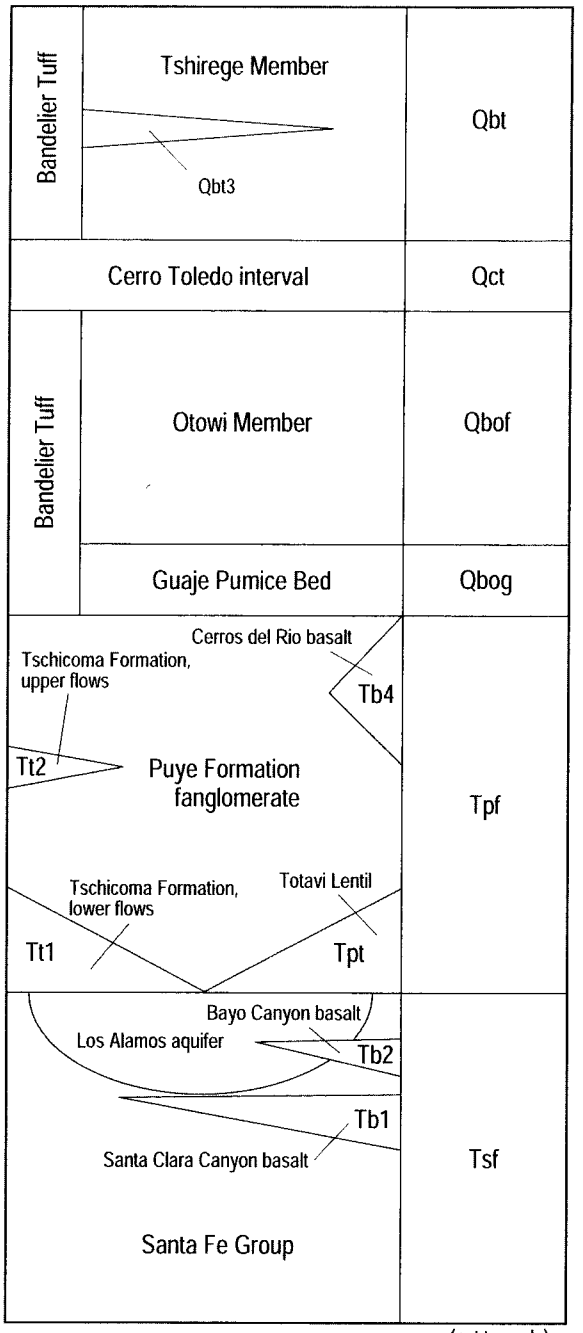


Figure 1.2-1. Location of Los Alamos National Laboratory



(not to scale)

F1.2-1 / Site-wide Atlas / 090800 / PTM
Modified F1.2-2/Site-wide Atlas/113000/RLM

Figure 1.2-2. Geologic column showing units included in the expanded hydrogeologic atlas

Top and bottom surfaces for most pre-Bandelier flow units are based on sparse data (mainly the presence or absence of the units in area drill holes. The Cerros del Rio basalt is the exception, cropping out prominently in White Rock Canyon, east of the Laboratory. However, the geometry of these flows is not well controlled in the subsurface.

The FY1999 geologic model is a major improvement over previous versions. However, the spatial characterization of the deeper units is still poorly constrained and future revisions are inevitable. Likewise, the pre-Puye paleogeograhic model no doubt will be modified, as additional data become available.

2.0 NEW SUBSURFACE MAPS

Maps for seven other geologic units were added to the expanded atlas. These include the unit 3/4 transition of the Tshirege Member of the Bandelier Tuff, the Totavi Lentil of the Puye Formation, both upper and lower flows of the Tschicoma Formation, the Los Alamos aquifer (coarse, upper part of the Santa Fe Group), the Bayo Canyon basalt, and the Santa Clara Canyon basalt.

2.1 Tshirege Member, Unit 3/4 Transition (Qbt3)

Although a decision was made at the outset of work on the preliminary atlas to not include maps for the informal subunits recognized in the members of the Bandelier Tuff, a map has been added for the unit 3/4 transition in the Tshirege Member. This seems justified, as saturation is associated with that interval in some areas (LANL 1998, 59891).

2.2 Totavi Lentil (Tpt)

The Totavi Lentil is a coarse clastic subunit at the base of the Puye Formation. It was lumped with the Puye Formation in the preliminary hydrogeologic atlas because the lateral extent, continuity, and correlation of deposits ascribed to it across the Pajarito Plateau are uncertain. However, it is potentially significant hydrologically, so a separate set of subsurface maps for the Totavi Lentil is warranted. Consequently, maps for the Puye Formation in the expanded atlas do not include the Totavi Lentil. The 3-D geologic model, and thus the atlas, treats the Totavi as a laterally continuous layer, but as the name "lentil" implies, it probably is not.

2.3 Tschicoma Formation (Ttu, Ttl)

The volcanic rocks of the Tschicoma Formation interfinger with the Puye Formation beneath the western part of the Pajarito Plateau. In view of this relationship and the fact that few wells tap this unit, the Tschicoma Formation was lumped with the Puye Formation in the preliminary atlas. Two flow packages (upper and lower) are recognized within this unit. As they may be significant hydrologically, separate sets of subsurface maps for them are included in this expanded atlas.

2.4 Los Alamos Aquifer (Tsfuv)

Purtymun (1984, 6513) advanced the notion that the coarse clastics in the upper portion of the Tesuque Formation (uppermost unit in the Santa Fe Group in most of the Laboratory area) yielded more water to wells than other materials that constitute the regional aquifer. He eventually separated these deposits from the Tesuque Formation and proposed the name Chaquehui Formation for them, after exposures of material he believed to be correlative in Chaquehui Canyon (Purtymun 1995, 45344). However, this unit has since been rejected by geologists and hydrologists on several grounds. For one thing, it was not

named in accordance with US Geological Survey (USGS) rules for stratigraphic nomenclature and would be suitable only for informal usage at best. Furthermore, it is known only from drill cuttings and is difficult to distinguish from other units in the Santa Fe Group. More importantly, the material in the proposed type area differs from material originally assigned to the unit in wells. Finally, from an examination of hydrologic characteristics of the geologic units that make up the regional aquifer, as penetrated by supply and test wells on the Pajarito Plateau (Purtymun 1995, 45344), it is not clear that the stratigraphic interval to which the name was applied is really a better water producer than others screened in supply wells (for example, the Puye Formation).

Nonetheless, because the coarse clastic unit in the upper Santa Fe Group may be significant hydrologically, this expanded atlas includes a set of subsurface maps for it. Although the Chaquehui is not a valid stratigraphic unit, it may be treated as a hydrostratigraphic unit since its hydrologic characteristics seem to be the main basis for distinguishing it. The name "Chaquehui aquifer" was considered, in order to retain Purtymun's original geographic name for the material. However, this was rejected in view of the lack of any geologic connection between the aquifer material and that exposed in Chaquehui Canyon. Also, it seemed desirable to select a name that does not dredge up all the previous clamor over the Chaquehui. The name "Los Alamos aquifer" ultimately was selected to replace the Chaquehui for reference to the upper Santa Fe Group (Tsfuv). This seems fitting, inasmuch as the unit does supply water to the Laboratory and the Los Alamos townsite. It should be noted, however, that this is not the only unit making up the regional aquifer and supplying water to area wells.

2.5 Bayo Canyon Basalt (Tb2)

Two additional Tertiary basalts, predating the Cerros del Rio basalt, were added to the FY1999 geologic model. Inasmuch as saturation has been found in the Cerros del Rio basalt beneath the Laboratory, maps were added to the expanded atlas to cover all basaltic rocks reported in the Los Alamos area.

The Bayo Canyon basalt (Tb2) represents volcanic activity at 8 to 9.5 Ma. It is interbedded with the Los Alamos aquifer in the upper part of the Santa Fe Group at a stratigraphic position above that of the Santa Clara basalt (Tb1).

2.6 Santa Clara Canyon Basalt (Tb1)

The Santa Clara basalt (Tb1) represents volcanic activity at 11 to 13 Ma. As currently conceptualized, the Santa Clara consists of two distinct basalt bodies, one in the Guaje well field and the other in the vicinity of supply well O-1. This unit is interbedded with sediments of the upper Santa Fe Group, but below the Los Alamos aquifer and the position of the Bayo Canyon basalt (Tb2).

3.0 OTHER NEW SHEETS

In addition to the subsurface maps for additional geologic units, this expanded atlas contains two other new sheets. These are a geologic map and a sheet showing cross sections for selected areas on the Pajarito Plateau.

3.1 Geologic Map

The preliminary atlas lacked a geologic map, as none was available in electronic form for the entire Laboratory area. Rogers (1995, 54419) published a map for the members and subunits of the Bandelier Tuff that covered the entire Laboratory area. Although her map remains an invaluable resource, it is not

available in electronic form. Thus, the geologic map for this expanded atlas was constructed from the contact surfaces for units in the FY1999 geologic model. These surfaces were developed using data from numerous sources, including Rogers (1995, 54419). More specifically, the geologic map was built by the successive stacking of younger units on older units until the topographic-surface grid was intersected. This was accomplished using grid and polygon operations of ArcInfo software.

The color scheme used for the map does not follow standard practice (adopted by the USGS and others) in which specific colors are employed to signify specific geologic ages (yellow for Quaternary, green for Cretaceous, etc.). That scheme did not work for so many units within such a narrow time interval as are found on the Pajarito Plateau. However, the colors used in the atlas are the same as those employed in the Laboratory's sitewide geologic model.

3.2 Cross Sections

Constructing cross sections along any line, using the 3-D sitewide geologic model, is fairly easy. Eight geologic cross sections are presented in this expanded atlas: six aligned northwest-to-southeast more or less along major canyons and two aligned more or less perpendicular to those (northeast-to-southwest). In addition to the small index map on the cross-section sheet (Sheet 45), the lines of section are shown more clearly on the geologic map (Sheet 2). Although showing the piezometric surface on the various cross sections would have been desirable, that would not have been a trivial operation because that surface was in the 3-D model, whereas the sections were made by Stratamodel™.

4.0 CHANGES TO MAPS PREVIOUSLY PRESENTED

All maps presented in the preliminary atlas were changed for this expanded atlas. The biggest changes were required by a revision in the 3-D sitewide geologic model as described in Section 1.3, FY1999 Sitewide Geologic Model, above. Other changes were of two main types: the addition of data not previously shown or major modifications to the design used for maps in the preliminary atlas.

4.1 Addition of Data Not Previously Shown

Some maps merely were updated by adding geologic or water-level data obtained in new wells. Other maps were changed by adding things not previously shown. These additions include hydraulic conductivity and reported occurrences of intermediate-depth perched groundwater in wells.

4.1.1 Hydraulic Conductivity

Knowledge of the hydraulic properties of the geologic units beneath the Pajarito Plateau is critical to hydrogeologic studies at the Laboratory, especially flow and transport modeling. For example, hydraulic conductivity (K) is a key parameter in Darcy's law: $Q = -KIA$, where Q = discharge, I = hydraulic gradient, and A = cross-sectional area of saturated zone. Therefore, existing horizontal K values have been added to the thickness maps for each geologic unit in the atlas. This allows quick determination of transmissivity (T), should that parameter be needed: $T = Kb$, where "b" is thickness.

Table 4.1-1 summarizes the hydraulic-conductivity data used. Data came from aquifer tests reported by Purtymun (1995, 45344). In each well tested, the screened interval spans more than a single geologic unit. Units covered by testing were determined from Purtymun's well logs, the current geologic interpretation of those logs, and the screen or slot length he reported. Results of recent hydrologic

Table 4.1-1
Hydraulic-Conductivity (K) Data used in the Expanded Atlas

Well	Units Covered by Test*	K (gpd/ft2)	Year of Test
Los Alamos Field			
LA-1B	Tsfu	9.3	1982
LA-2	Tsfu	3.5	1982
LA-3	Tsfu	3.3	1982
LA-4	Tsfu	5.7	1981
LA-5	Tsfu	3.0	1982
LA-6	Tsfu	9.1	1982
Guaje Field			
G-1	Tsfuv, Tb1, Tsfu	7.0	1982
G-1A	Tsfuv, Tb1, Tsfu	9.1	1982
G-2	Tsfuv, Tsfu	9.1	1982
G-3	Tsfuv, Tb1, Tsfu	5.3	1982
G-4	Tsfuv, Tb1, Tsfu	11.3	1982
G-5	Tsfuv, Tb1, Tsfu	8.7	1982
G-6	Tsfuv, Tb1, Tsfu	6.7	1982
Pajarito Field			
PM-1	Tsfuv, Tb2, Tsfu	31	1982
PM-2	Tpf, Tpt, Tsfuv, Tb2,	28	1982
PM-3	Tsfuv, Tb2, Tsfu	179	1982
PM-4	Tpf, Tpt, Tsfuv, Tb2	24	1982
PM-5	Tpf, Tpt, Tsfuv, Tb2, Tsfu	5.3	1982
Otowi Field			
O-1	Tsfu	4.7	1990
O-4	Tsfuv, Tb2, Tsfu	30	1990
Test Wells			
DT-5A	Tb4, Tpf, Tpt, Tsfuv	17	1960
DT-9	Tb4, Tpf, Tpt, Tsfuv	122	1960
DT-10	Tb4, Tpf, Tpt, Tsfuv	111	1960
TW-1	Tpt	4.0	1951
TW-2	Tpt	241	1951
TW-3	Tpt	120	1951
TW-4	Tt1	19	1951
TW-8	Tpf	25	1960

Source: Purtyman 1995, 45344; Carey et al. 1999, 67782.

*Units screened in well: Tb4 = Cerros del Rio Basalt; Tpf = Puye Formation, fanglomerate; Tt1 = Tschicoma Formation, upper flows; Tpt = Puye Formation, Totavi Lentil; Tsfuv = Los Alamos aquifer; Tb2 = Bayo Canyon basalt; Tb1 = Santa Clara Canyon basalt; Tsfu = Santa Fe Group, undifferentiated.

testing at the new regional characterization wells being installed under the hydrogeologic work plan (R-9i, R-15, R-19, R-22, R-31, and CDV-R-15-3) are not tabulated or plotted on the maps, as they are based on only cursory calculations and may be changed after test data have been subjected to more thorough analysis.

4.1.2 Occurrences of Intermediate-Depth Perched Groundwater

In addition to knowing the position of the regional water table, it also is useful in Laboratory hydrogeologic studies to know where perched groundwater can be expected. Although shallow perched water occurs locally in the alluvium along canyon bottoms, this saturation is mainly ephemeral and was not mapped. However, reported occurrences of intermediate-depth perched saturation in Laboratory wells were plotted on the map of the regional piezometric surface (Sheet 43).

A standard shaded area around wells where perched water has been observed depicts such occurrences. It should be noted that the actual extent of perched saturation likely varies through time and is not known at any of these locations. Thus, the symbol is merely for location purposes and the size of the shaded areas does not represent the actual extent of the perched saturation reported. Each occurrence (shaded area) is accompanied by a notation giving the depth to the perched water table and the geologic unit that contains the saturation.

Table 4.1-2 gives the intermediate-depth, perched-water observations used in the expanded atlas. The data came mainly from three sources: Purtymun (1995, 45344), canyon work plans, and completion reports for wells recently installed under the hydrogeologic work plan (LANL 1998, 59599).

4.2 Modifications of Preliminary Maps

Still other maps were modified by improving on the original design or making necessary corrections. This involved including outcrops and subsurface extent of units on the subsurface maps as appropriate, as well as correcting Rio Grande elevations and recontouring water-level data on the regional piezometric-surface map.

4.2.1 Inclusion of Outcrops and Subsurface Extent of Units

Subsurface maps in the preliminary atlas lacked edges or zero lines for geologic units. A concerted effort was made to make such boundaries more clear in this expanded atlas. This was mainly achieved by including outcrop areas as well as lines that show the subsurface extent of geologic units that are not pervasive beneath the Pajarito Plateau. Some units pinch out to the east, others to the west, some in both directions. A careful examination of a given map should reveal which is the case for that unit. For consistency and clarity, the outcrops are shown in the same color as on the geologic map (Sheet 2).

4.2.2 Revision of the Regional Piezometric-Surface Map

The regional piezometric-surface map was changed in three ways in the expanded atlas. First, as noted above, reported occurrences of intermediate-depth perched groundwater were added. Second, anomalous elevations for the Rio Grande incorporated on the preliminary piezometric-surface map have been corrected. (The anomalies apparently arose from using two different software programs for topographic-data sets in that part of the map: one for the river and another for topography.) The third change involved totally rethinking the contouring of available water-level data.

Table 4.1-2
Occurrences of Intermediate-Depth Perched Groundwater

Well	Perched Water Level Depth (ft)	Unit Containing Perched Saturation	Data Source
Pueblo Canyon			
TW-2A	120	Puye Formation	Purtymun 1995, 45344
O-1	183	Puye Formation	Purtymun 1995, 45344
TW-1A	180	Cerros del Rio basalt	Purtymun 1995, 45344
Los Alamos Canyon			
H-19	(20-ft interval)	Guaje Pumice bed	LANL 1995, 50290
LAO(A)	295	Guaje Pumice bed	LANL 1995, 50290
LADP-3	325	Guaje Pumice Bed	LANL 1995, 50290
O-4	253	Puye Formation	Purtymun 1995, 45344
R-9	137	Cerros del Rio basalt	Broxton et al. 2000, 66599
R-9	264	Cerros del Rio basalt	Broxton et al. 2000, 66599
R-9	524	Cerros del Rio basalt	Broxton et al. 2000, 66599
Sandia Canyon			
R-12	424	Cerros del Rio basalt	Broxton et al. 2000, 66601
PM-1	450	Cerros del Rio basalt	Purtymun 1995, 45344
Mortandad Canyon			
MCM-51	55	Tsankawi/Cerro Toledo	LANL 1997, 56835
MCM-5.9	105	Tsankawi/Cerro Toledo	LANL 1997, 56835
R-15	646	Cerros del Rio basalt	Longmire et al. 2000, 66602
Pajarito Canyon			
SHB-4	145	Cerro Toledo interval	LANL 1998, 59577
54-1016	592	Cerros del Rio basalt	LANL 1998, 59577
Ancho Canyon			
R-31	440	Cerros del Rio basalt	Marin 2000, 68082

Insufficient data (too few deep wells) hinder any confident mapping of the piezometric surface beneath the Laboratory. Furthermore, the few wells that are available have long screened intervals so water levels obtained from them are composite values. Even taking this into account, the placement of some contours on the preliminary version seems arbitrary.

Rather than move a few contours in a few places for the expanded atlas, the map of the regional piezometric surface was completely redrawn from scratch, using the most recent water levels available. Data used are given in Table 4.2-1. As for the preliminary atlas, data from the White Rock Canyon springs were not used in constructing the piezometric-surface map, as most of these springs are believed to yield water that has become perched above the regional zone of saturation (Stone 1996, 63989).

Table 4.2-1
Records of Wells used in Regional Piezometric-Surface Map

Well	Total Depth (ft)[a]	Unit at Total Depth[b]	Ground Surface Elevation (ft)[a]	Water Level Depth (ft)	Water Level Date (yr)	Water Level Elevation (ft)	Screen Length (ft)[c]	Data Source
CdV-R-15-3	1675	Tp	7257	1245	2000	6012	M	Environmental Restoration Project 2000, 67328
DT-5A	1821	Tsf	7144	1184	1996	5960	220	Purtymun 1995, 45344; McLin et al. 1998, 63506
DT-9	1501	Tsf	6935	1016	1997	5919	183	Purtymun 1995, 45344; McLin et al. 1998, 63506
DT-10	1409	Tsf	7020	1097	1997	5923	141	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-1	2020	Tsf	5840	274	1997	5566	490	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-1A	2071	Tsf	6014	309	1997	5705	563	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-2	2006	Tsf	6056	358	1997	5698	425	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-3	1997	Tsf	6139	375	1986	5764	400	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-4	2002	Tsf	6229	375	1997	5854	360	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-5	1997	Tsf	6306	459	1994	5847	400	Purtymun 1995, 45344; McLin et al. 1998, 63506
G-6	2005	Tsf	6422	581	1997	5841	810	Purtymun 1995, 45344; McLin et al. 1998, 63506
GR-1	2000	Tsf	6417	552	1998	5865	1233	McLin 2000, 68299
GR-2	2000	Tsf	6141	323	1998	5818	1415	McLin 2000, 68299
GR-3	2000	Tsf	6213	397	1998	5816	1390	McLin 2000, 68299
GR-4	2000	Tsf	6300	461	1998	5839	1325	McLin 2000, 68299
LA-1	1001	Tsf	5624	9	1996?	5615	805	Purtymun 1995, 45344; Map 24, Stone et al.1999, 64039
LA-1B	2256	Tsf	5622	+18	1996	5640	591	Purtymun 1995, 45344; McLin et al. 1998, 63506
LA-2	882	Tsf	5651	120	1996?	5531	760	Purtymun 1995, 45344; Map 24, Stone et al. 1999, 64039
LA-3	910	Tsf	5672	12	1996?	5560	760	Purtymun 1995, 45344; Map 24, Stone et al.1999, 64039
LA-4	2019	Tsf	5975	248	1996?	5727	350	Map 24, Stone et al.1999, 64039
LA-5	2024	Tsf	5840	148	1996?	5692	350	Map 24, Stone et al.1999, 64039

Table 4.2-1 (continued)

Well	Total Depth (ft)[a]	Unit at Total Depth[b]	Ground Surface Elevation (ft)[a]	Water Level Depth (ft)	Water Level Date (yr)	Water Level Elevation (ft)	Screen Length (ft)[c]	Data Source
LA-6	2030	Tsf	5770	88	1996?	5682	400	Purtymun 1995, 45344; Map 24, Stone et al.1999, 64039
O-1	2609	Tsf	6396	676	1997	5720	1460	Purtymun 1995, 45344; McLin et al. 1998, 63506
O-4	2806	Tsf	6627	762	1995	5865	1481	Purtymun 1995, 45344; McLin et al. 1998, 63506
PM-1	2501	Tsf	6520	760	1997	5760	1534	Purtymun 1995, 45344; McLin et al. 1998, 63506
PM-2	2600	Tsf	6715	870	1995	5845	1276	Purtymun 1995, 45344; McLin et al. 1998, 63506
PM-3	2552	Tsf	6640	779	1997	5861	1576	Purtymun 1995, 45344; McLin et al. 1998, 63506
PM-4	2220	Tsf	6920	1093	1997	5827	1594	Purtymun 1995, 45344; McLin et al. 1998, 63506
PM-5	3110	Tsf	7095	1254	1997	5841	1632	Purtymun 1995, 45344; McLin et al. 1998, 63506
R-9	771	Tsf	6384	688	1999	5696	65	Broxton et al. 2000, 66599
R-12	847	Tsf	6501	805	1998	5696	M	Broxton et al. 2000, 66601
R-15	1043	Tp	6818	964	1999	5854	62	Longmire et al. 2000, 66602
R-19	1902	Tp	7060	1156	2000	5904	M	Broxton et al. 2000, 66603
R-25	1942	Tp	7517	1285	2000	6232	M	LANL 1999, 68416
R-31	1078	Tp	6365	522	2000	5843	M	Marin 2000, 68082; Marin 2000, 68417
TW-1	642	Tp	6369	529	1997	5840	10	McLin et al. 1998, 63506
TW-2	834	Tp	6648	797	1996	5851	56	McLin et al. 1998, 63506
TW-3	814	Tp	6595	782	1997	5813	5	McLin et al. 1998, 63506
TW-4	1205	Ttu	7245	1176	1996	6069	10	McLin et al. 1998, 63506
TW-8	1065	Tp	6878	994	1997	5884	112	McLin et al. 1998, 63506

[a]Final, plugged-back depth.

[b]Tp = Puye Formation; Ttu = Tschicoma Formation, undifferentiated; Tsf = Santa Fe Group.

[c]Includes slotted pipe, perforations or louvers; M = multiple screened intervals of various lengths at various depths.

Note: Depths and elevations are rounded to nearest foot.

Some previous water-level maps for the Laboratory area are characterized by smooth contours that extend unswervingly through areas of known groundwater withdrawal and diverse water levels. This leaves anomalous values between contours. The piezometric-surface map presented in this version of the atlas (Sheet 43) attempts to better accommodate known water-level values. Thus, contours make broad swings around supply wells. This is especially obvious near the Pajarito and Guaje well fields. Nonetheless, because some isolated anomalous water levels don't contour easily, the map is still not ideal. Presumably, additional data from new wells will provide a basis for improving it.

A piezometric-surface grid was developed for the model from the digitized version of the hand-drawn water-level map. The approach to constructing the map showing geology at the regional piezometric surface was the same as that for constructing the geologic map (which is simply geology at the topographic surface). In the former case, however, the reference was the piezometric-surface grid rather than the topographic grid.

5.0 DISCUSSION

A few words of explanation are warranted on things that do not clearly fall under any of the headings above. For one thing, contours on some maps appear to branch (which is not allowed). In such cases, contours are merely merging at vertical boundaries.

Also, some values reported for structure and depth of units on the subsurface maps deserve clarification. It is fairly standard practice to use "less-than" (<) and "greater-than" (>) signs on subsurface maps. For example, a less-than (<) sign beside an elevation on a structure (elevation-of-top-of-unit) map usually indicates that the unit was not encountered before reaching total depth (TD) and its top presumably would be deeper or less than the elevation of TD. Similarly, greater-than (>) signs commonly accompany data on a depth (to-top-of-unit) map to indicate that the top of a unit lies below the well's TD.

However, some subsurface maps in this expanded atlas employ a reverse approach to such symbols because of the design philosophy of the 3-D geologic model upon which it is based. More specifically, the Laboratory's geologic model stresses projected noneroded surfaces for units. Thus, the elevation value for the top of a unit may be accompanied by a greater-than (>) sign, indicating that the well is in the outcrop area of the unit and the ideal (projected noneroded) top is at an elevation higher than that of the ground surface at the well. Similarly, values plotted for some wells on the depth maps may be preceded by a less-than (<) sign, indicating that the well is in the outcrop area for the unit and the depth-to-top of the ideal (projected noneroded) top is at a lesser depth than shown. These symbols may appear even if the model did not extend the outcrop area into the well locations.

Finally, although the atlas is not perfect, it is believed to be a good synthesis of existing information. As such, it is a useful tool for illustrating what is currently known and conceptualized of the hydrogeology of the Pajarito Plateau and the Laboratory. Its use should simplify planning of ER projects and result in a common thread in ER Project work plans.

The atlas has an unexpected secondary function of providing the perfect means for evaluating the sitewide geologic model. That is, persons familiar with this area's geology can review and critique the various sheets. Users of the atlas are not only invited but also expected to provide suggestions for the sitewide geologic model.

6.0 AVAILABILITY OF THE EXPANDED ATLAS

Hard copies of the expanded atlas are being distributed to those persons most actively involved in hydrogeologic work at the Laboratory (that is, those who drill wells, interpret hydrologic data, model groundwater systems, oversee environmental activities, etc.). As in the case of the preliminary atlas, this includes distribution of at least one copy to each Laboratory, US Department of Energy, New Mexico Environment Department, pueblo, and citizen group involved or interested in such studies, as well as the Los Alamos National Laboratory Research Library. Additional copies of part or all of the expanded atlas are available through the Laboratory's Facility for Information Management, Analysis, and Display (FIMAD).

To facilitate ordering separate parts of the expanded atlas, they are listed below by sheet number, abbreviated title, and FIMAD plot identification number:

1. Topography (109020)
2. Bedrock geology (109021)
3. Thickness of the Tshirege Member (109022)
4. Structure on top of Tshirege, unit 3/4 transition (109023)
5. Depth to top of the Tshirege, unit 3/4 transition (109024)
6. Thickness of the Tshirege, unit 3/4 transition (109025)
7. Structure on top of Cerro Toledo interval (109026)
8. Depth to top of Cerro Toledo interval (109027)
9. Thickness of the Cerro Toledo interval (109028)
10. Structure on top of ash flow, Otowi Member (109029)
11. Depth to top ash flow, Otowi Member (109030)
12. Thickness of the ash flow, Otowi Member (109031)
13. Structure on top of Guaje Pumice Bed (109032)
14. Depth to top of Guaje Pumice Bed (109033)
15. Thickness of the Guaje Pumice Bed (109034)
16. Structure on top of Cerros del Rio basalt (109035)
17. Depth to top of Cerros del Rio basalt (109036)
18. Thickness of the Cerros del Rio basalt (109037)
19. Structure on top of Puye Formation (109038)
20. Depth to top of Puye Formation (109039)
21. Thickness of the Puye Formation (109040)
22. Structure on top of Totavi Lentil (109041)
23. Depth to top of Totavi Lentil (109042)
24. Thickness of the Totavi Lentil (109043)
25. Structure on top of Tschicoma Formation, upper flows (109044)
26. Depth to top of Tschicoma Formation, upper flows (109045)
27. Thickness of the Tschicoma Formation, upper flows (109046)

28. Structure on top of Tschicoma Formation, lower flows (109047)
29. Depth to top of Tschicoma Formation, lower flows (109048)
30. Thickness of Tschicoma Formation, lower flows (109049)
31. Structure on top of Los Alamos aquifer (109050)
32. Depth to top of Los Alamos aquifer (109051)
33. Thickness of the Los Alamos aquifer (109052)
34. Structure on top of Santa Fe Group (109053)
35. Depth to top of Santa Fe Group (109054)
36. Partial thickness of the Santa Fe Group (109055)
37. Structure on top of Bayo Canyon basalt (109056)
38. Depth to top of Bayo Canyon basalt (109057)
39. Thickness of the Bayo Canyon basalt (109058)
40. Structure on top of Santa Clara Canyon basalt (109059)
41. Depth to top of Santa Clara Canyon basalt (109060)
42. Thickness of the Santa Clara Canyon basalt (109061)
43. Regional piezometric surface (109062)
44. Geology at the regional piezometric surface (109063)
45. Geologic cross sections (109064)

In accordance with the original project plan, complete sets of the atlas will not be prepared and distributed (or documented) beyond this version. Although the 3-D sitewide geologic model will be updated annually to incorporate data obtained from any new wells drilled, and thus updated atlas sheets can be prepared readily; they will only be made by FIMAD upon demand.

7.0 ACKNOWLEDGMENTS

The ER Project's Analysis and Assessment Focus Area funded both the preliminary and the expanded hydrogeologic atlas. Diana Hollis of that group was especially supportive. Rick Warren (EES-1) made results of new petrographic studies of sediments of the upper Santa Fe Group and Totavi Lentil available for the 3-D sitewide geologic model. Members of the Groundwater Integration Team provided helpful comments throughout the project. Jan Torline (ER Project) was the editor for the document and Pam Maestas and Randi Moore (ER Project) were the compositors.

8.0 REFERENCES

The following list includes all references cited in this document. The parenthetical information following the reference provides the author, publication date, and ER Project identification (ER ID) number. This information is also included in the citation in the text and can be used to locate the document.

ER ID numbers are assigned by the Laboratory's ER Project to track all material associated with Laboratory potential release sites. These numbers can be used to locate copies of the documents at the ER Project's Records Processing Facility and, where applicable, within the ER Project reference library. The references cited in this work plan can be found in the volumes of the reference library titled "Reference Set for Canyons."

Copies of the reference library are maintained at the New Mexico Environment Department Hazardous and Radioactive Materials Bureau, the Los Alamos Area Office of the US Department of Energy, and the ER Project Office. This library is a living document that was developed to ensure that the administrative authority has all the necessary material to review the decisions and actions proposed in this work plan. However, documents previously submitted to the administrative authority are not included in the reference library.

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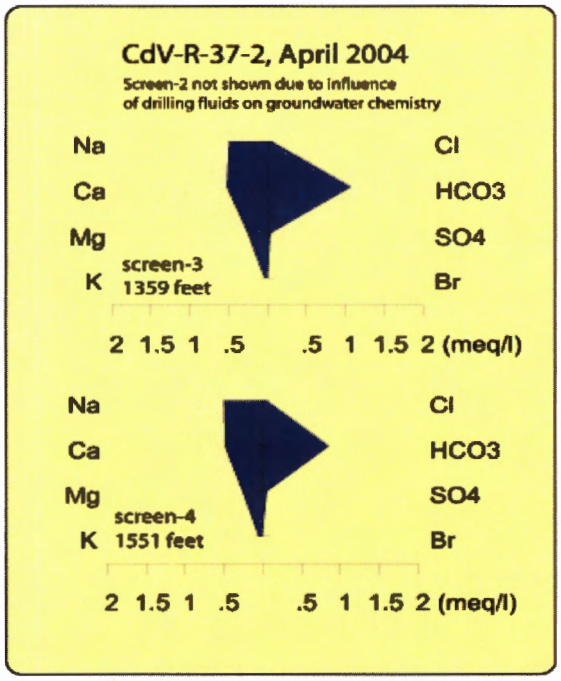
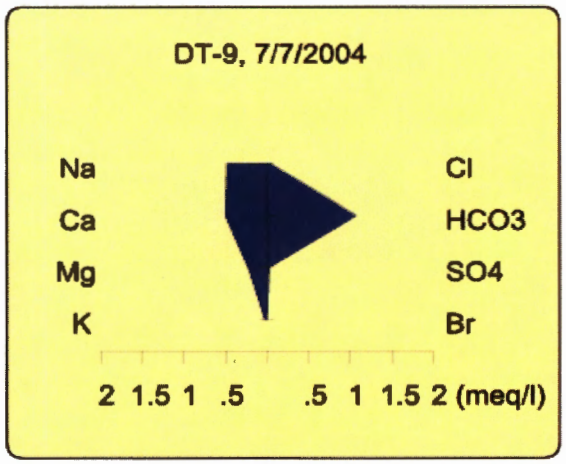
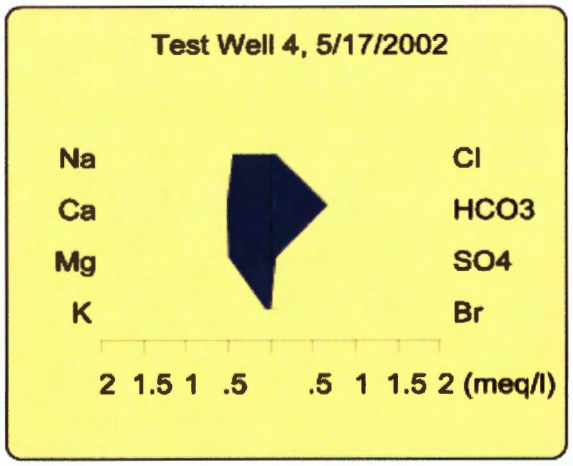
Appendix C

General Hydrochemistry for Groundwater Flow Regimes

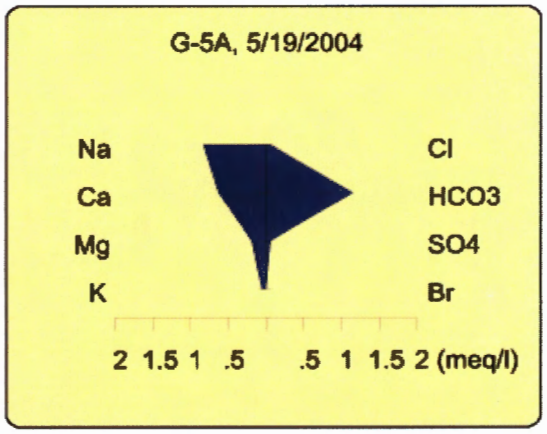
Representative hydrochemistry of regional groundwater in the western portion of the Laboratory (zone-1)

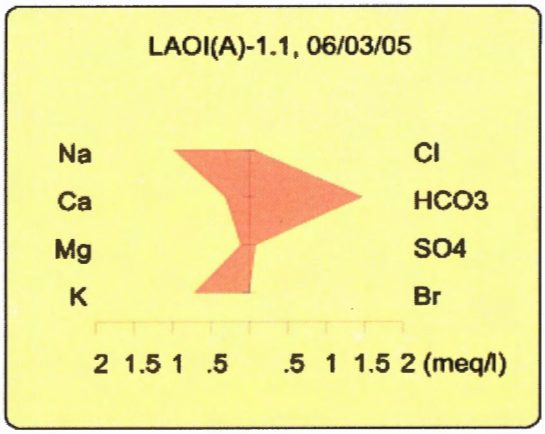


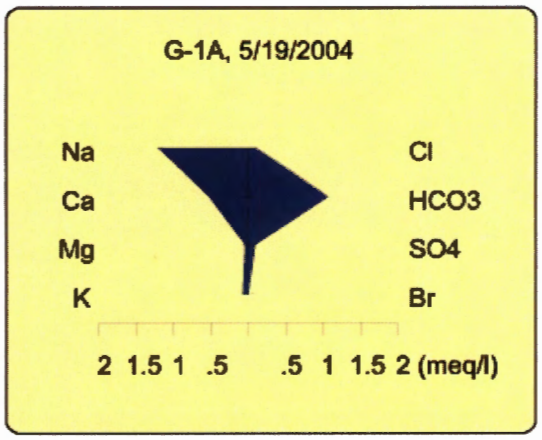


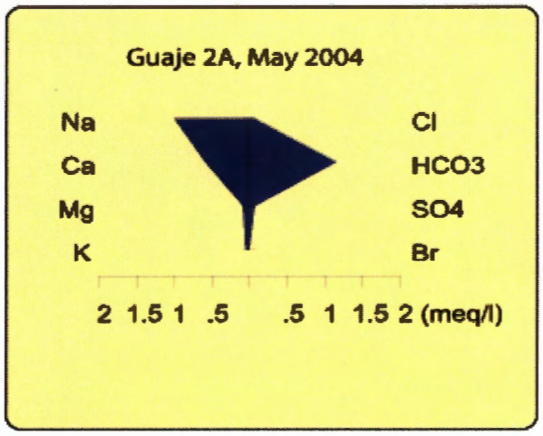


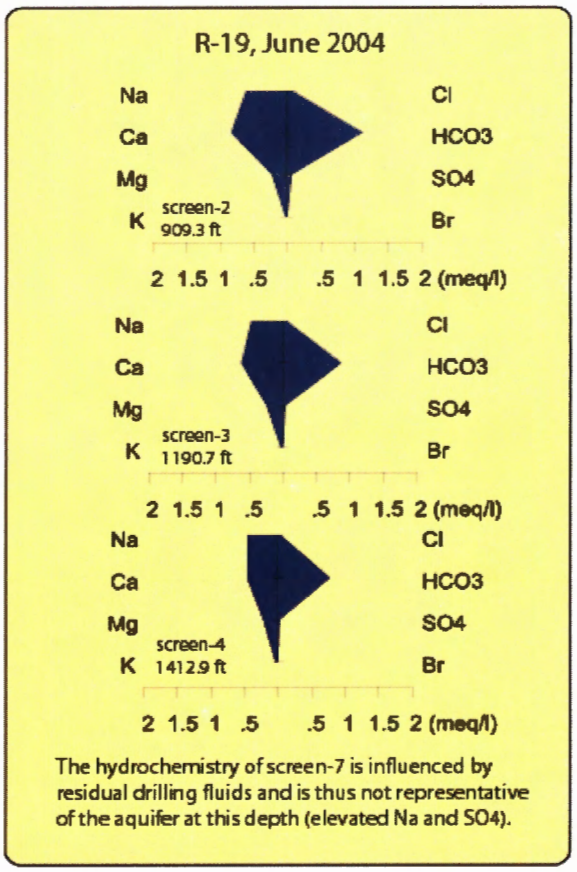
Representative hydrochemistry of regional groundwater in the middle portion of the Laboratory (zone-2)





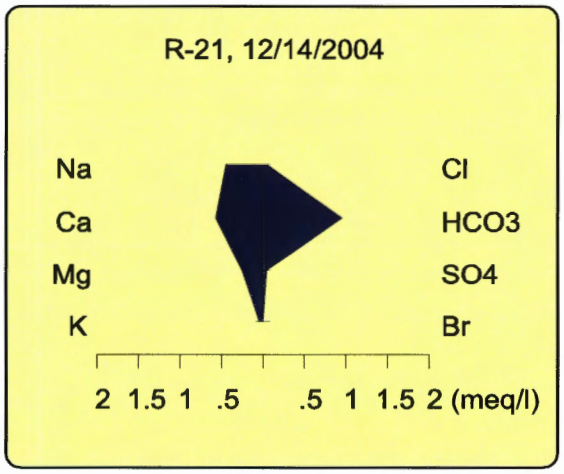


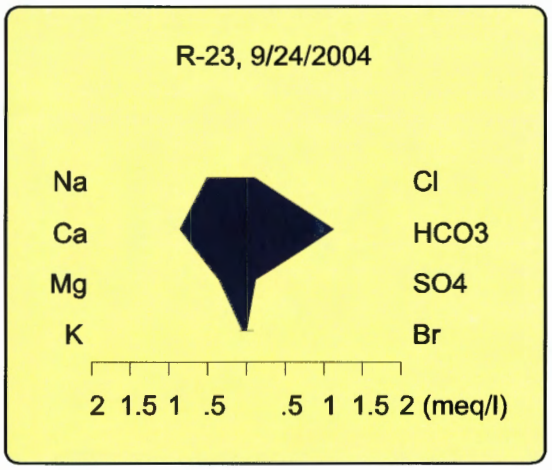


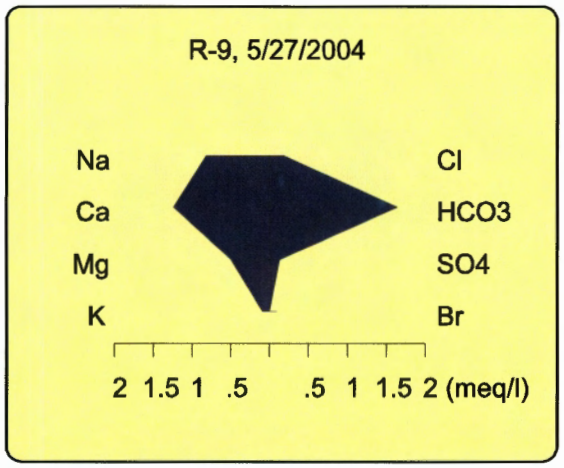


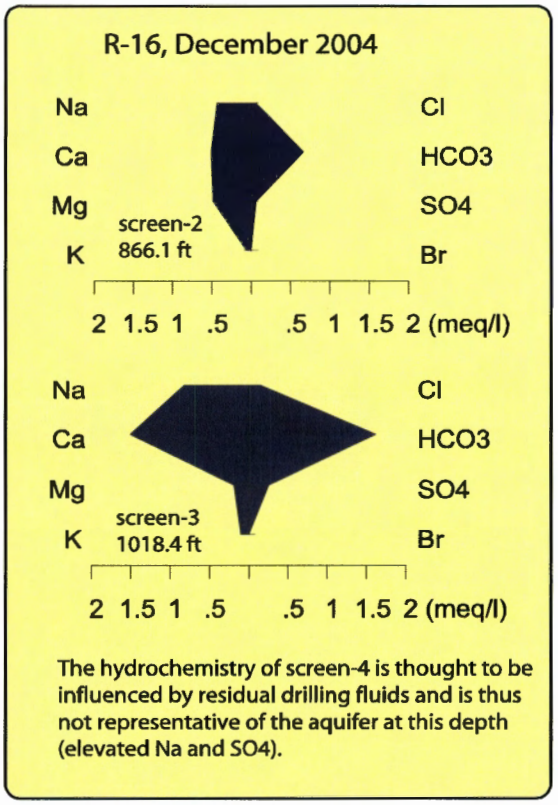
The hydrochemistry of screen-7 is influenced by residual drilling fluids and is thus not representative of the aquifer at this depth (elevated Na and SO4).

Representative hydrochemistry of regional groundwater in the eastern portion of the Laboratory (zone-3)



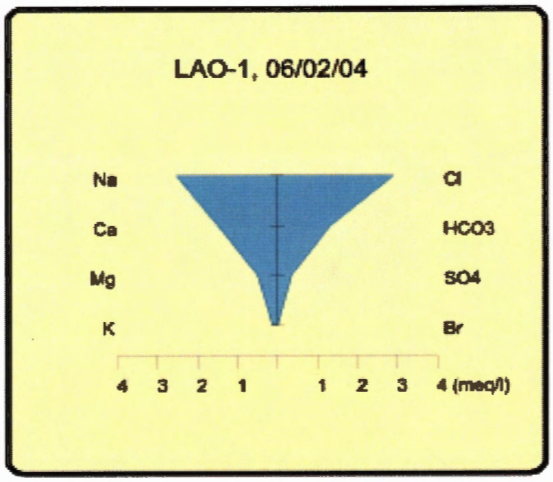


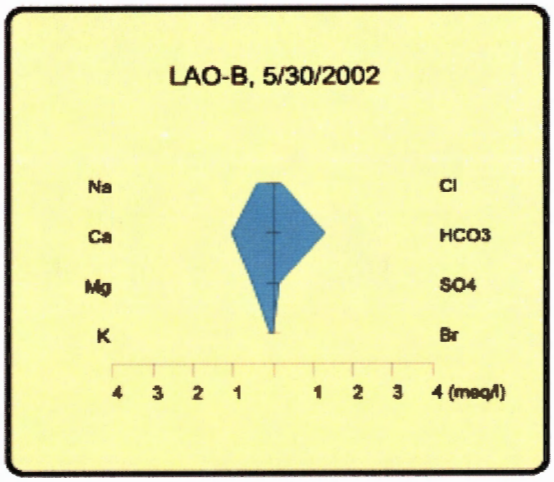


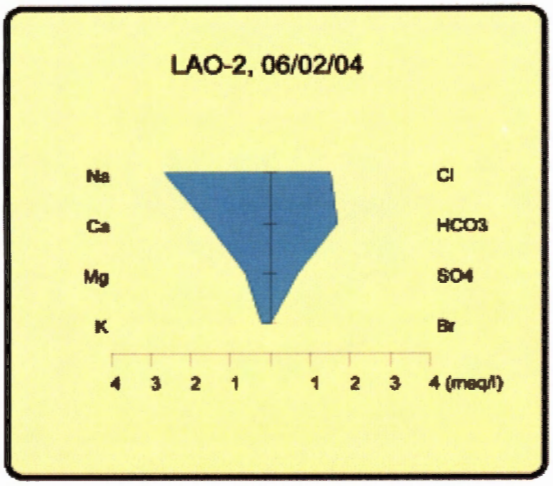


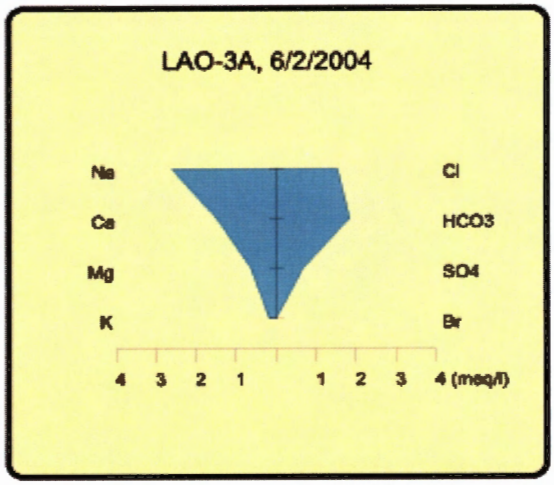
The hydrochemistry of screen-4 is thought to be influenced by residual drilling fluids and is thus not representative of the aquifer at this depth (elevated Na and SO4).

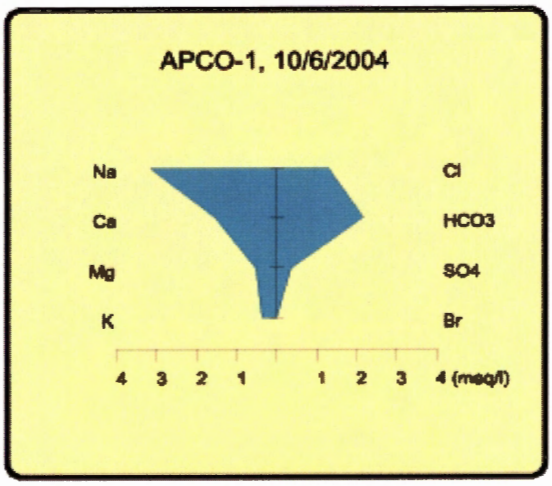
Representative hydrochemistry of alluvial groundwater in Los Alamos and Pueblo Canyons



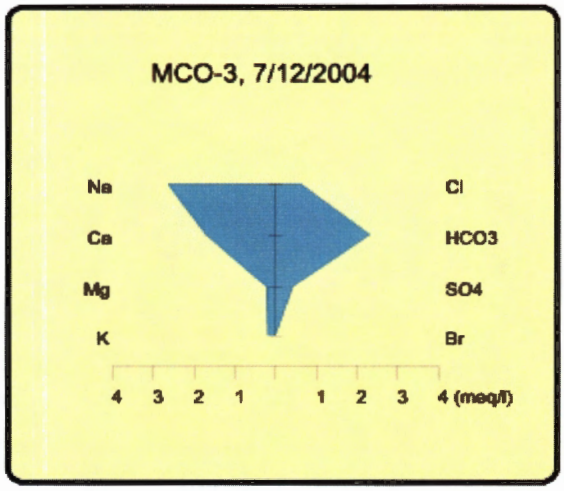


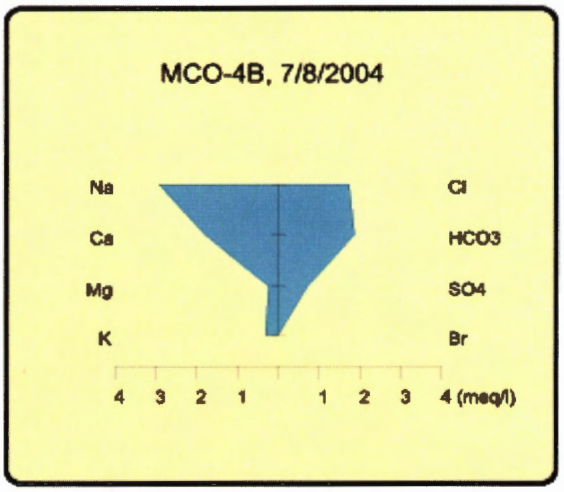


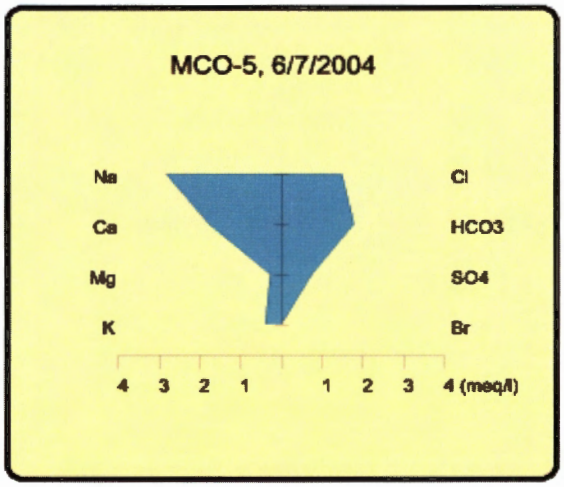




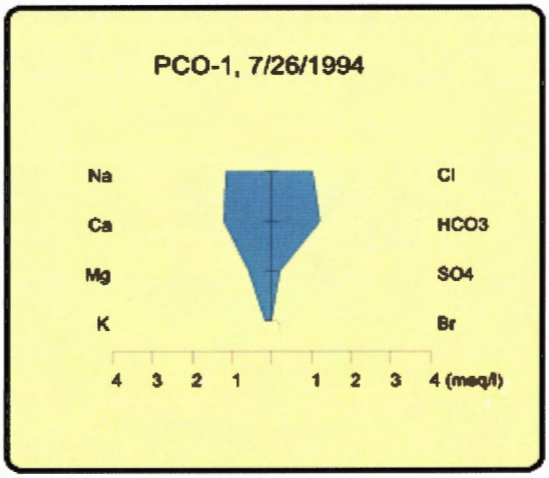
Representative hydrochemistry of alluvial groundwater in Mortandad Canyon

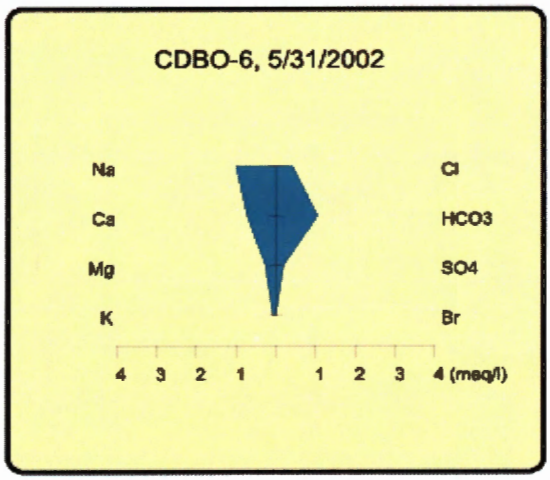


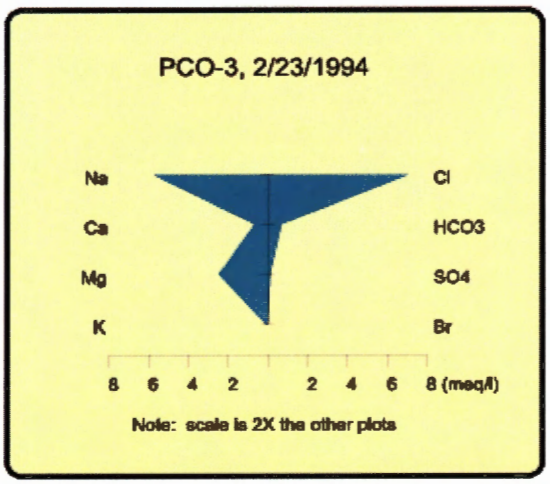




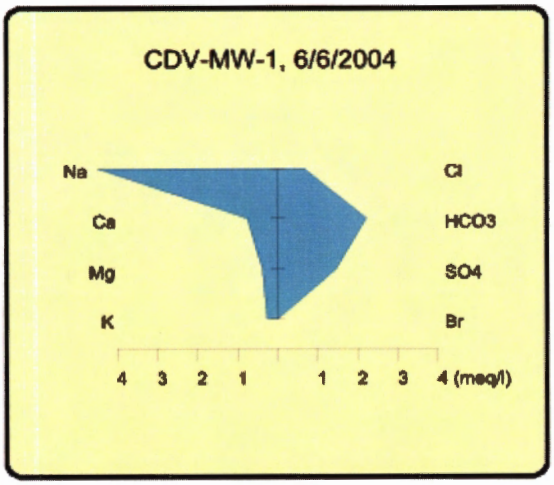
Representative hydrochemistry of alluvial groundwater in Pajarito and Canada del Buey

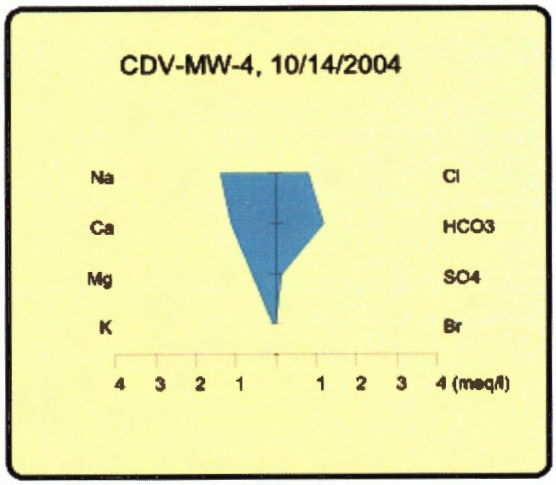


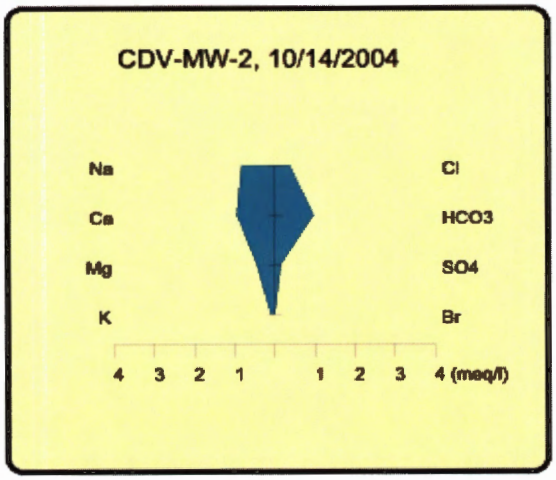


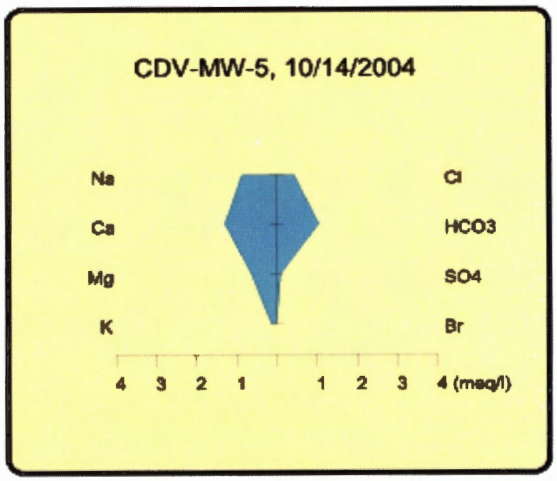


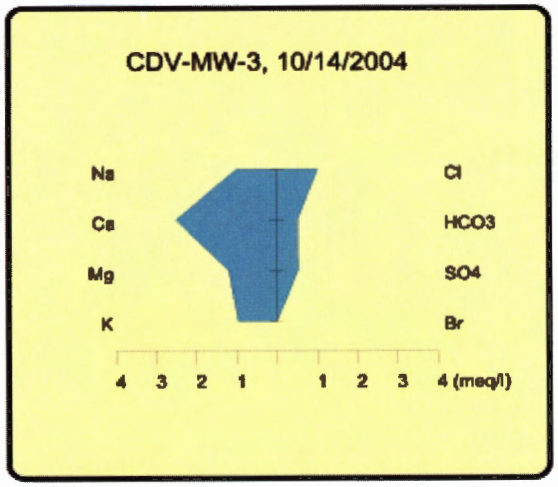
Representative hydrochemistry of alluvial groundwater in Canyon de Valle



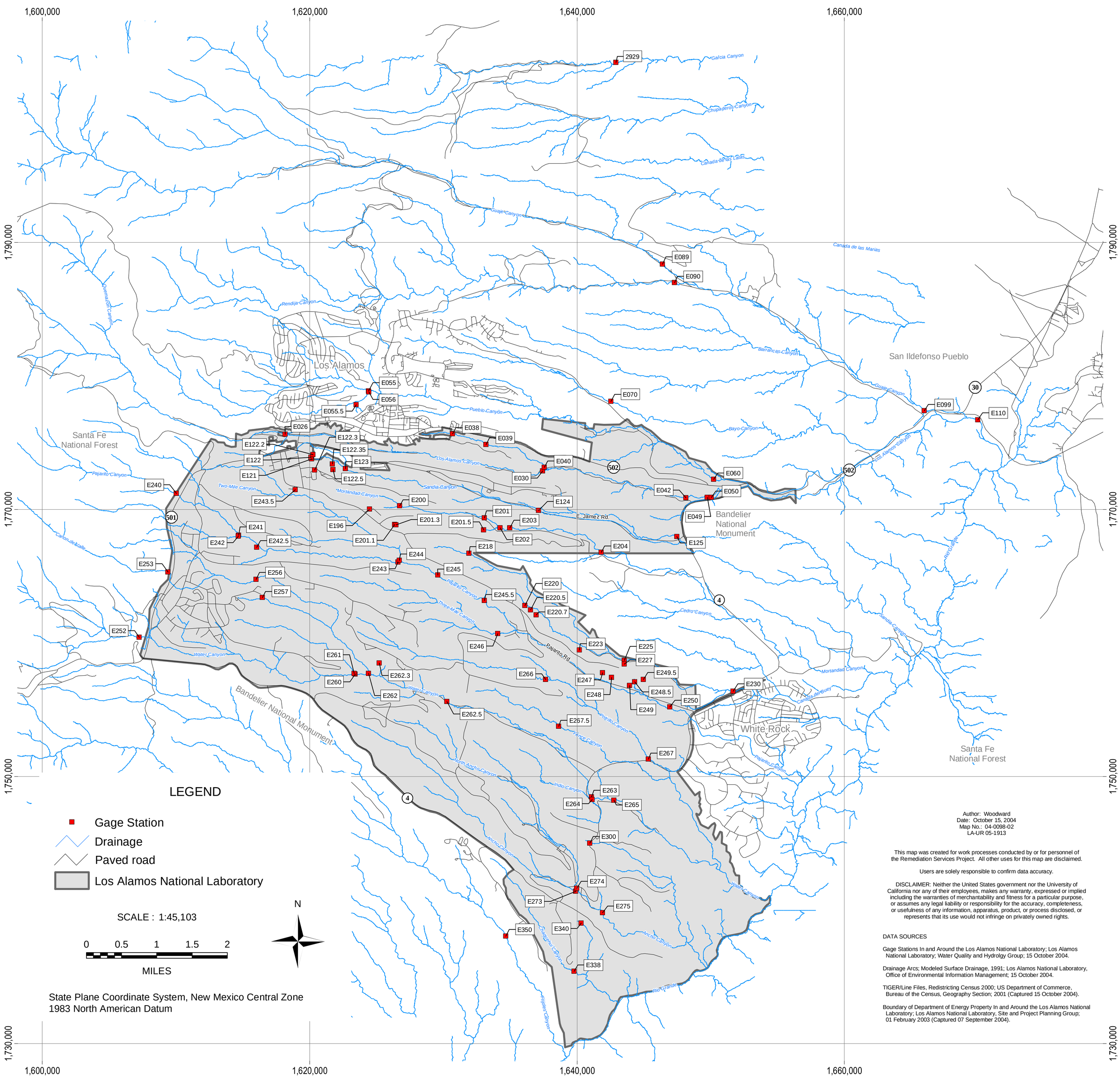




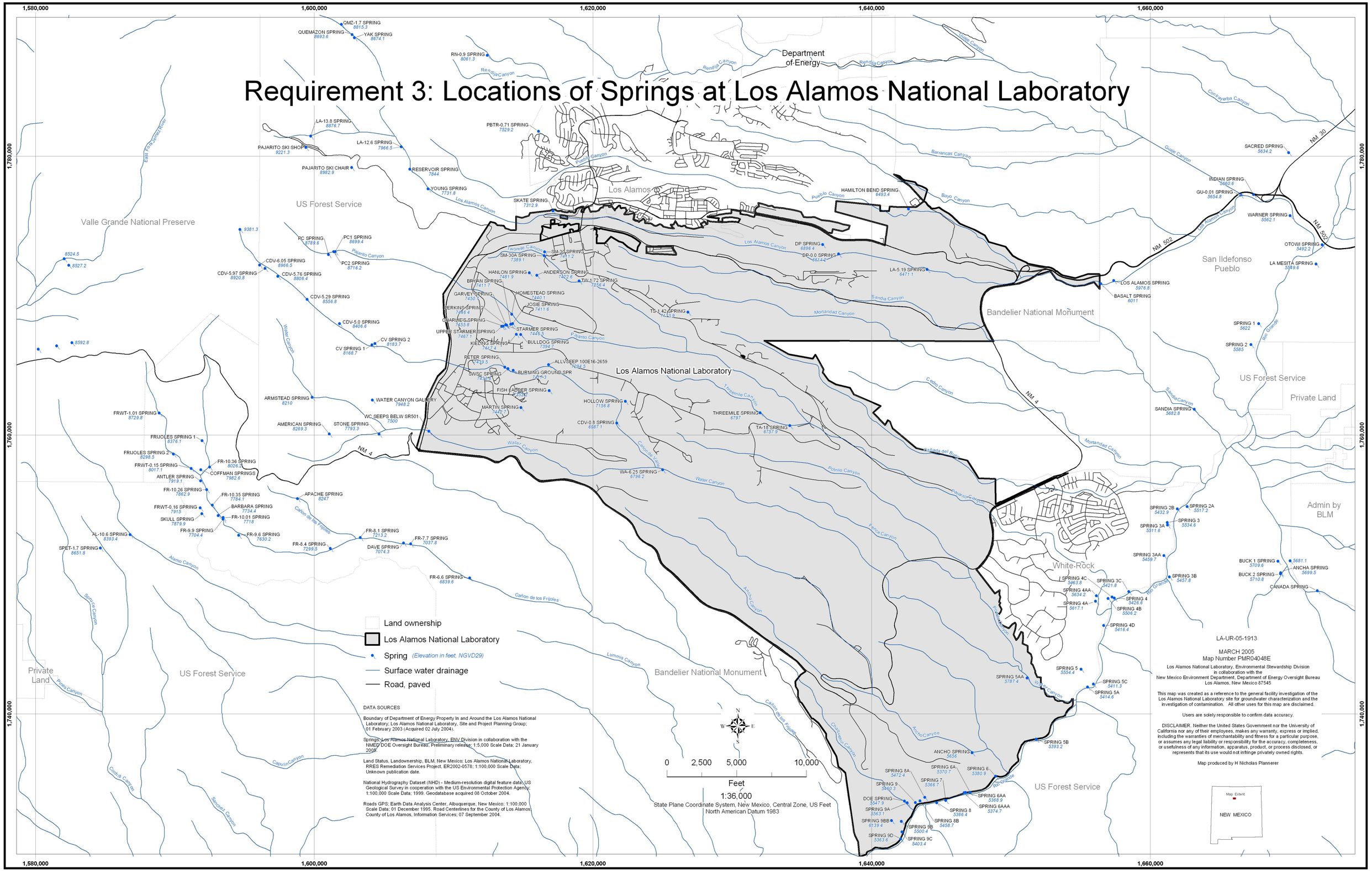




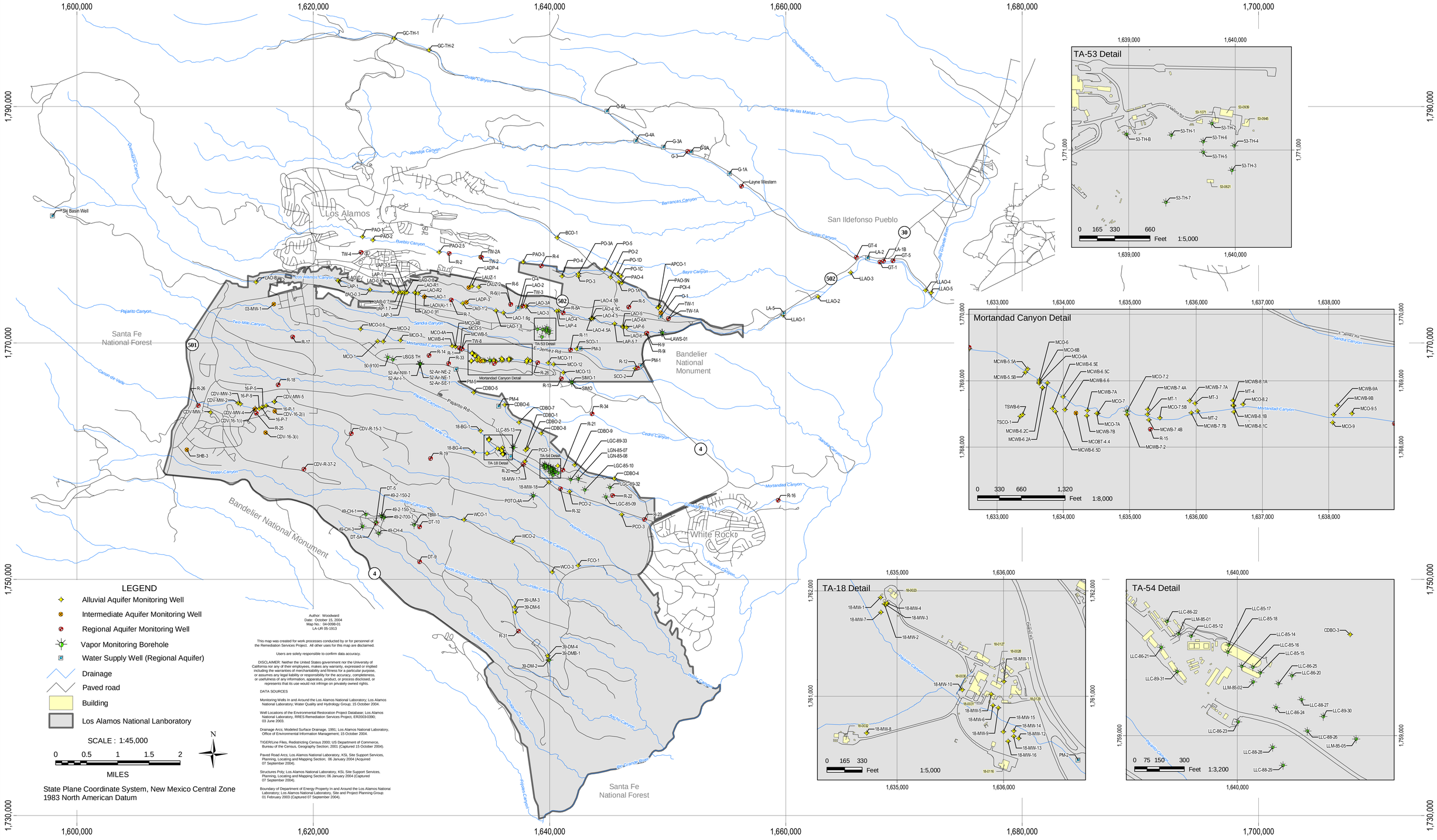
Requirement 3: Locations of Surface Water Gaging Stations at Los Alamos National Laboratory



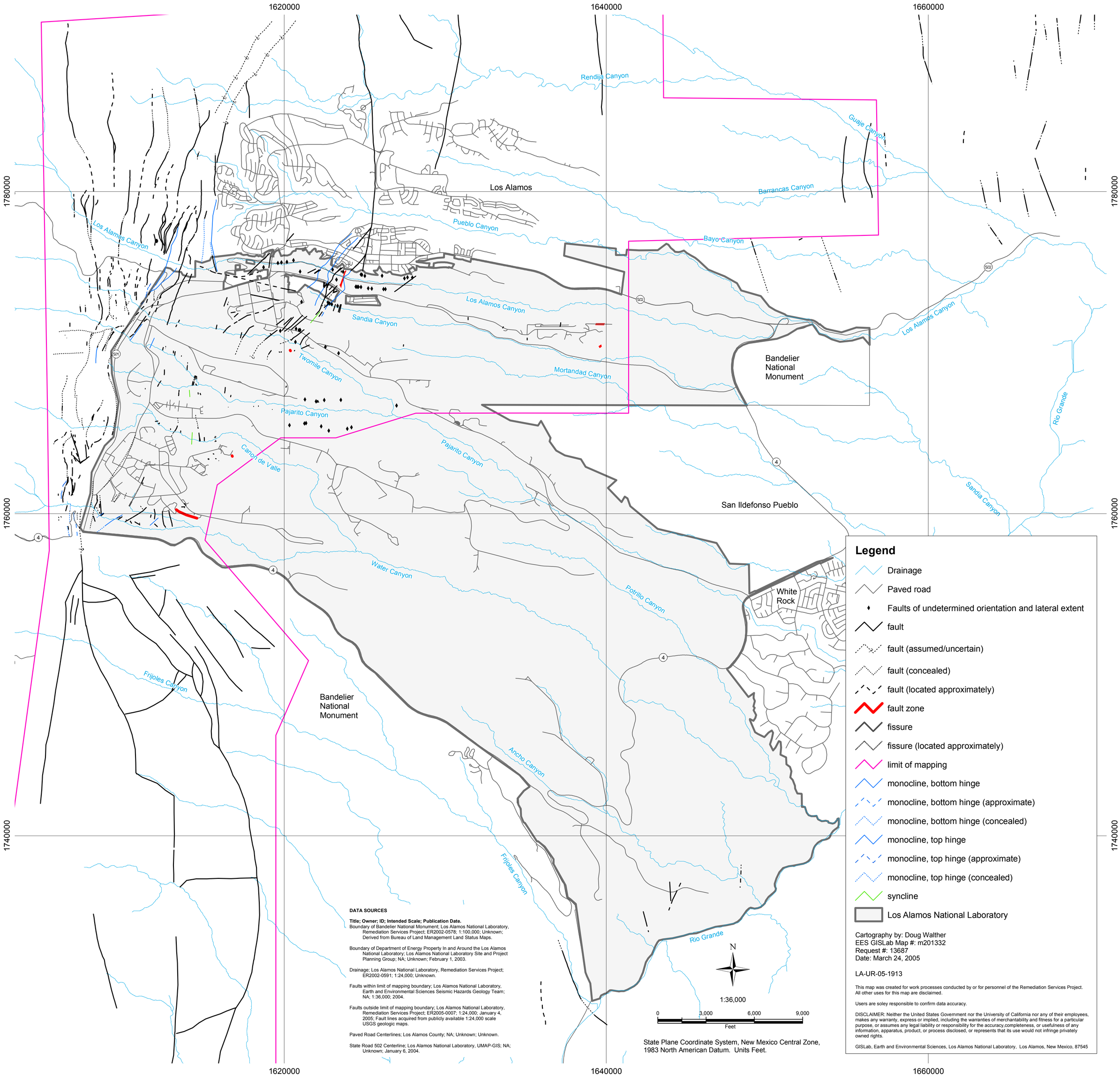
Requirement 3: Locations of Springs at Los Alamos National Laboratory



Requirement 3: Locations of Monitoring Wells, Water Supply Wells and Vapor Monitoring Boreholes at Los Alamos National Laboratory



Requirement 4: Faults at Los Alamos National Laboratory



DATA SOURCES

Title; Owner; ID; Intended Scale; Publication Date.

Boundary of Bandelier National Monument; Los Alamos National Laboratory, Remediation Services Project; ER2002-0578; 1:100,000; Unknown; Derived from Bureau of Land Management Land Status Maps.

Boundary of Department of Energy Property In and Around the Los Alamos National Laboratory; Los Alamos National Laboratory Site and Project Planning Group; NA; Unknown; February 1, 2003.

Drainage; Los Alamos National Laboratory, Remediation Services Project; ER2002-0591; 1:24,000; Unknown.

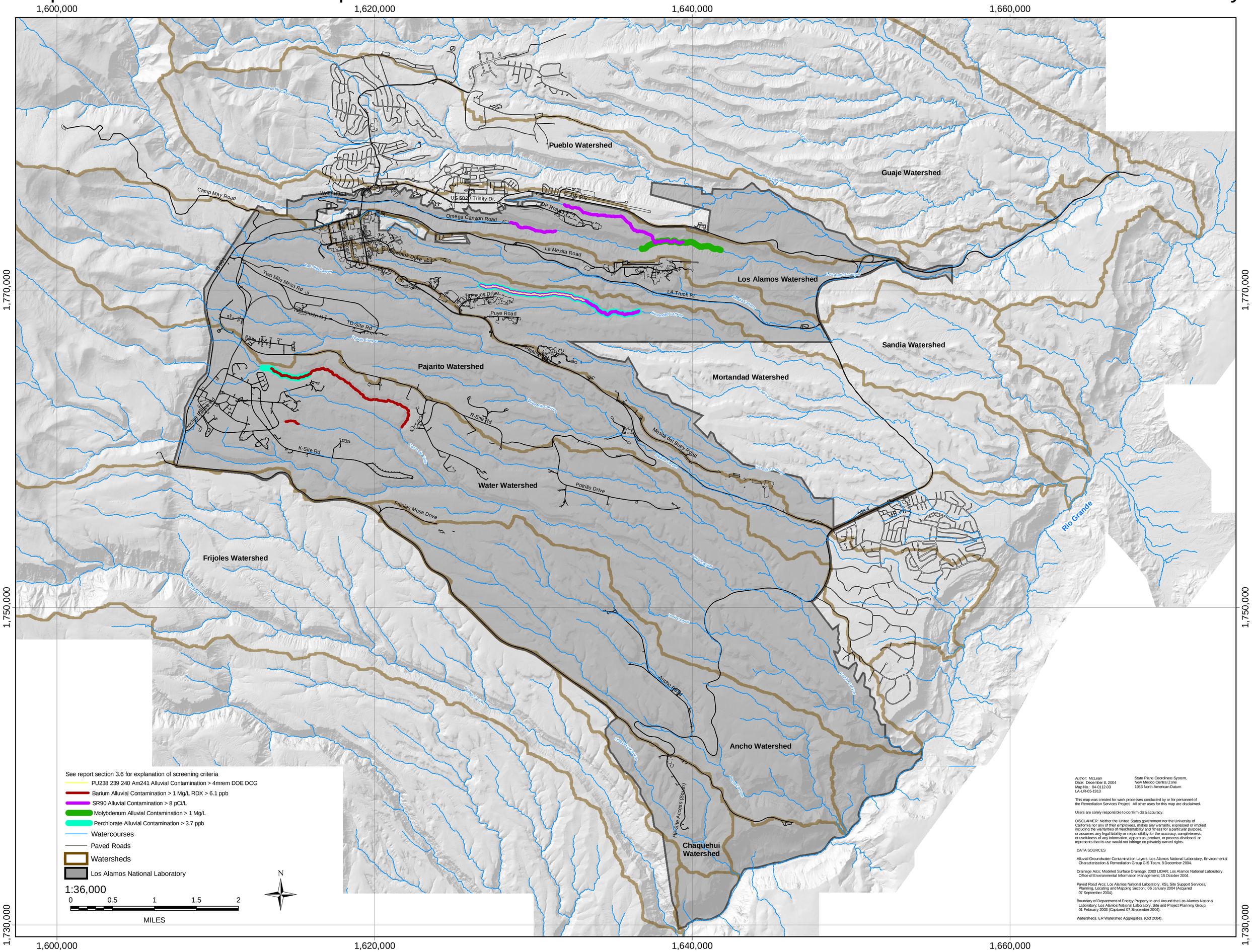
Faults within limit of mapping boundary; Los Alamos National Laboratory, Earth and Environmental Sciences Seismic Hazards Geology Team; NA; 1:36,000; 2004.

Faults outside limit of mapping boundary; Los Alamos National Laboratory, Remediation Services Project; ER2005-0007; 1:24,000; January 4, 2005; Fault lines acquired from publicly available 1:24,000 scale USGS geologic maps.

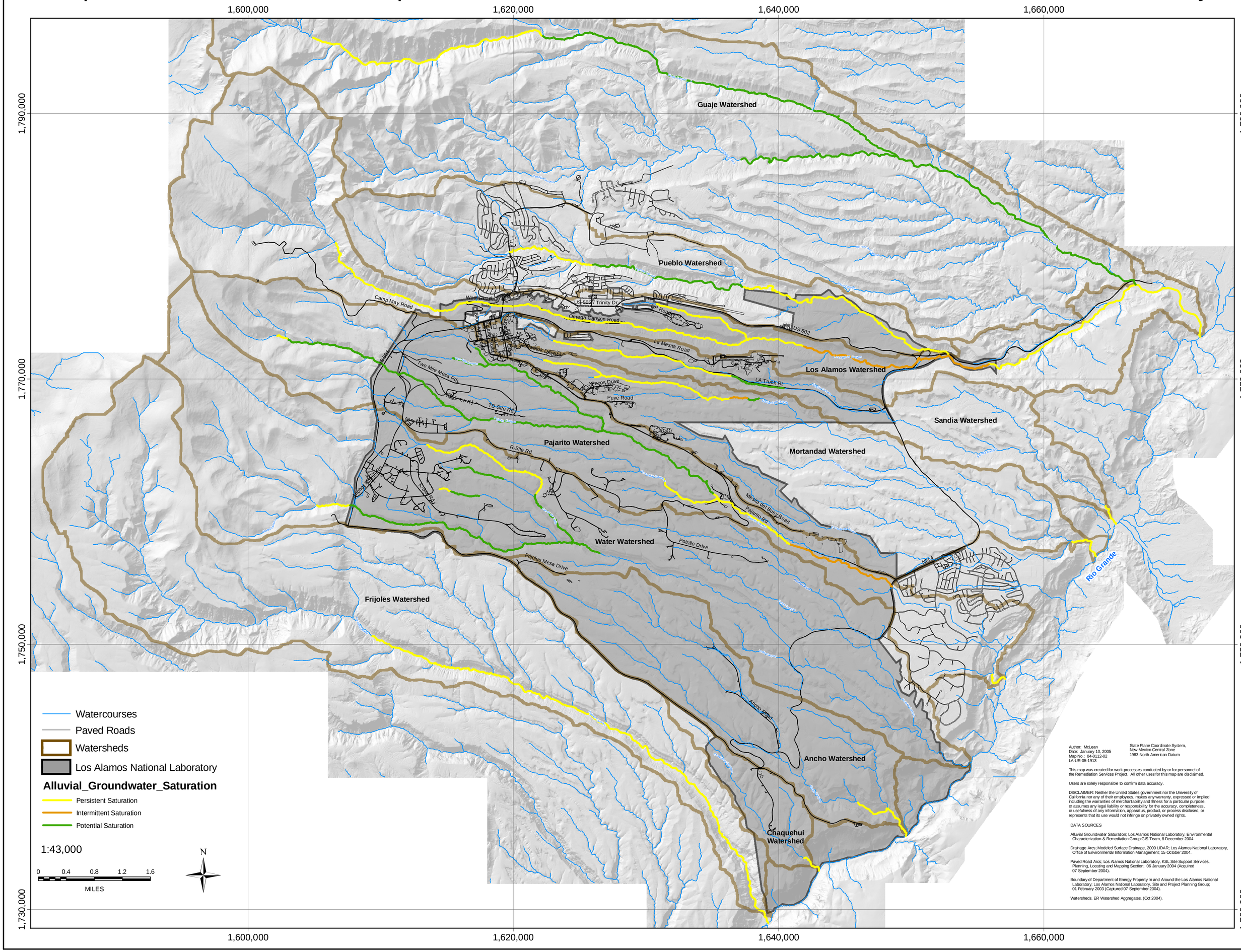
Paved Road Centerlines; Los Alamos County; NA; Unknown; Unknown.

State Road 502 Centerline; Los Alamos National Laboratory, UMAP-GIS; NA; Unknown; January 6, 2004.

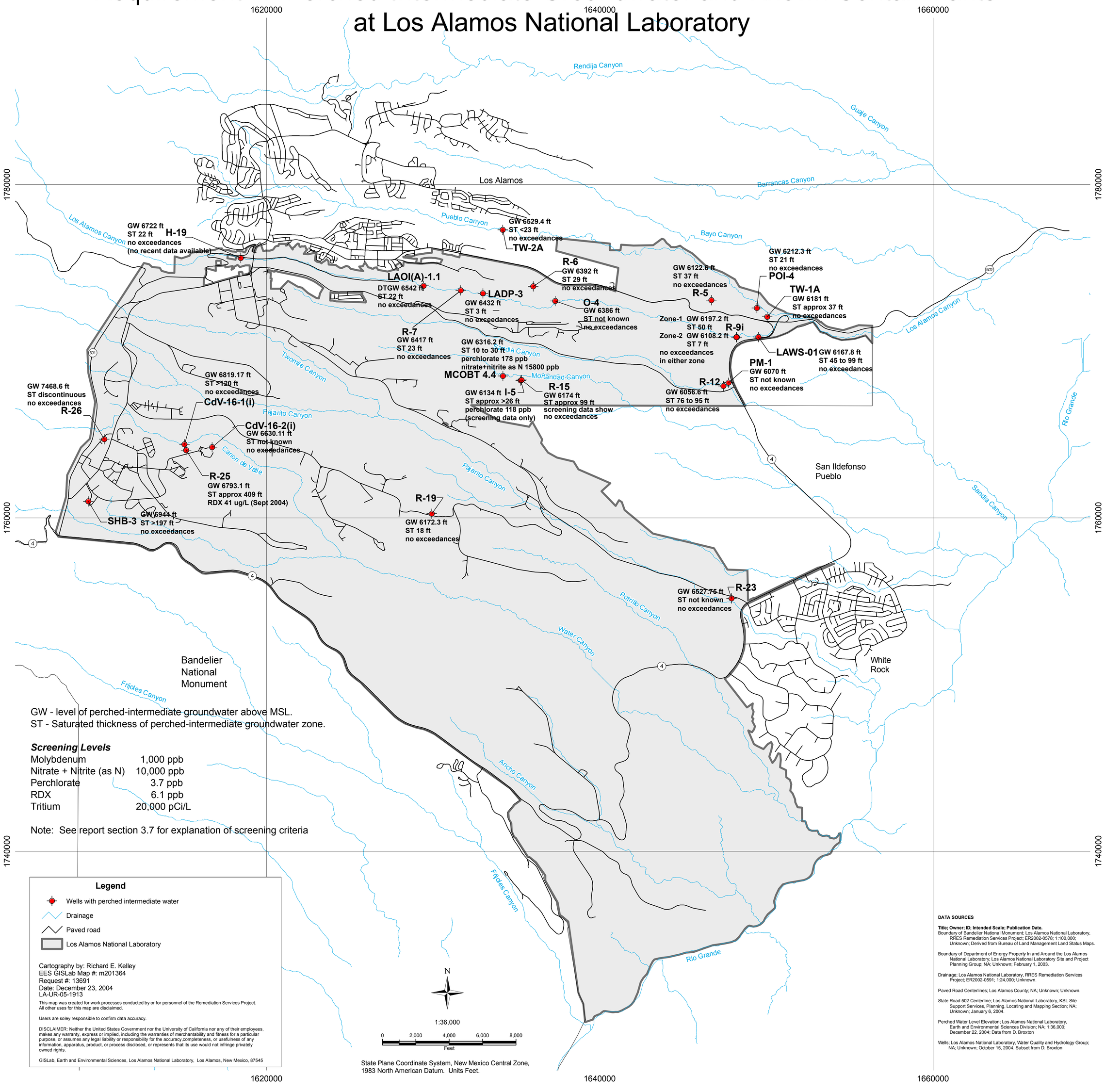
Requirement 6: Known and Suspected Extent of Alluvial Groundwater Contamination at Los Alamos National Laboratory



Requirement 6: Known and Suspected Extent of Alluvial Groundwater at Los Alamos National Laboratory



Requirement 7: Perched-Intermediate Groundwater and Known Contaminants at Los Alamos National Laboratory



GW - level of perched-intermediate groundwater above MSL.
ST - Saturated thickness of perched-intermediate groundwater zone.

Screening Levels

Molybdenum	1,000 ppb
Nitrate + Nitrite (as N)	10,000 ppb
Perchlorate	3.7 ppb
RDX	6.1 ppb
Tritium	20,000 pCi/L

Note: See report section 3.7 for explanation of screening criteria

Legend

- Wells with perched intermediate water
- Drainage
- Paved road
- Los Alamos National Laboratory

Cartography by: Richard E. Kelley
EES GISLab Map #: m201364
Request #: 13691
Date: December 23, 2004
LA-UR-05-1913

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GISLab, Earth and Environmental Sciences, Los Alamos National Laboratory, Los Alamos, New Mexico, 87545

DATA SOURCES

Title; Owner; ID; Intended Scale; Publication Date.

Boundary of Bandelier National Monument; Los Alamos National Laboratory, RRES Remediation Services Project; ER2002-0578; 1:100,000; Unknown; Derived from Bureau of Land Management Land Status Maps.

Boundary of Department of Energy Property In and Around the Los Alamos National Laboratory; Los Alamos National Laboratory Site and Project Planning Group; NA; Unknown; February 1, 2003.

Drainage; Los Alamos National Laboratory, RRES Remediation Services Project; ER2002-0591; 1:24,000; Unknown.

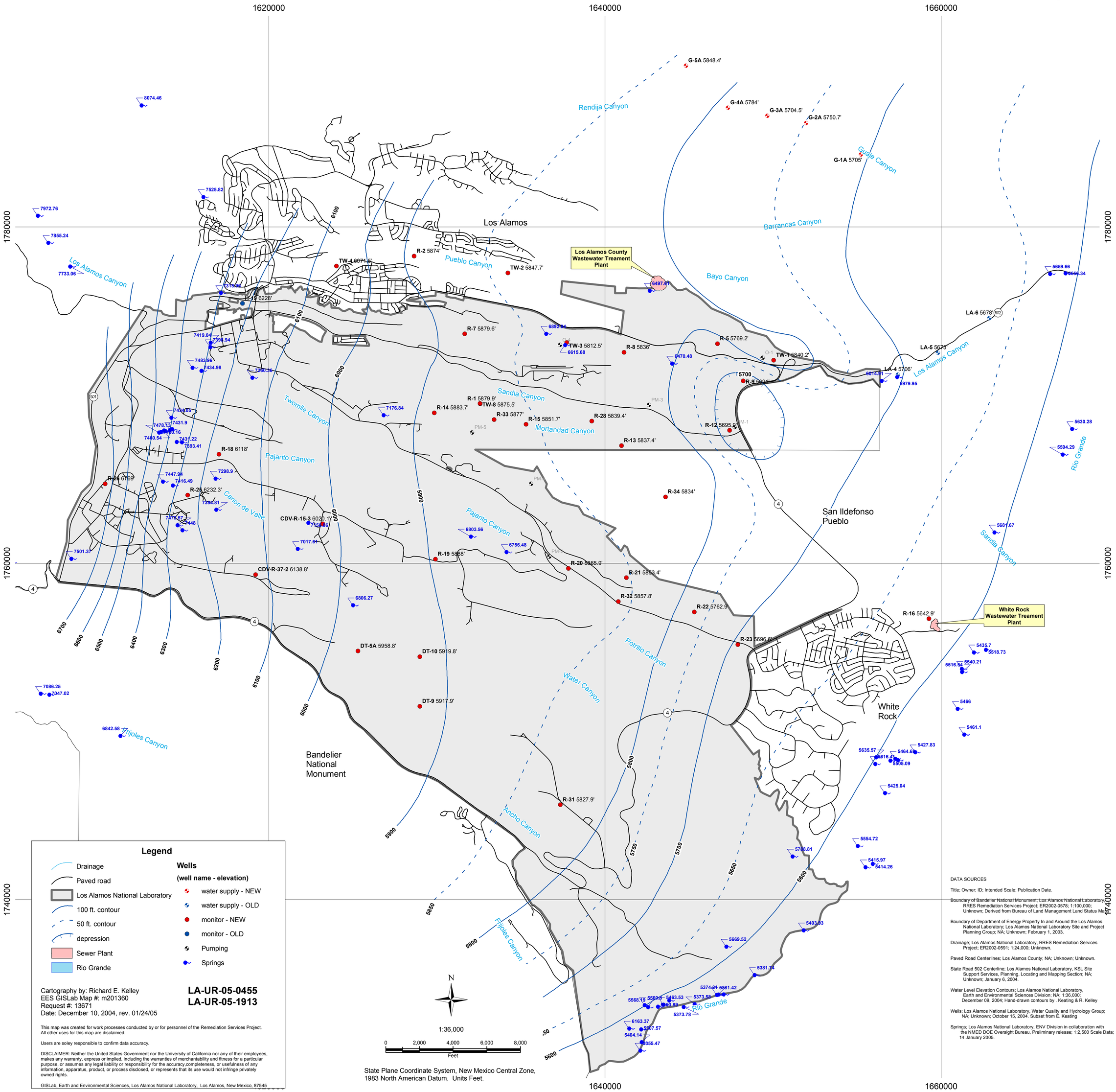
Paved Road Centerlines; Los Alamos County; NA; Unknown; Unknown.

State Road 502 Centerline; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; NA; Unknown; January 6, 2004.

Perched Water Level Elevation; Los Alamos National Laboratory, Earth and Environmental Sciences Division; NA; 1:36,000; December 22, 2004; Data from D. Broxton

Wells; Los Alamos National Laboratory, Water Quality and Hydrology Group; NA; Unknown; October 15, 2004. Subset from D. Broxton

Requirement 8: Elevation of Top of Regional Aquifer for Los Alamos National Laboratory



Legend

- Drainage
- Paved road
- Los Alamos National Laboratory
- 100 ft. contour
- 50 ft. contour
- depression
- Sewer Plant
- Rio Grande

Wells
(well name - elevation)

- water supply - NEW
- water supply - OLD
- monitor - NEW
- monitor - OLD
- Pumping
- Springs

Cartography by: Richard E. Kelley
EES GISLab Map #: m201360
Request #: 13671
Date: December 10, 2004, rev. 01/24/05

LA-UR-05-0455
LA-UR-05-1913

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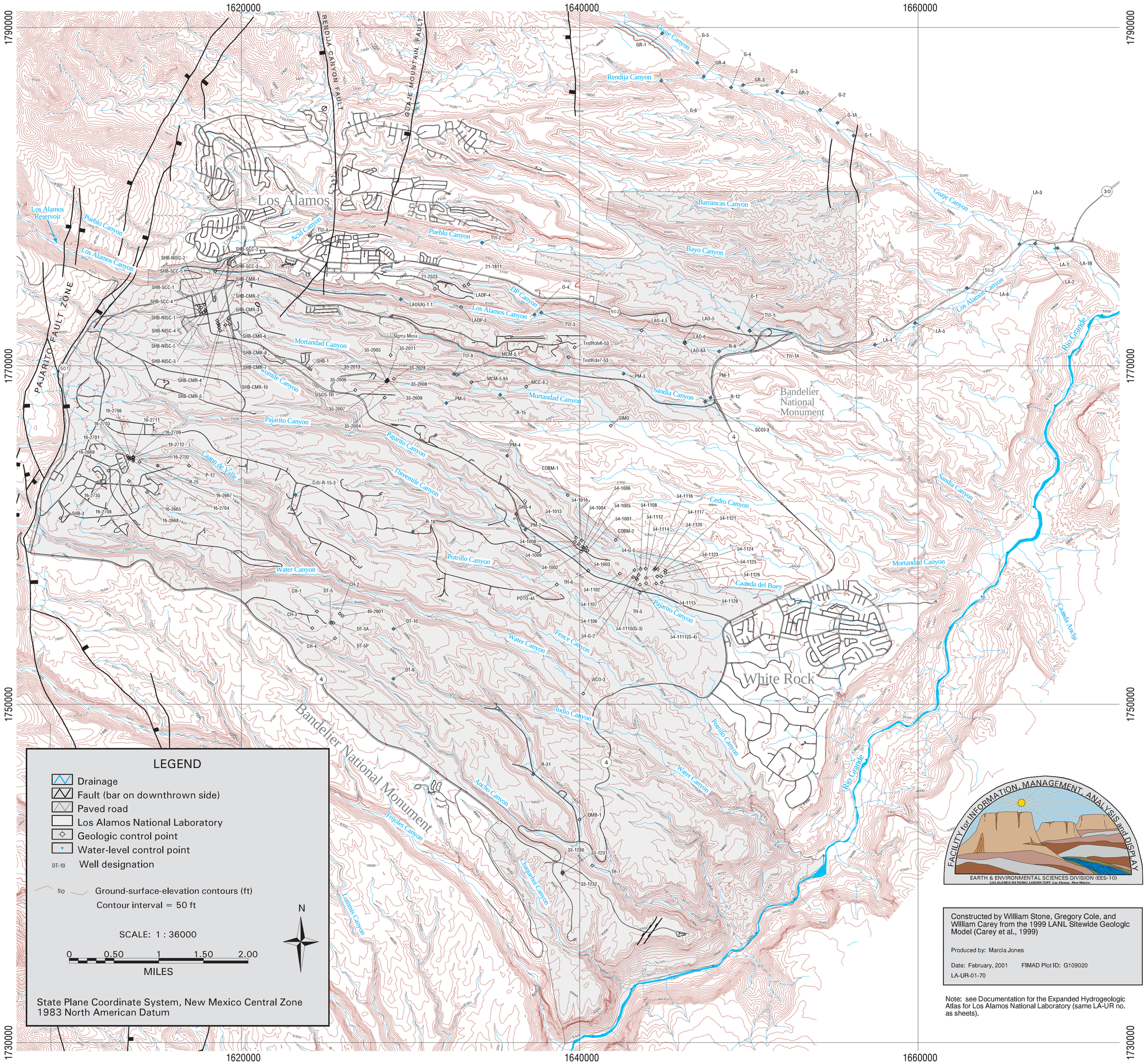
State Road 502 Centerline; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; NA; Unknown; January 6, 2004.

Water Level Elevation Contours; Los Alamos National Laboratory, Earth and Environmental Sciences Division; NA; 1:36,000; December 09, 2004; Hand-drawn contours by . Keating & R. Kelley

Wells; Los Alamos National Laboratory, Water Quality and Hydrology Group; NA; Unknown; October 15, 2004. Subset from E. Keating

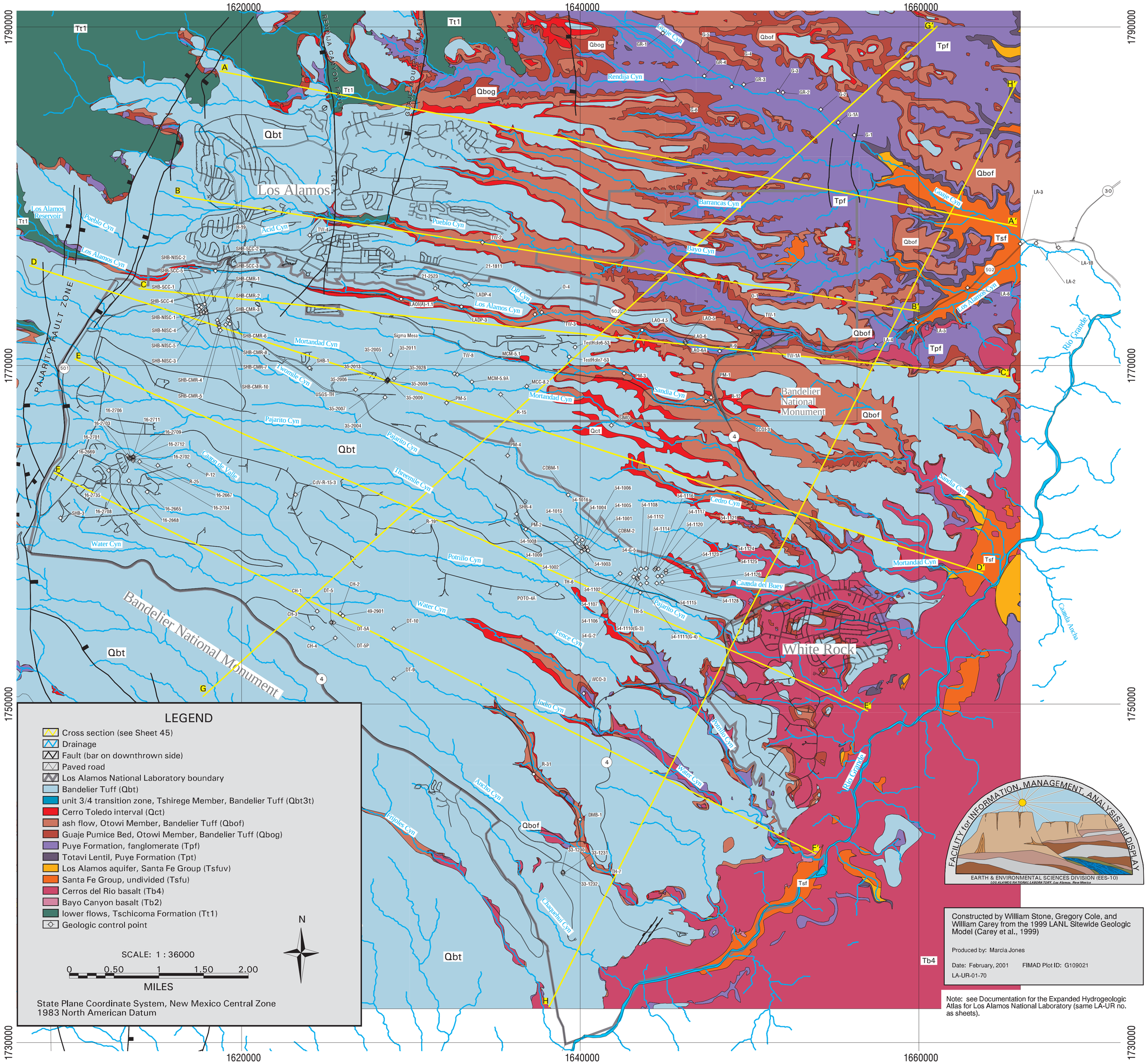
Springs; Los Alamos National Laboratory, ENV Division in collaboration with the NMED DOE Oversight Bureau, Preliminary release; 1:2,500 Scale Data; 14 January 2005.

Hydrogeologic Atlas for Los Alamos National Laboratory



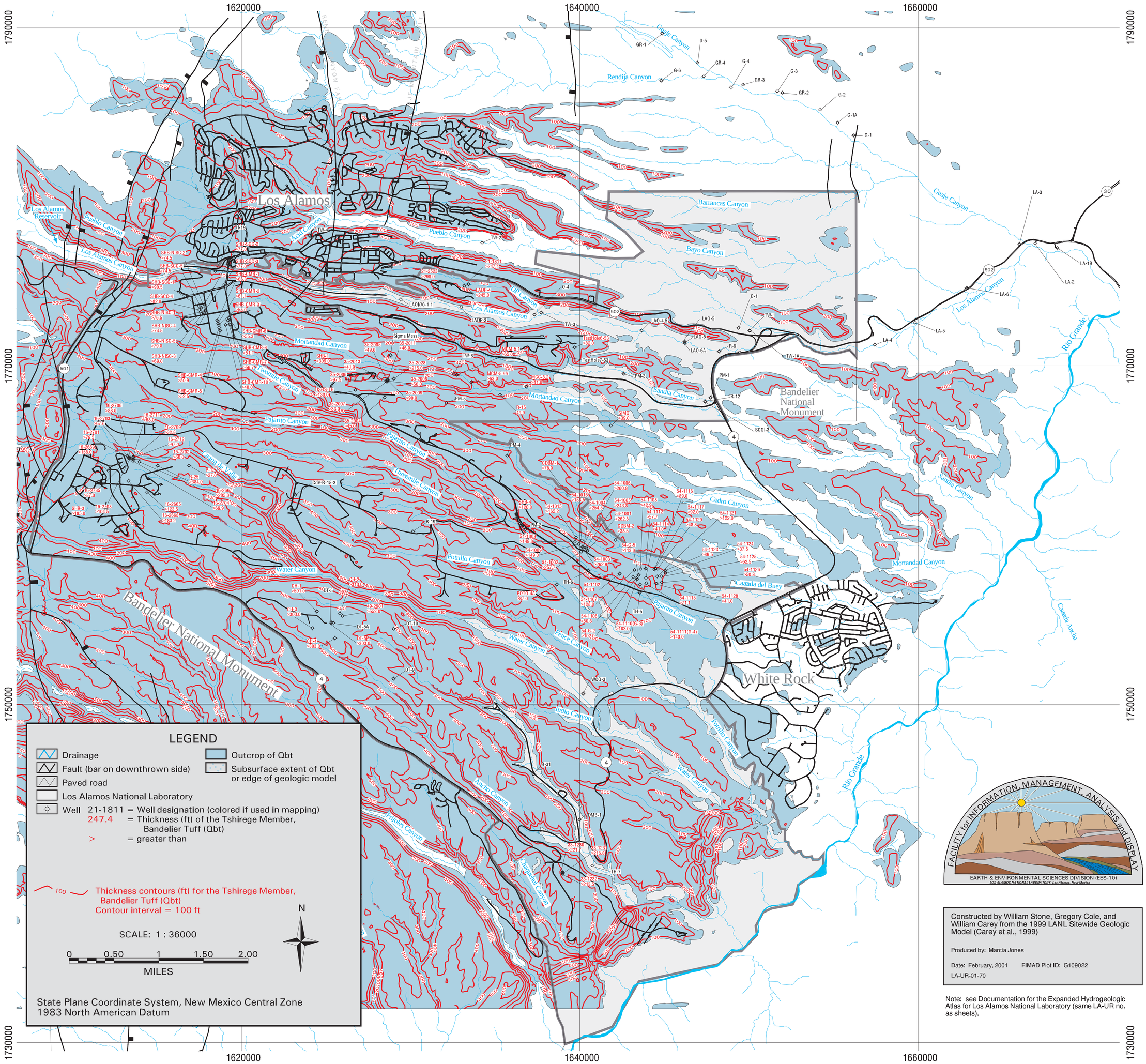
Sheet 1. Topography of the Los Alamos Area

Hydrogeologic Atlas for Los Alamos National Laboratory



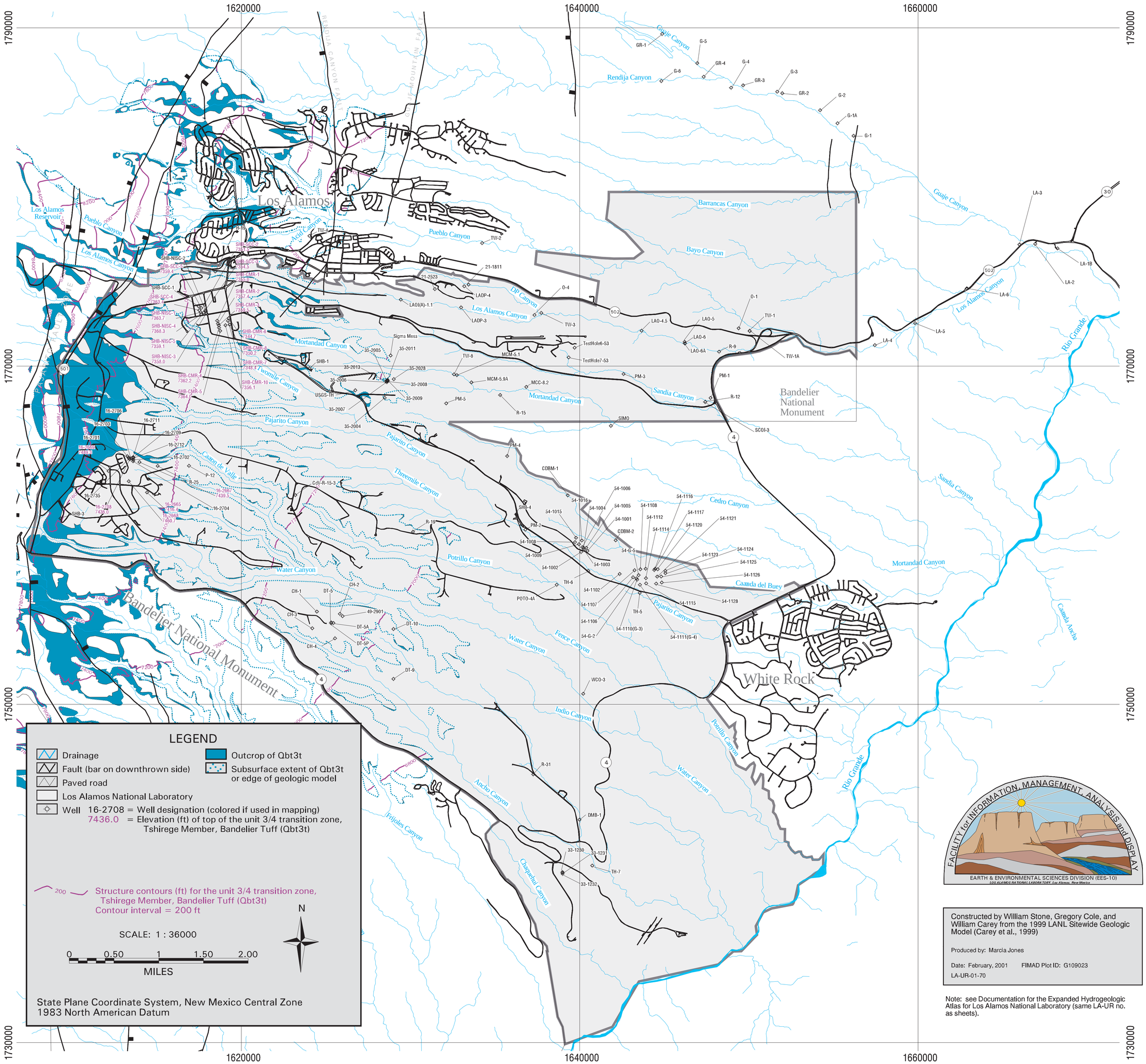
Sheet 2. Bedrock Geology of the Los Alamos Area (limited to units covered by atlas that crop out)

Hydrogeologic Atlas for Los Alamos National Laboratory



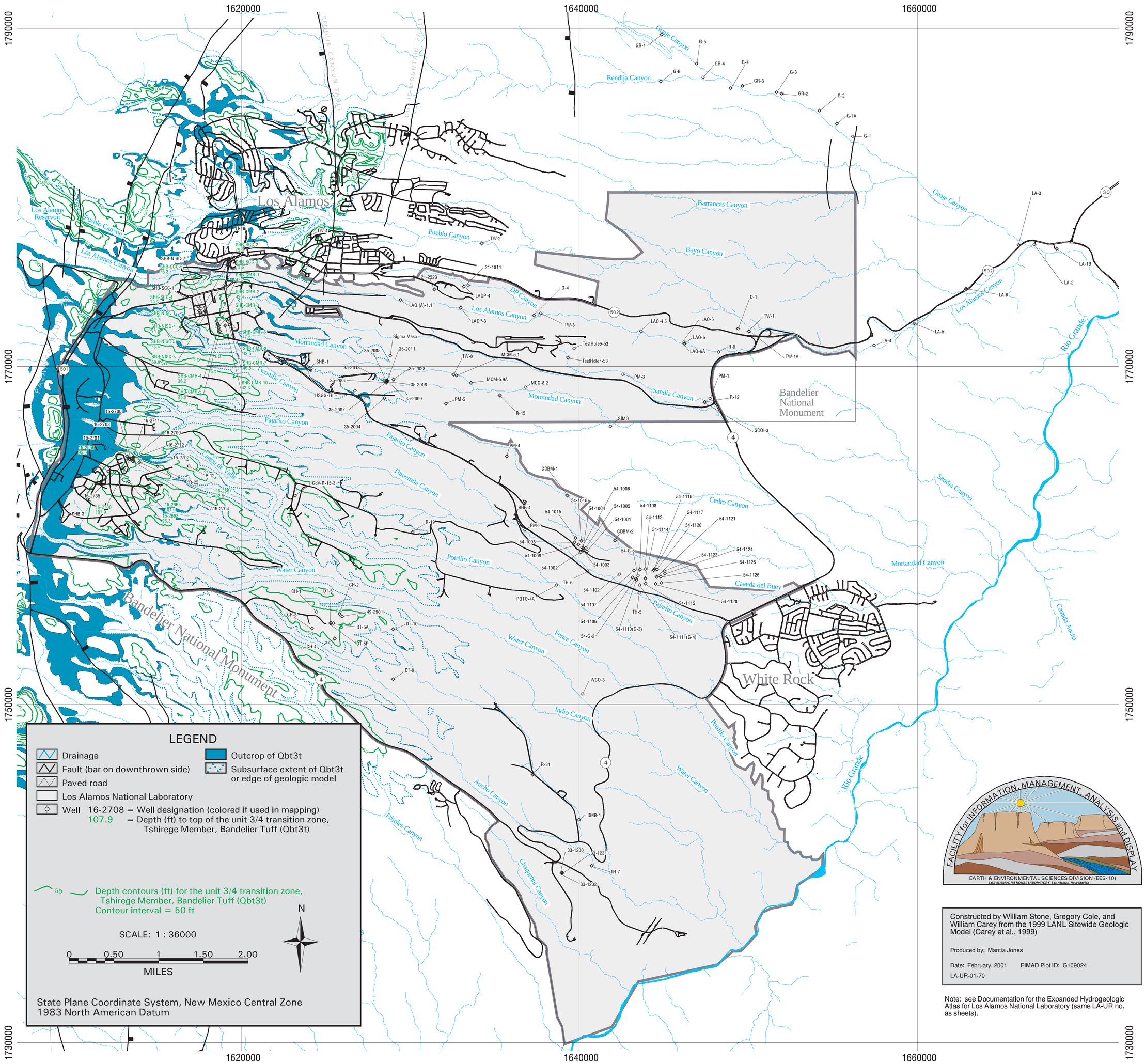
Sheet 3. Thickness of the Tshirege Member, Bandelier Tuff (Qbt)

Hydrogeologic Atlas for Los Alamos National Laboratory



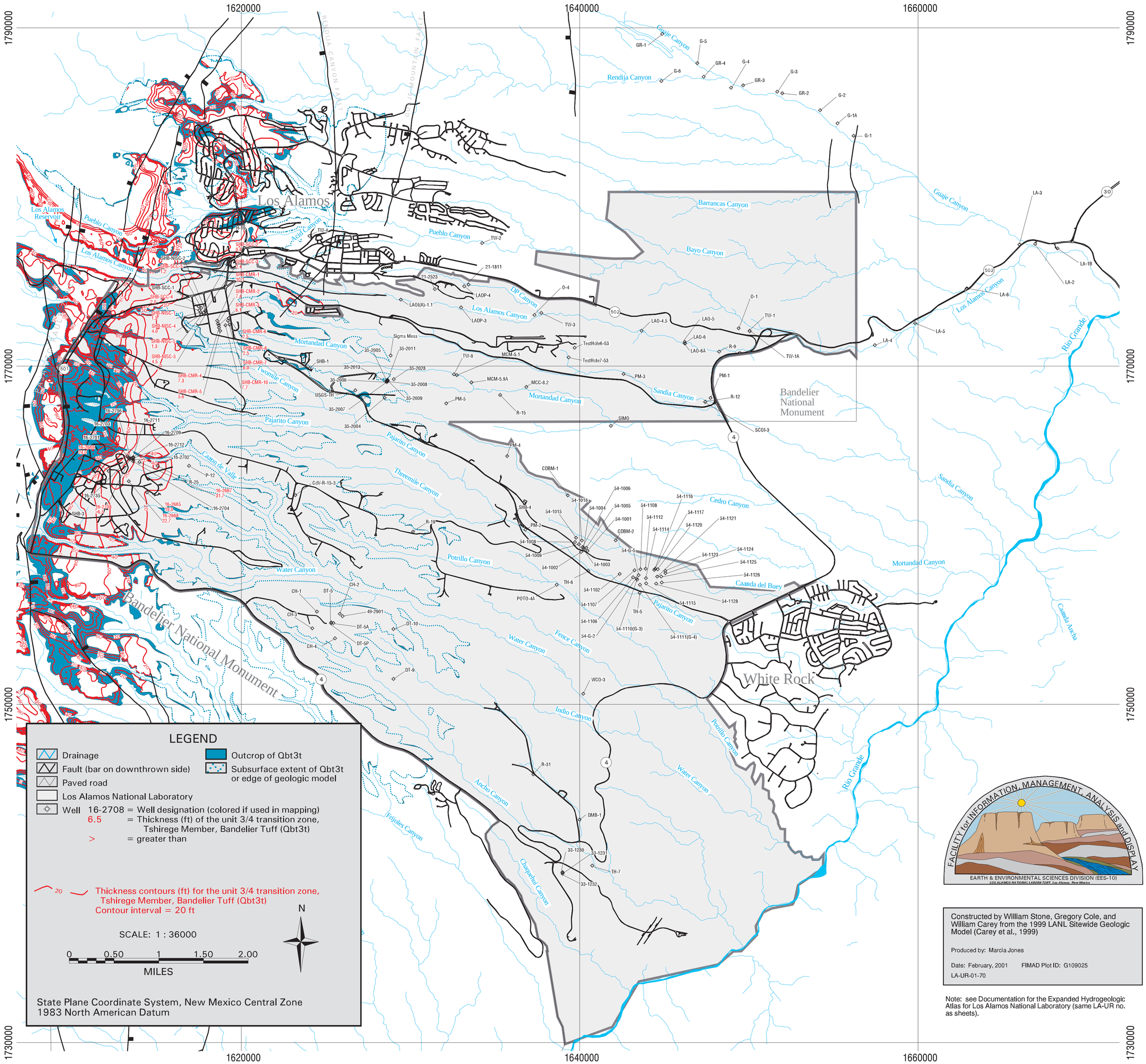
Sheet 4. Structure on top of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)

Hydrogeologic Atlas for Los Alamos National Laboratory



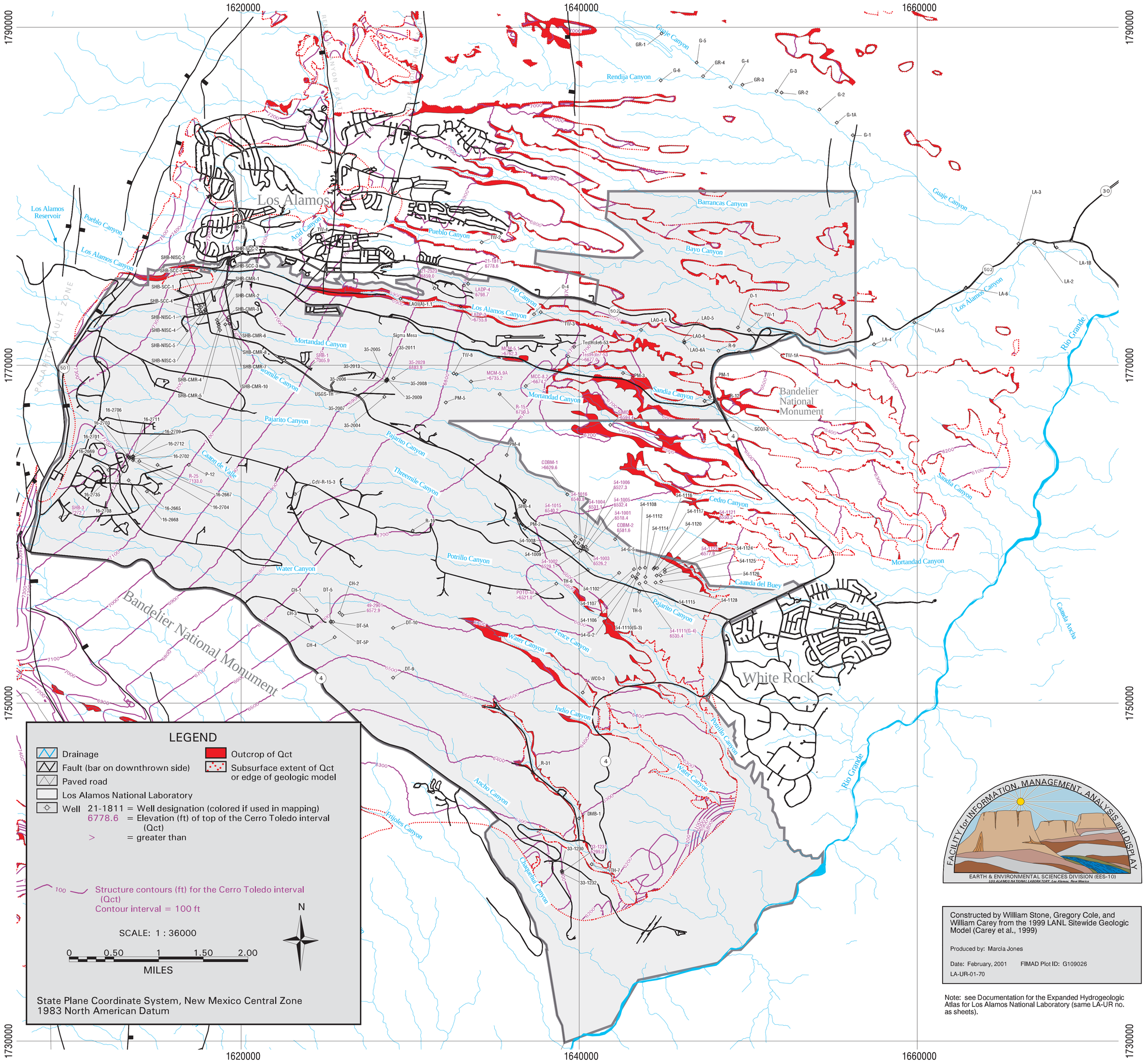
Sheet 5. Depth to top of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)

Hydrogeologic Atlas for Los Alamos National Laboratory



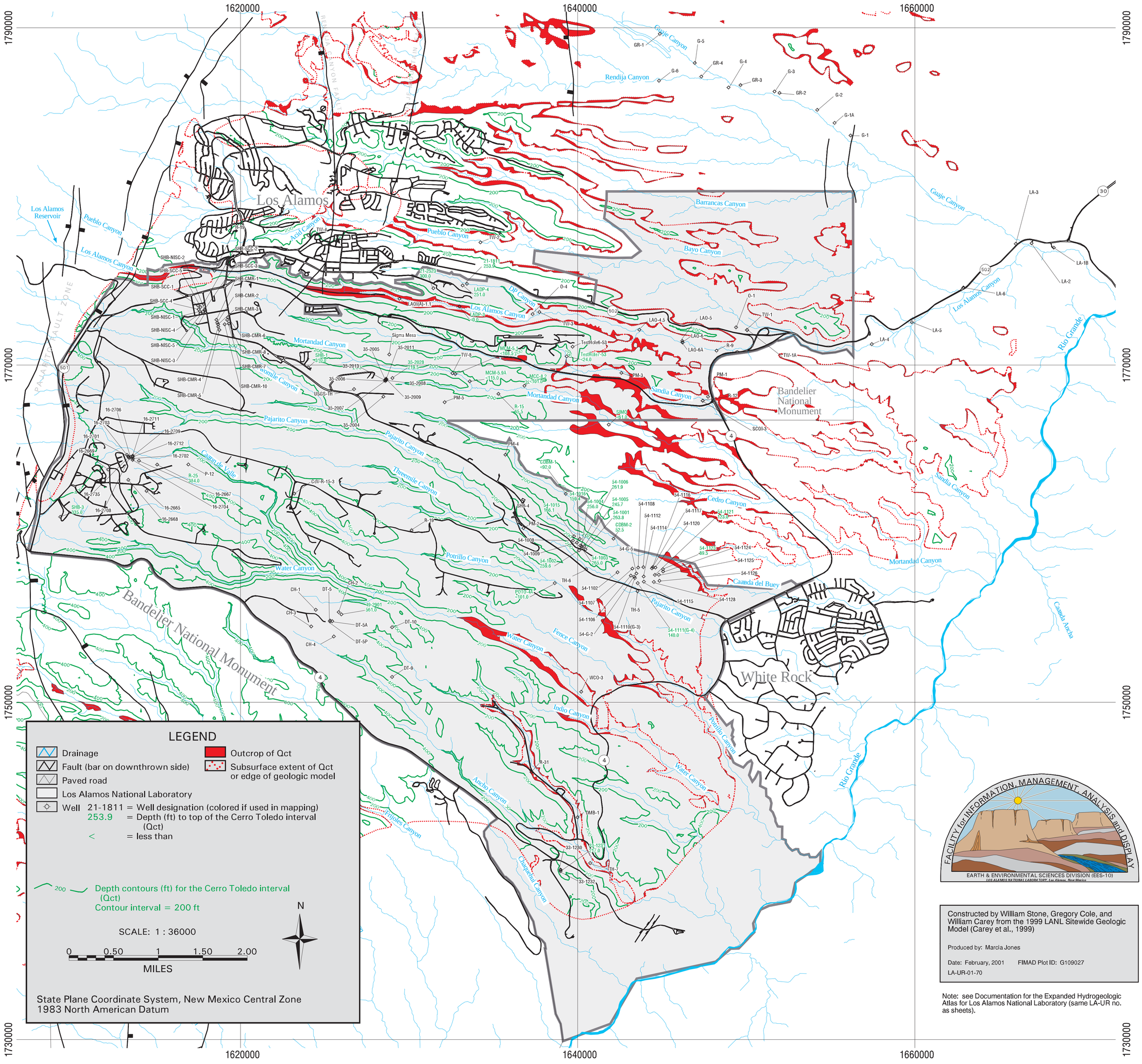
Sheet 6. Thickness of the unit 3/4 transition zone, Tshirege Member, Bandelier Tuff (Qbt3t)

Hydrogeologic Atlas for Los Alamos National Laboratory



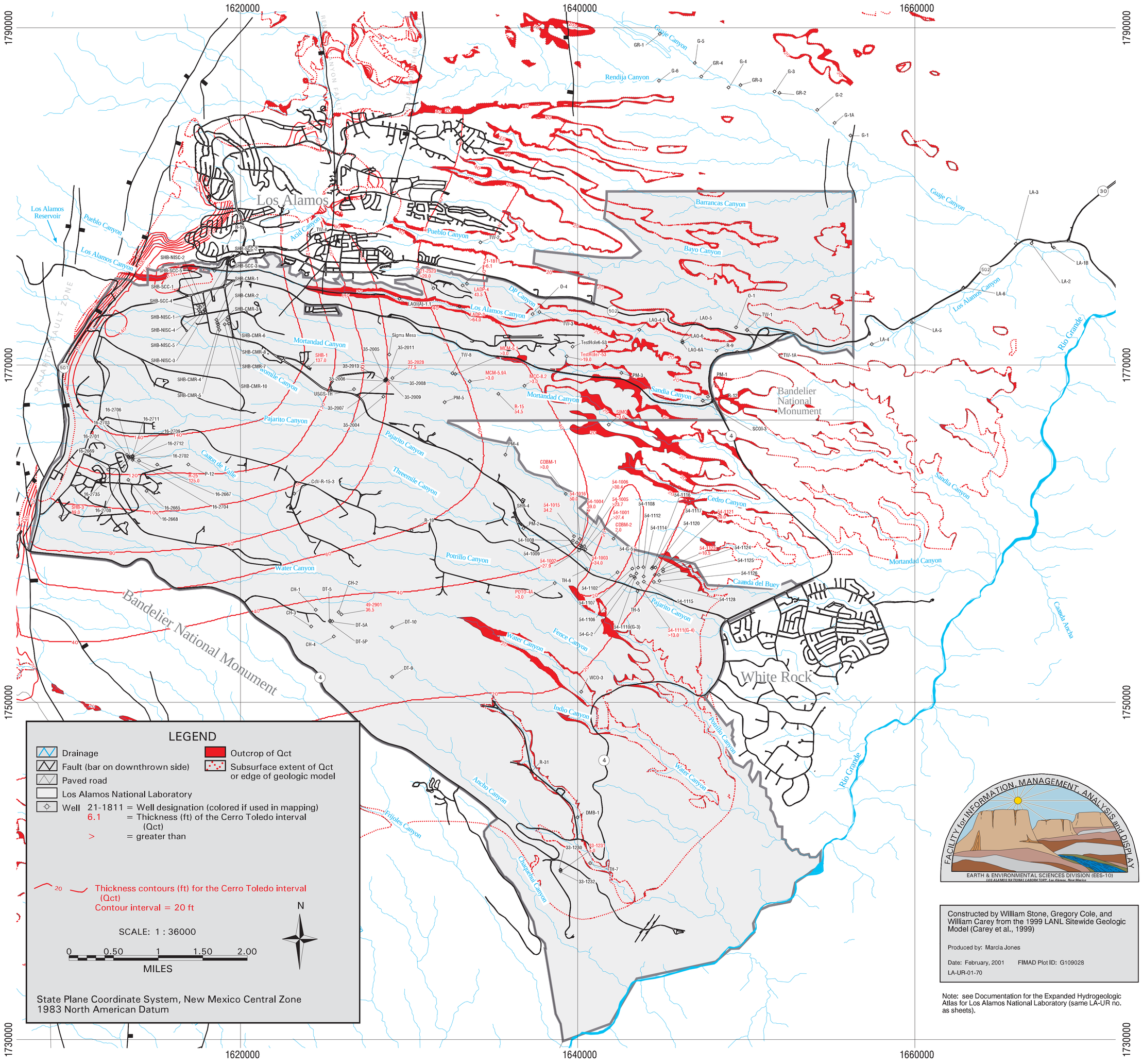
Sheet 7. Structure on top of the Cerro Toledo interval (Qct)

Hydrogeologic Atlas for Los Alamos National Laboratory



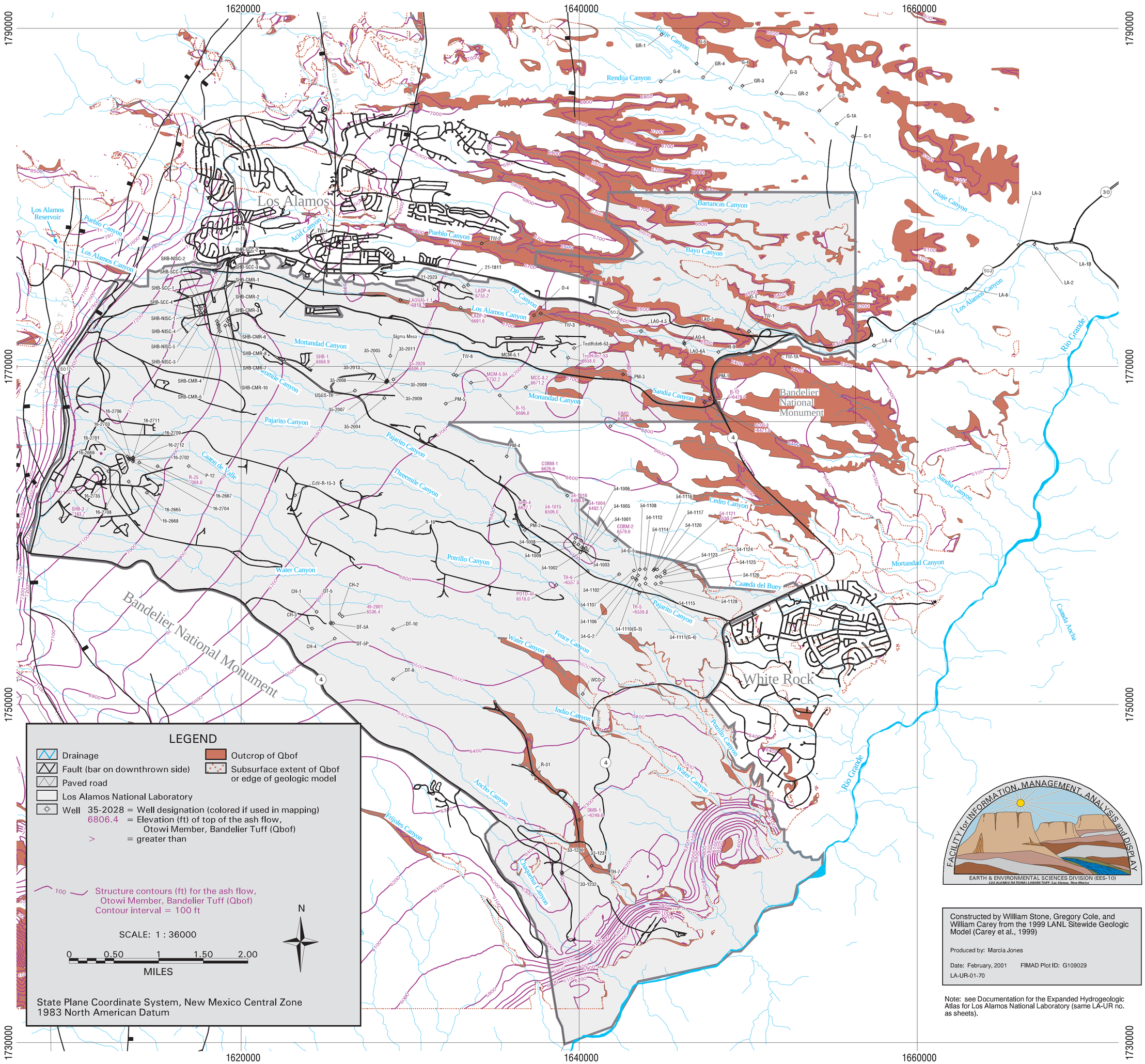
Sheet 8. Depth to top of the Cerro Toledo interval (Qct)

Hydrogeologic Atlas for Los Alamos National Laboratory



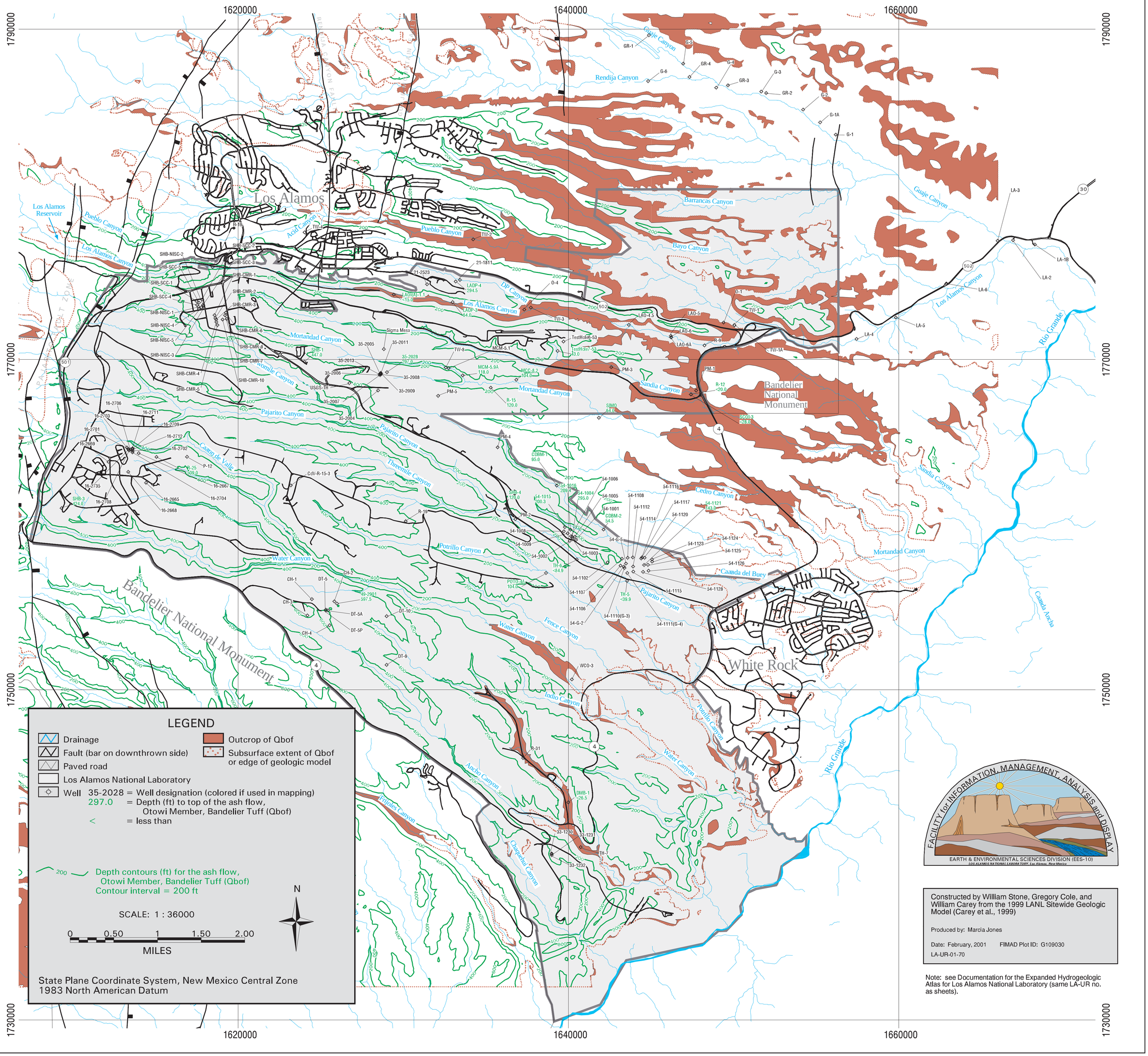
Sheet 9. Thickness of the Cerro Toledo interval (Qct)

Hydrogeologic Atlas for Los Alamos National Laboratory



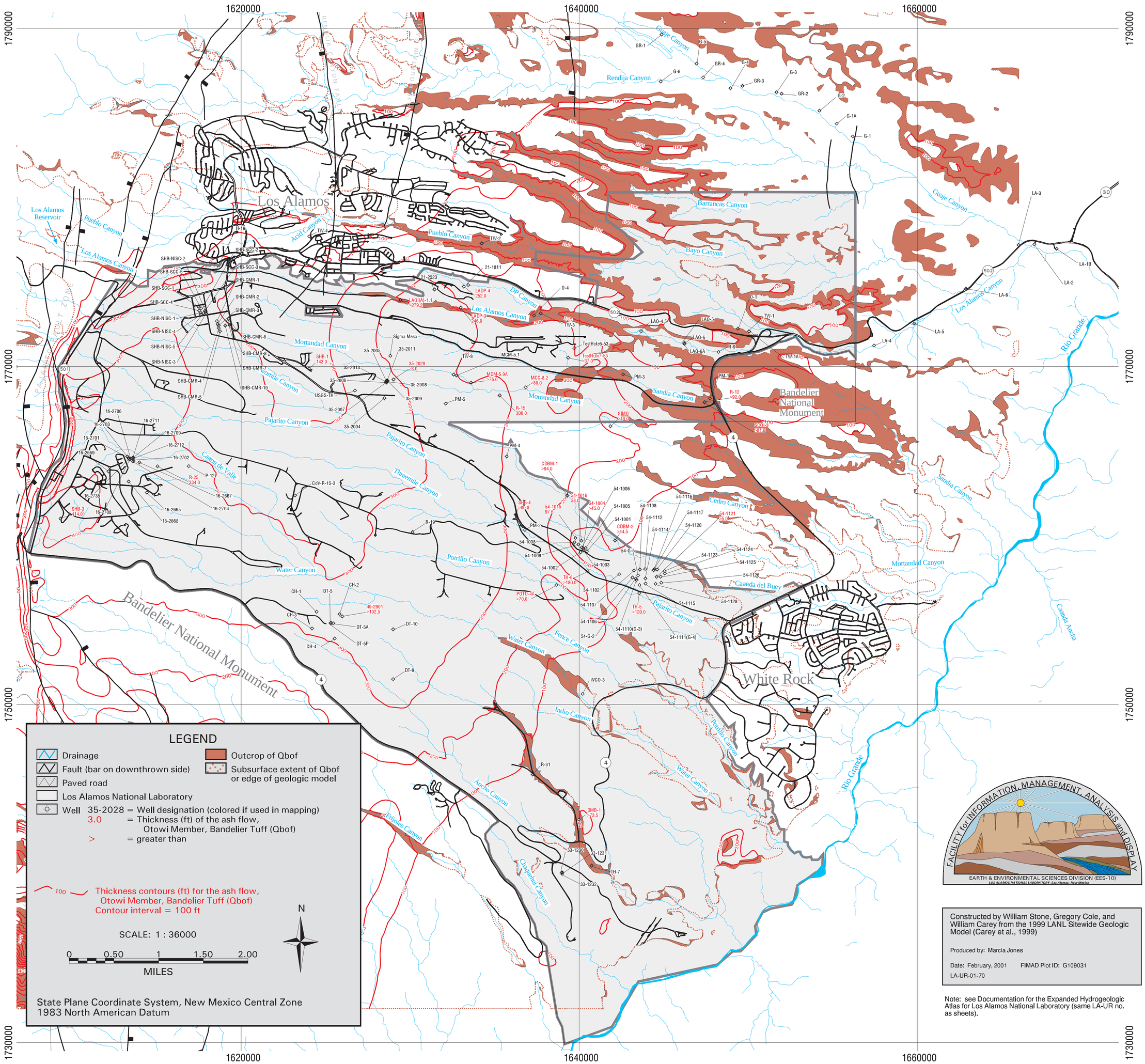
Sheet 10. Structure on top of the ash flow, Otowi Member, Bandelier Tuff (Qbof)

Hydrogeologic Atlas for Los Alamos National Laboratory



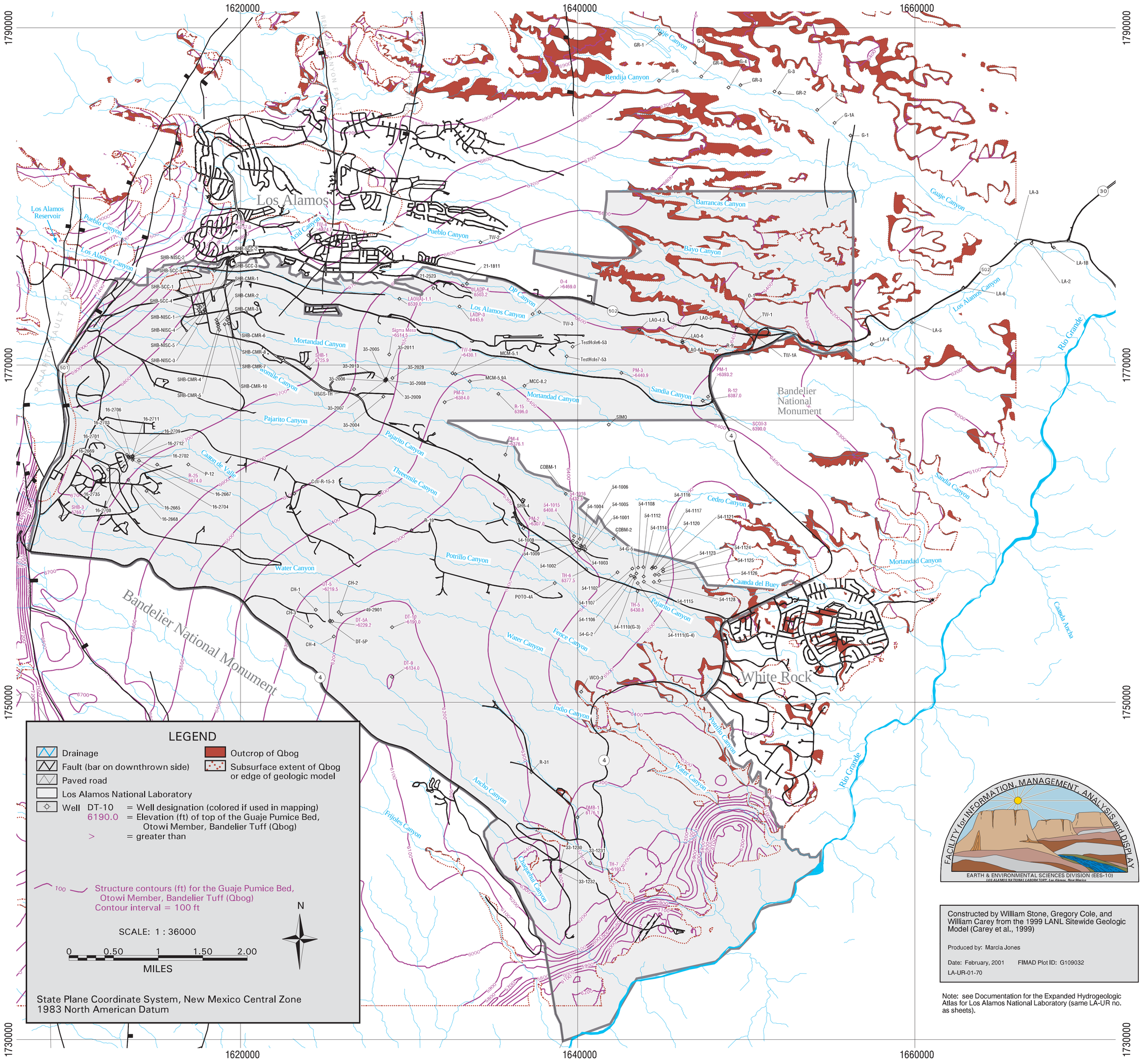
Sheet 11. Depth to top of the ash flow, Otowi Member, Bandelier Tuff (Qbof)

Hydrogeologic Atlas for Los Alamos National Laboratory



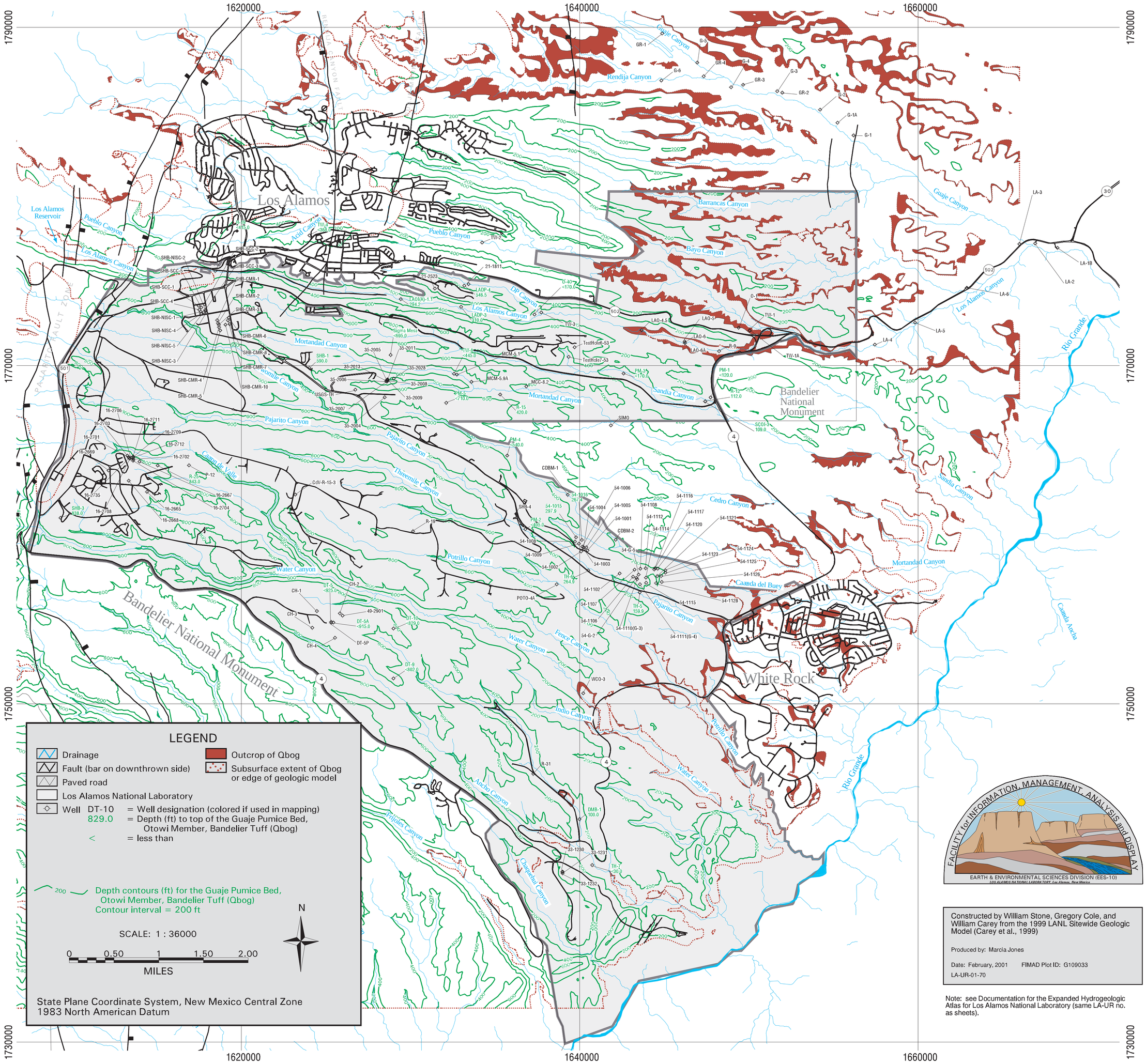
Sheet 12. Thickness of the ash flow, Otowi Member, Bandelier Tuff (Qbof)

Hydrogeologic Atlas for Los Alamos National Laboratory



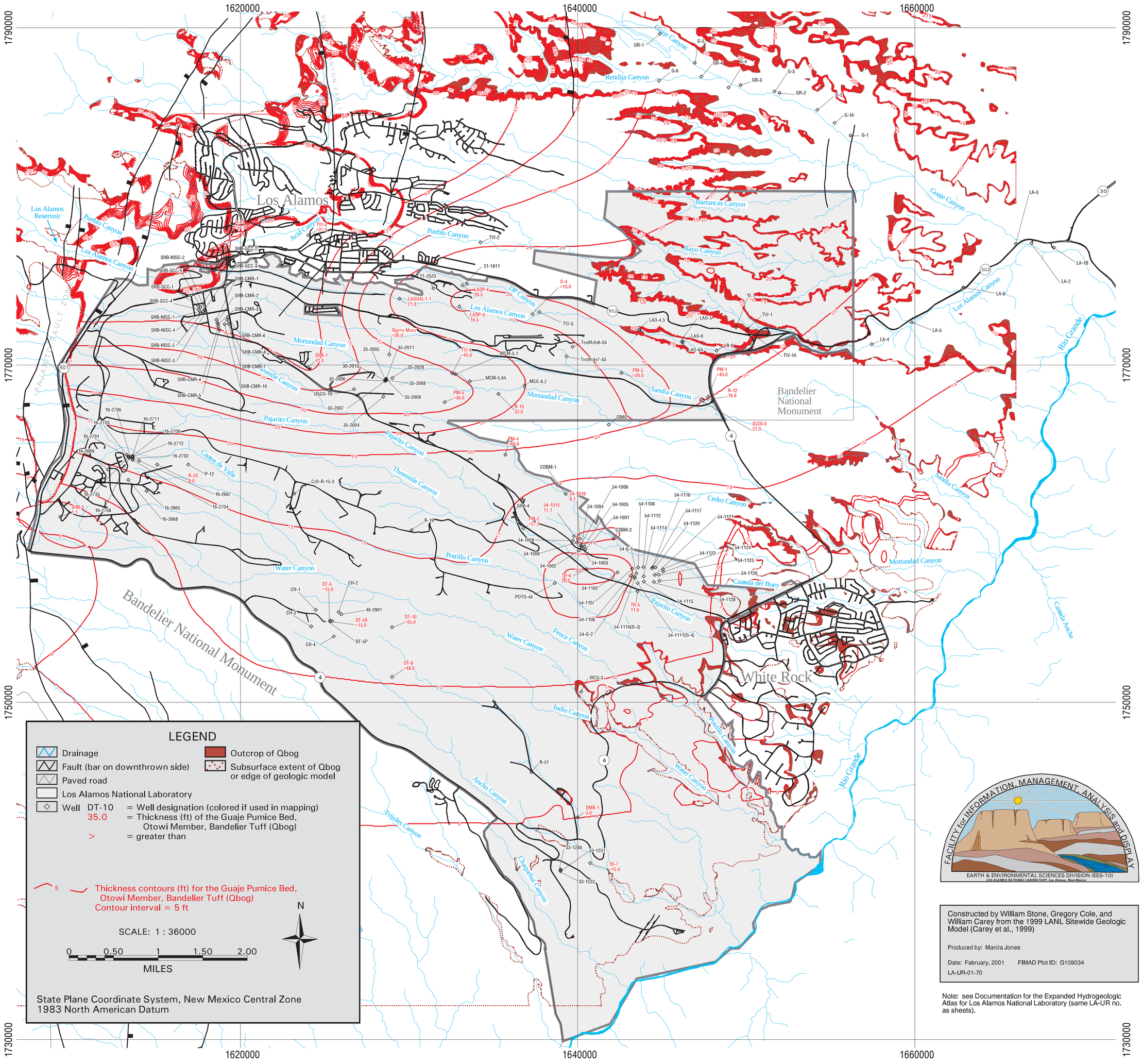
Sheet 13. Structure on top of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)

Hydrogeologic Atlas for Los Alamos National Laboratory



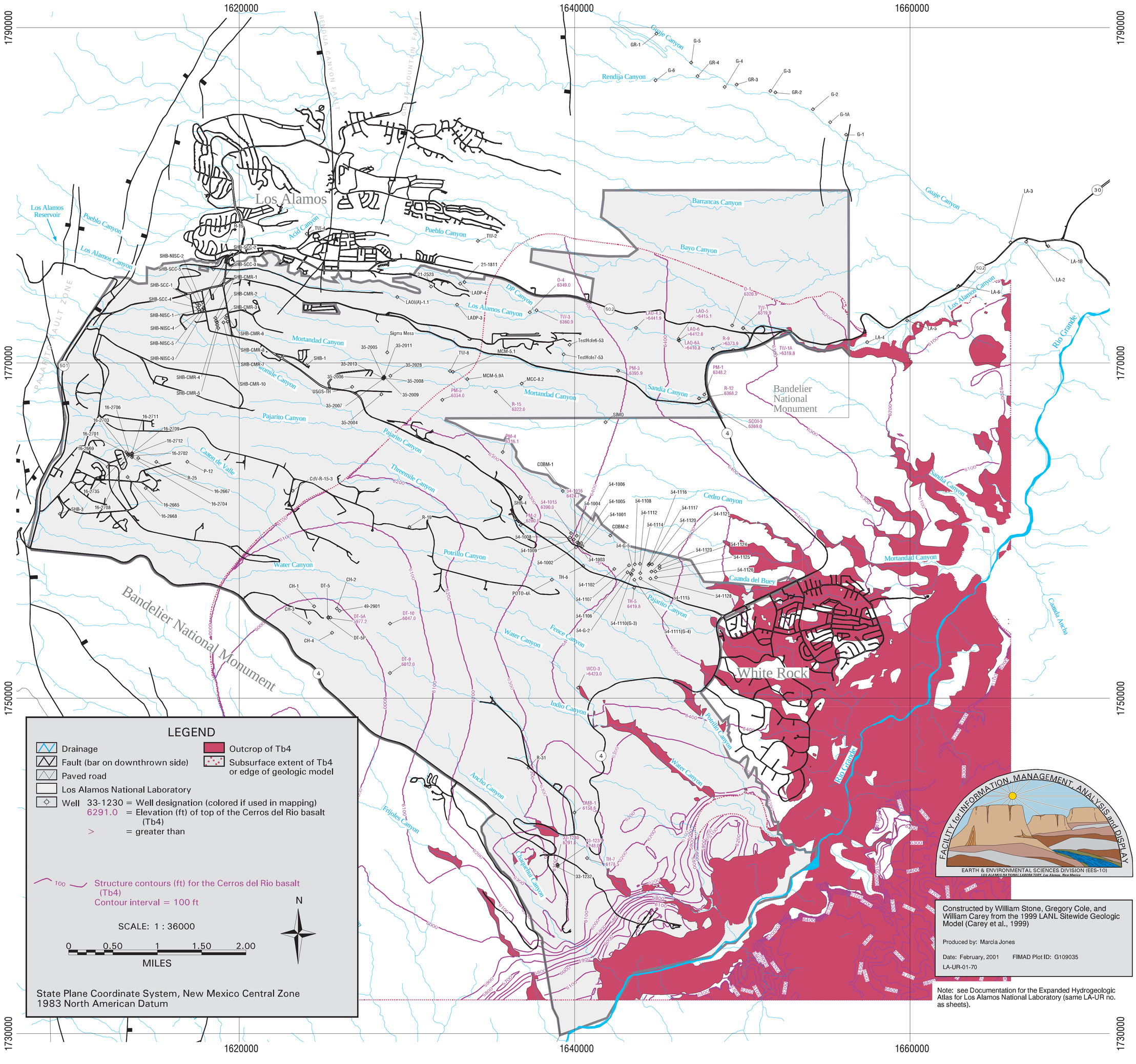
Sheet 14. Depth to top of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)

Hydrogeologic Atlas for Los Alamos National Laboratory



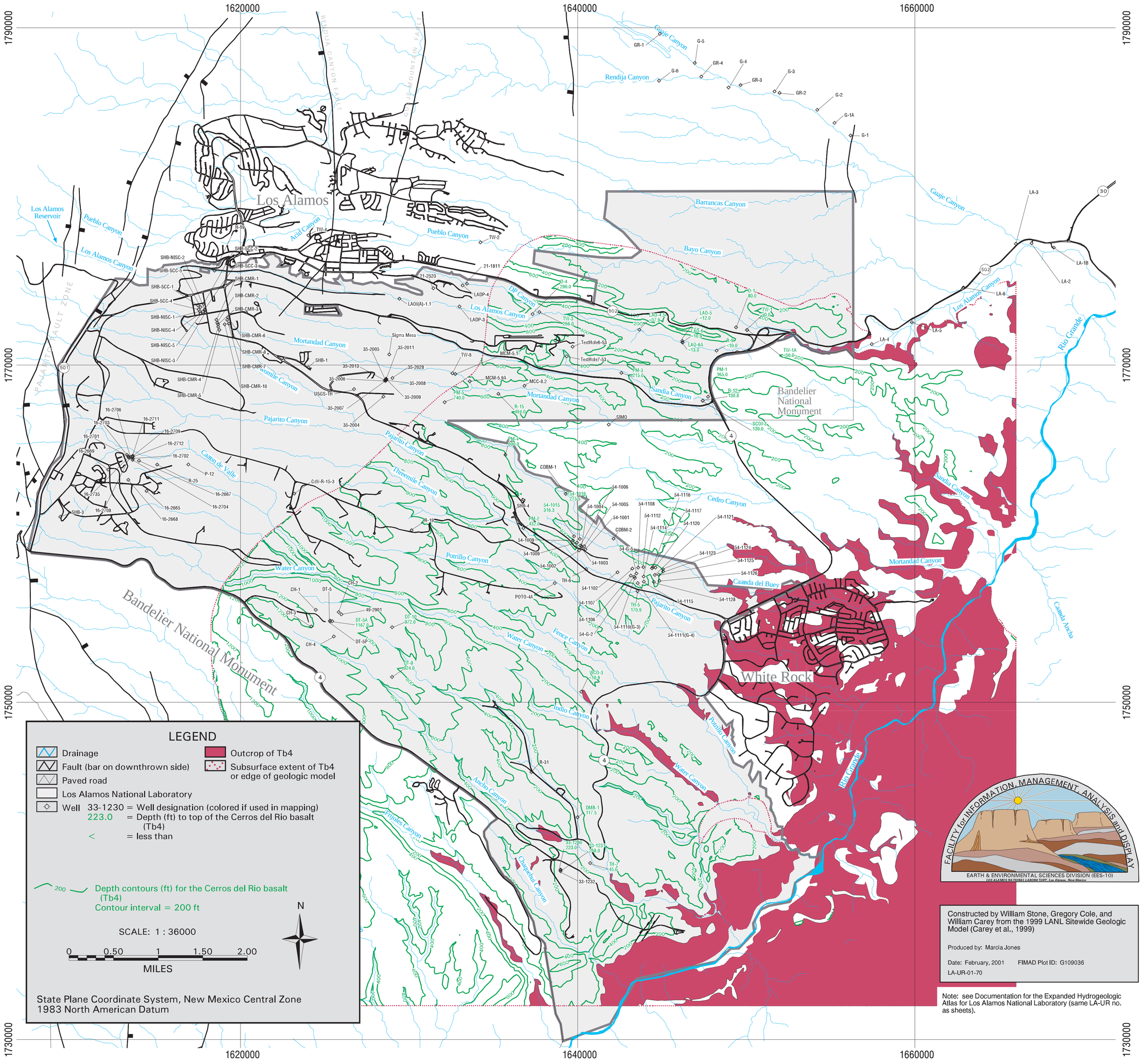
Sheet 15. Thickness of the Guaje Pumice Bed, Otowi Member, Bandelier Tuff (Qbog)

Hydrogeologic Atlas for Los Alamos National Laboratory



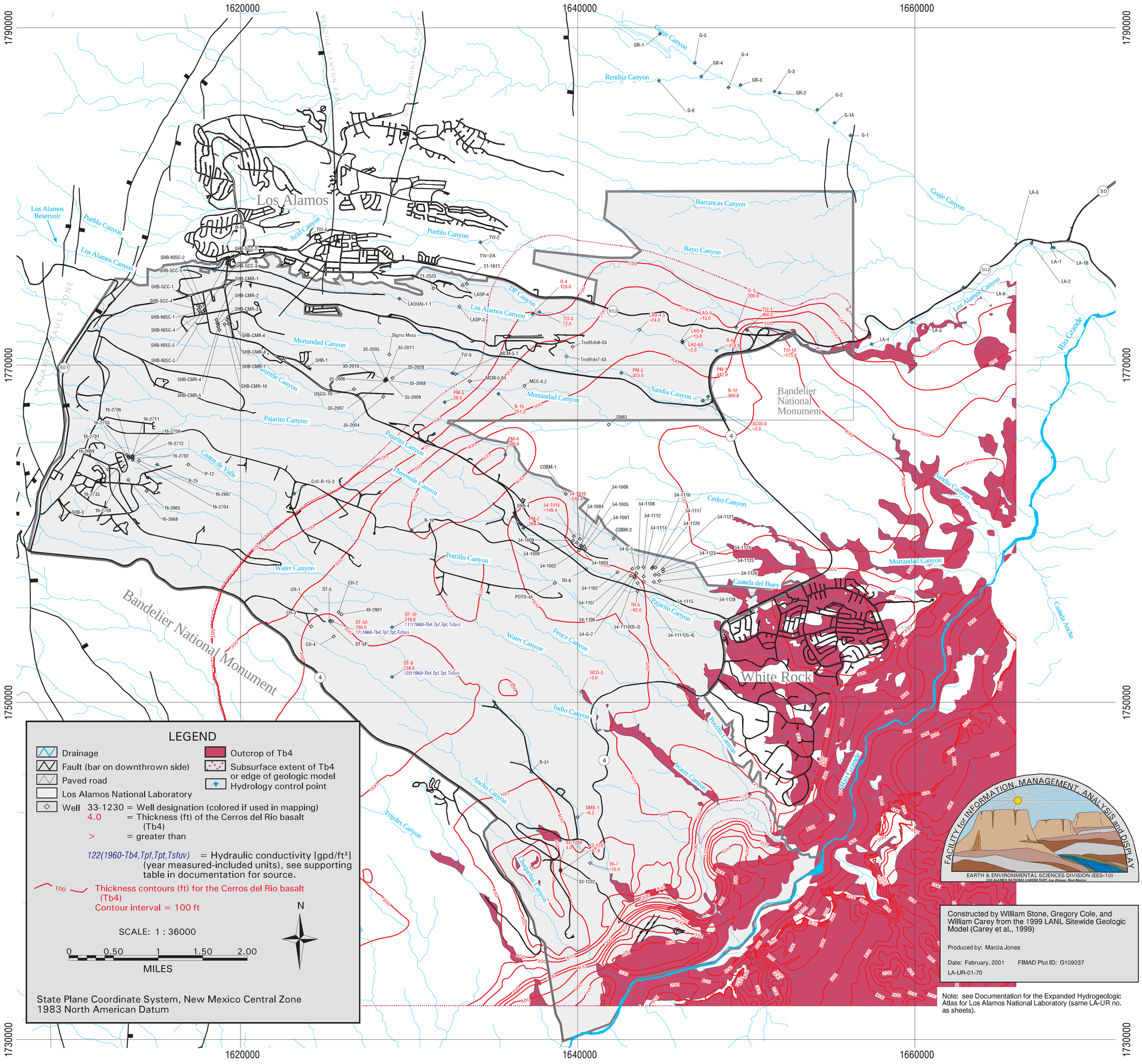
Sheet 16. Structure on top of the Cerros del Rio basalt (Tb4)

Hydrogeologic Atlas for Los Alamos National Laboratory



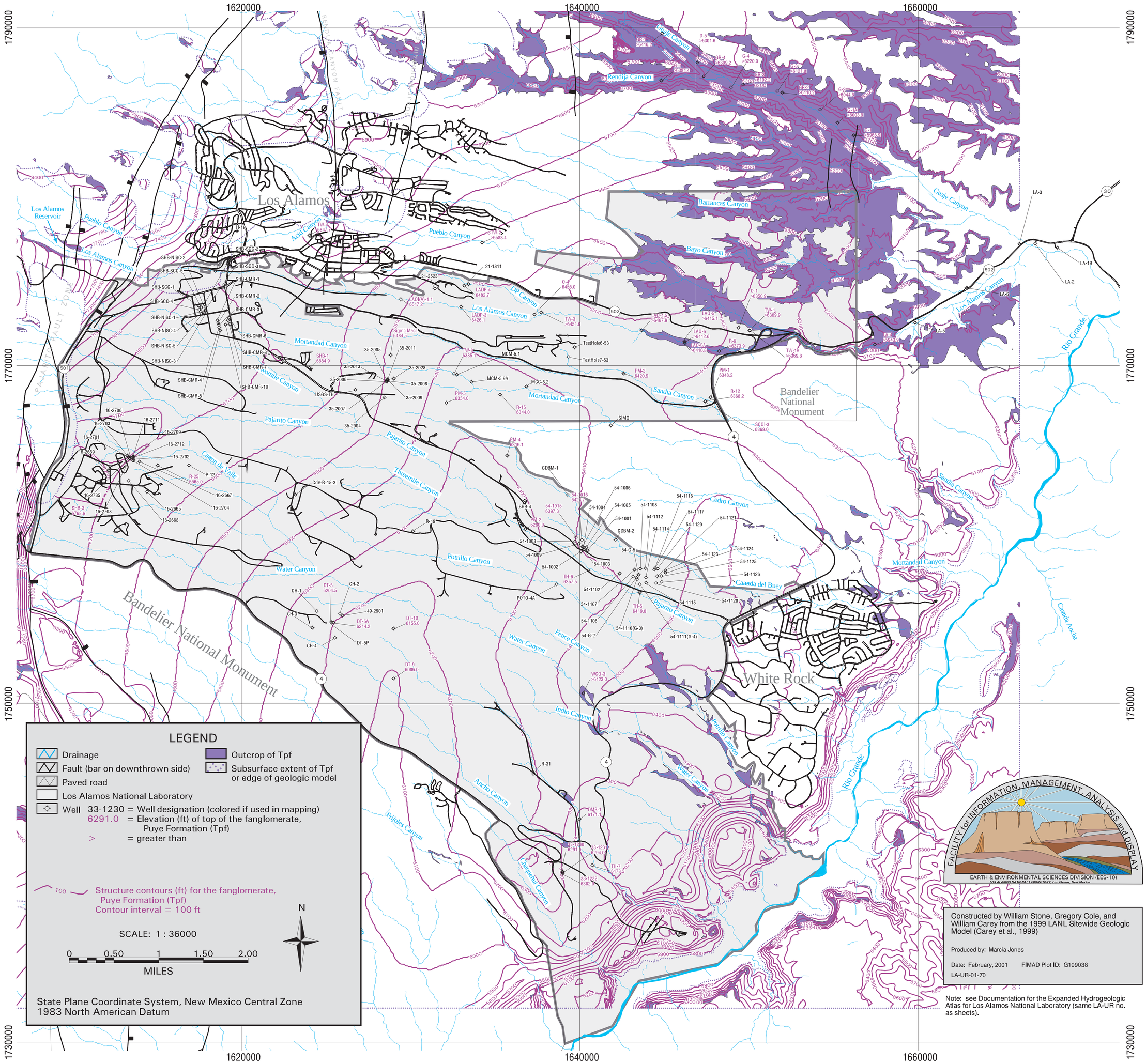
Sheet 17. Depth to top of the Cerros del Rio basalt (Tb4)

Hydrogeologic Atlas for Los Alamos National Laboratory



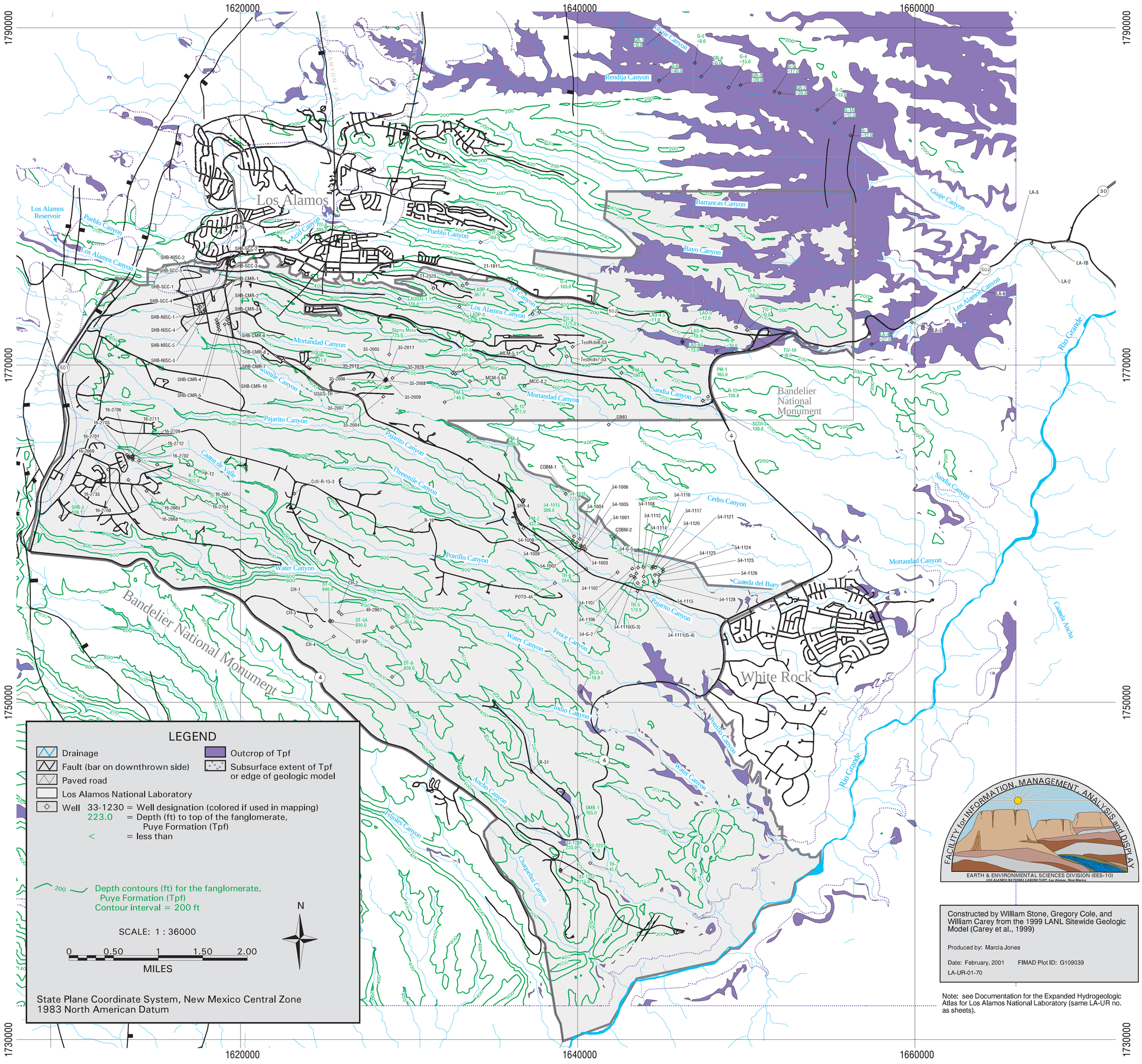
Sheet 18. Thickness of the Cerros del Rio basalt (Tb4)

Hydrogeologic Atlas for Los Alamos National Laboratory



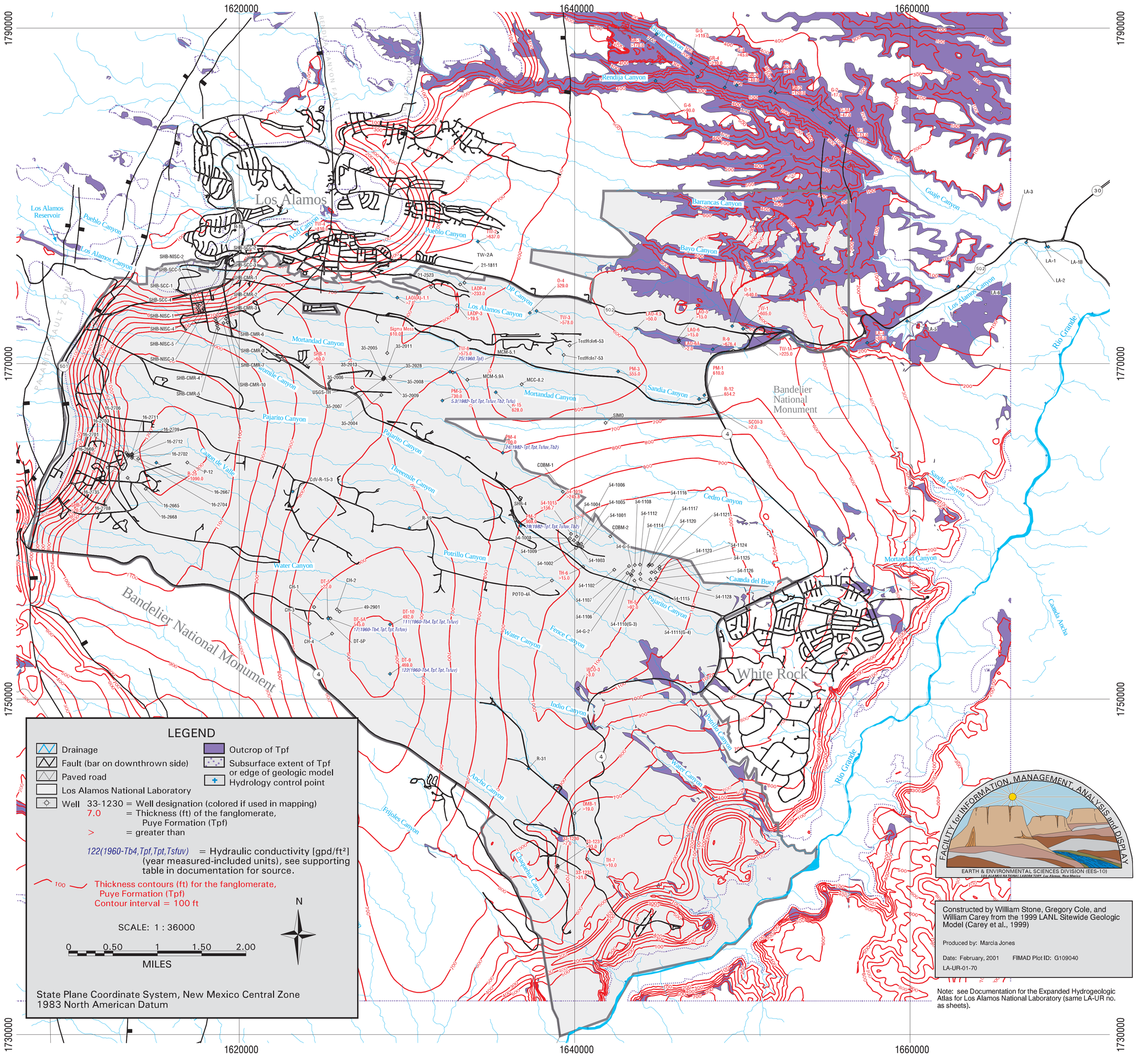
Sheet 19. Structure on top of the fanglomerate, Puye Formation (Tpf)

Hydrogeologic Atlas for Los Alamos National Laboratory



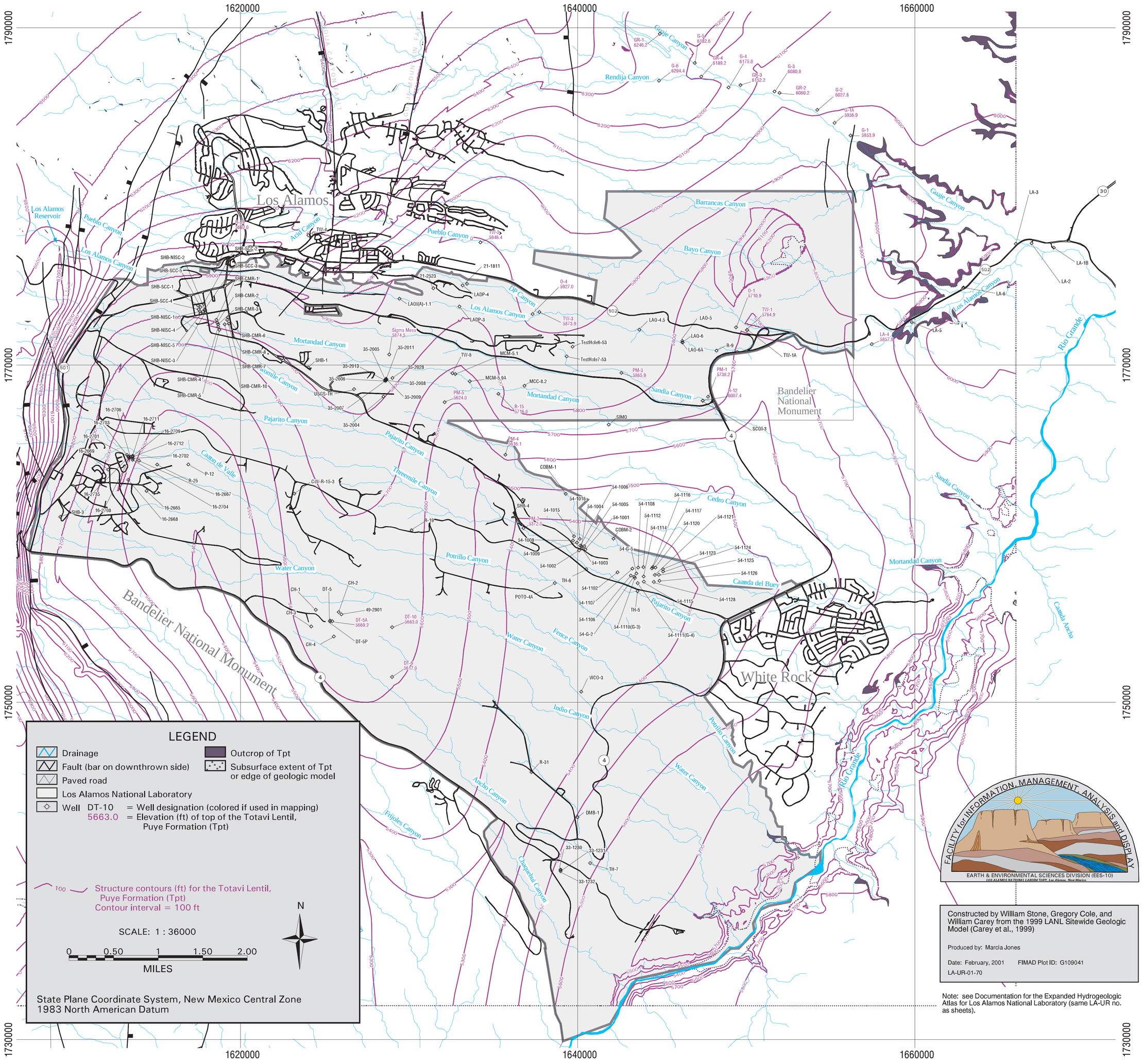
Sheet 20. Depth to top of the fanglomerate, Puye Formation (Tpf)

Hydrogeologic Atlas for Los Alamos National Laboratory



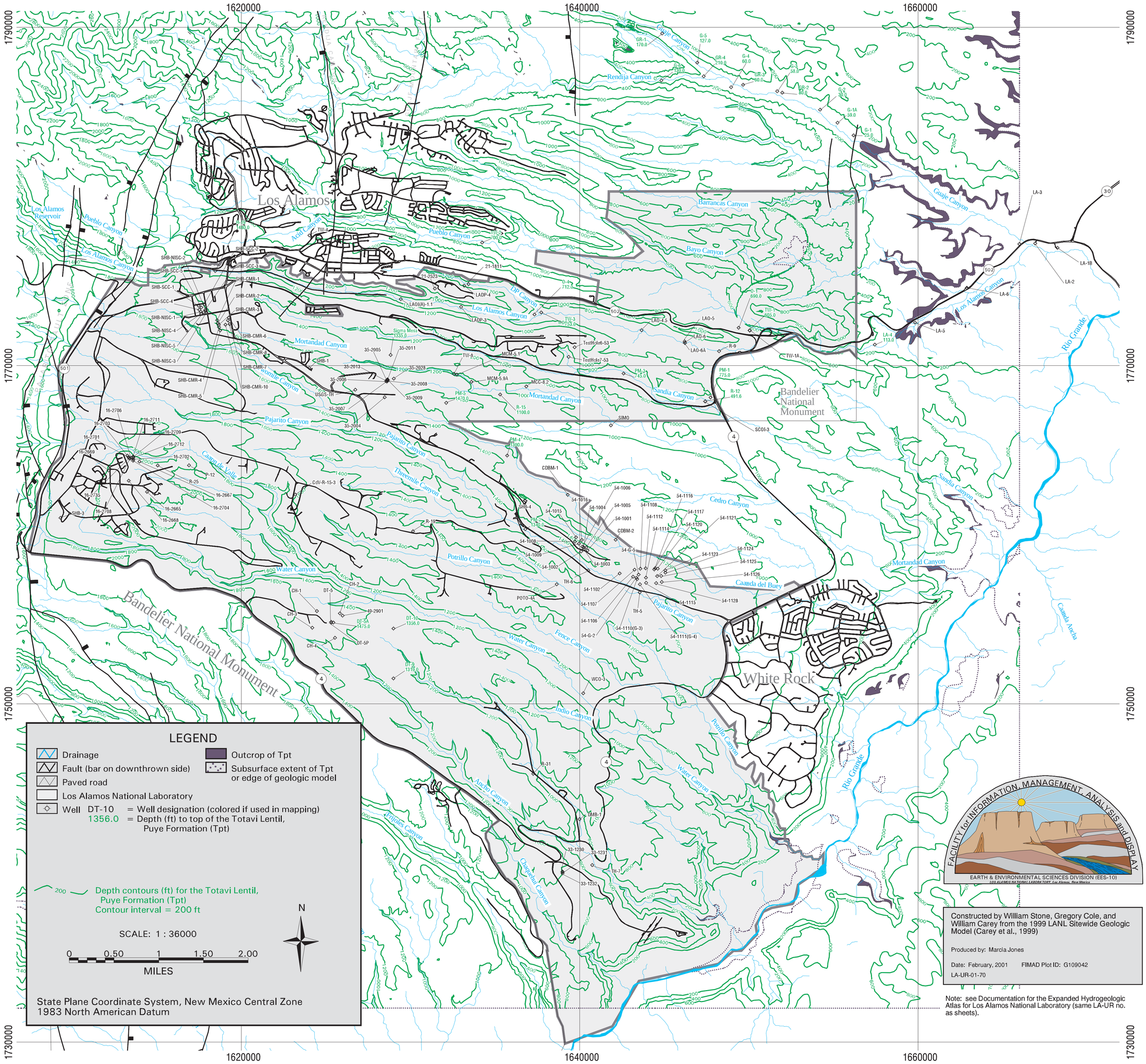
Sheet 21. Thickness of the fanglomerate, Puye Formation (Tpf)

Hydrogeologic Atlas for Los Alamos National Laboratory



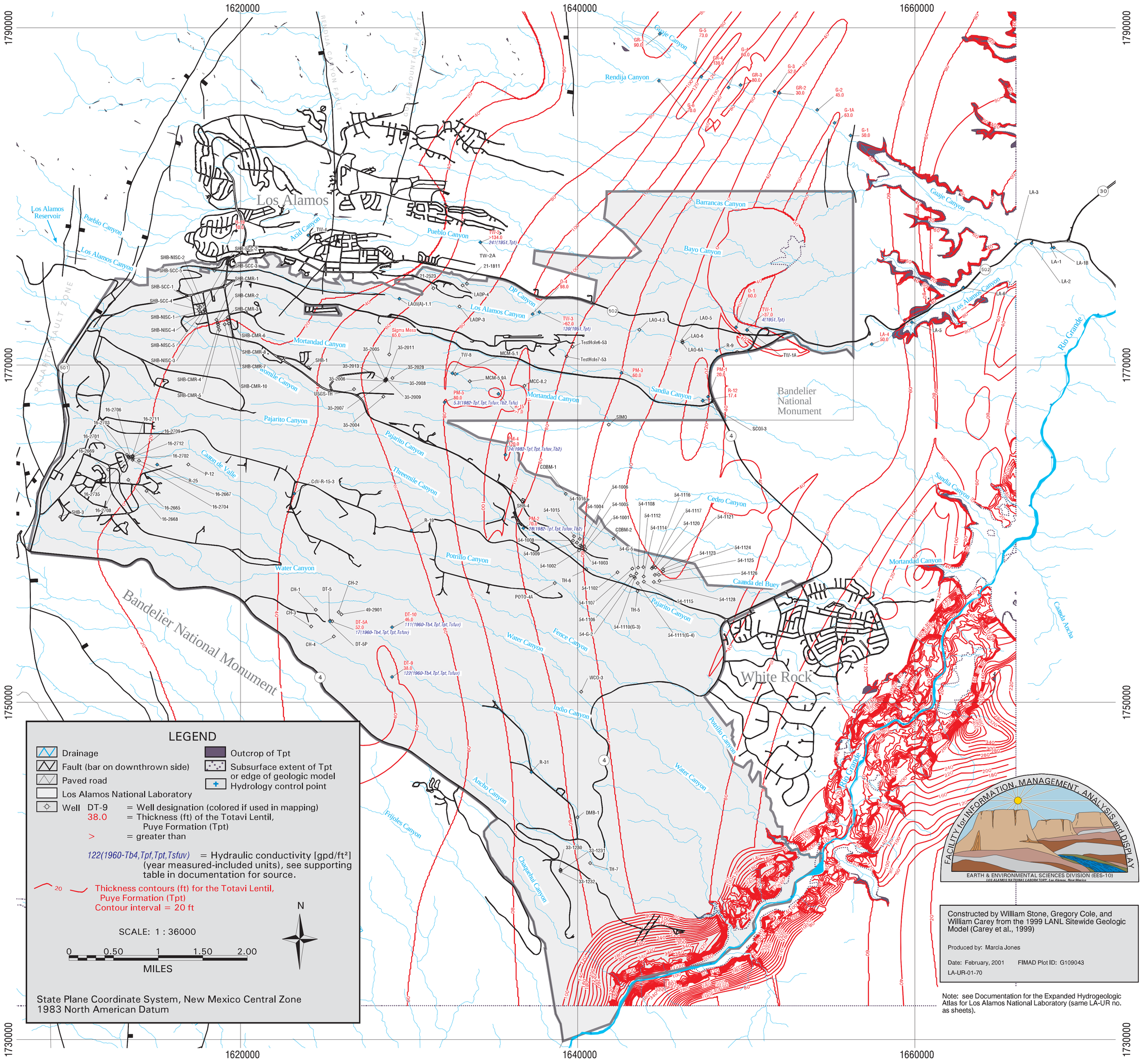
Sheet 22. Structure on top of the Totavi Lentil, Puye Formation (Tpt)

Hydrogeologic Atlas for Los Alamos National Laboratory



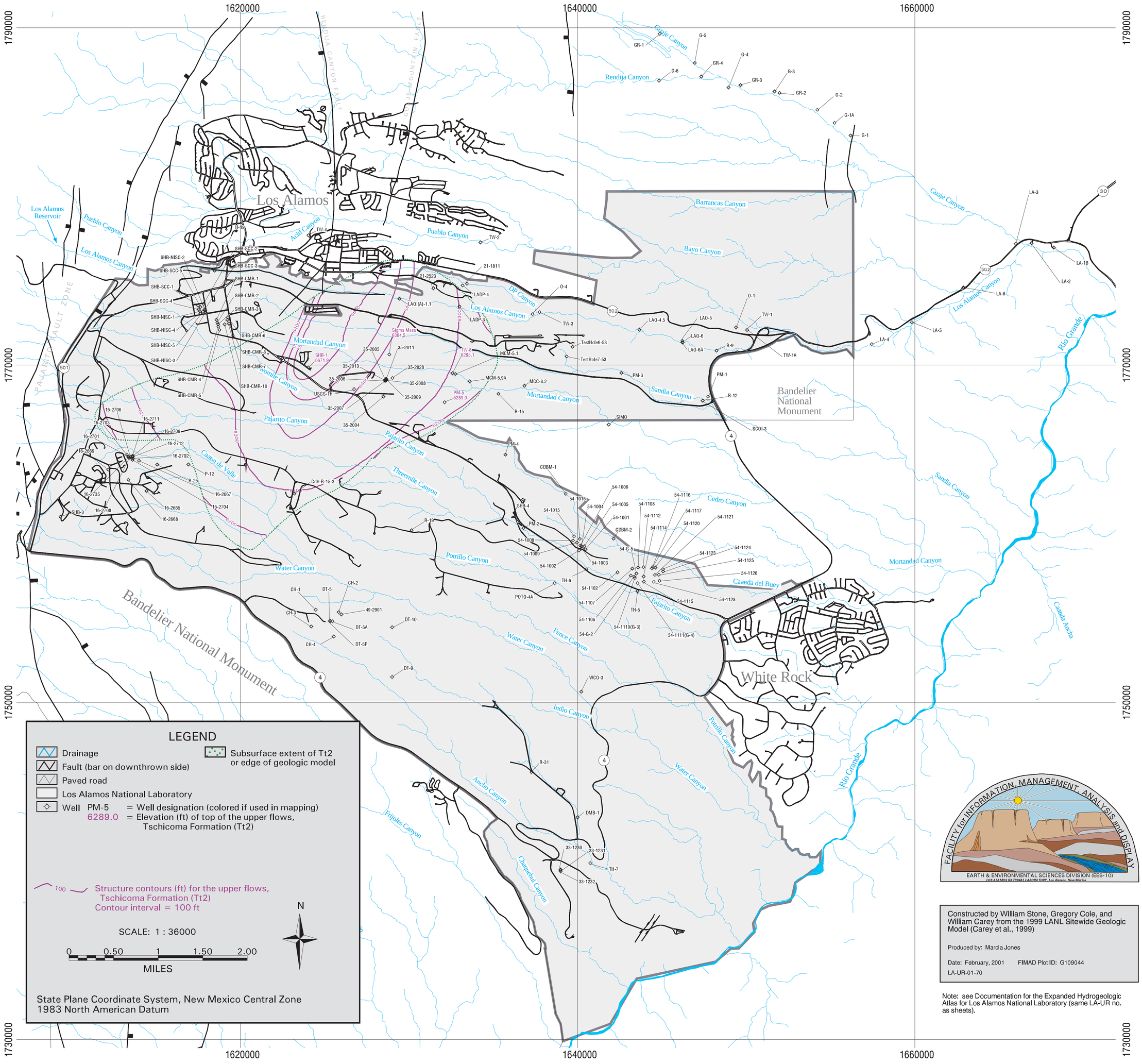
Sheet 23. Depth to top of the Totavi Lentil, Puye Formation (Tpt)

Hydrogeologic Atlas for Los Alamos National Laboratory



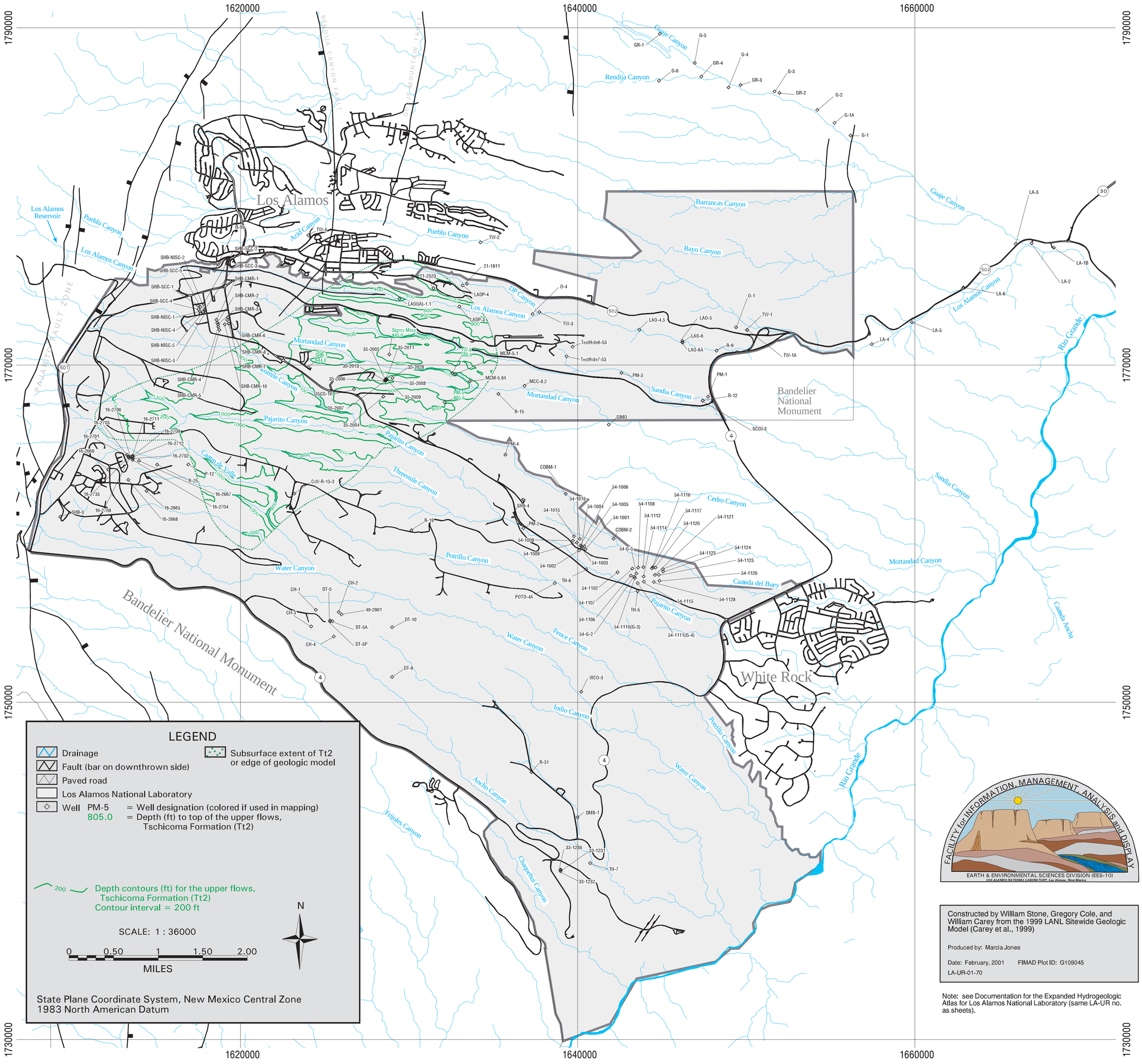
Sheet 24. Thickness of the Totavi Lentil, Puye Formation (Tpt)

Hydrogeologic Atlas for Los Alamos National Laboratory



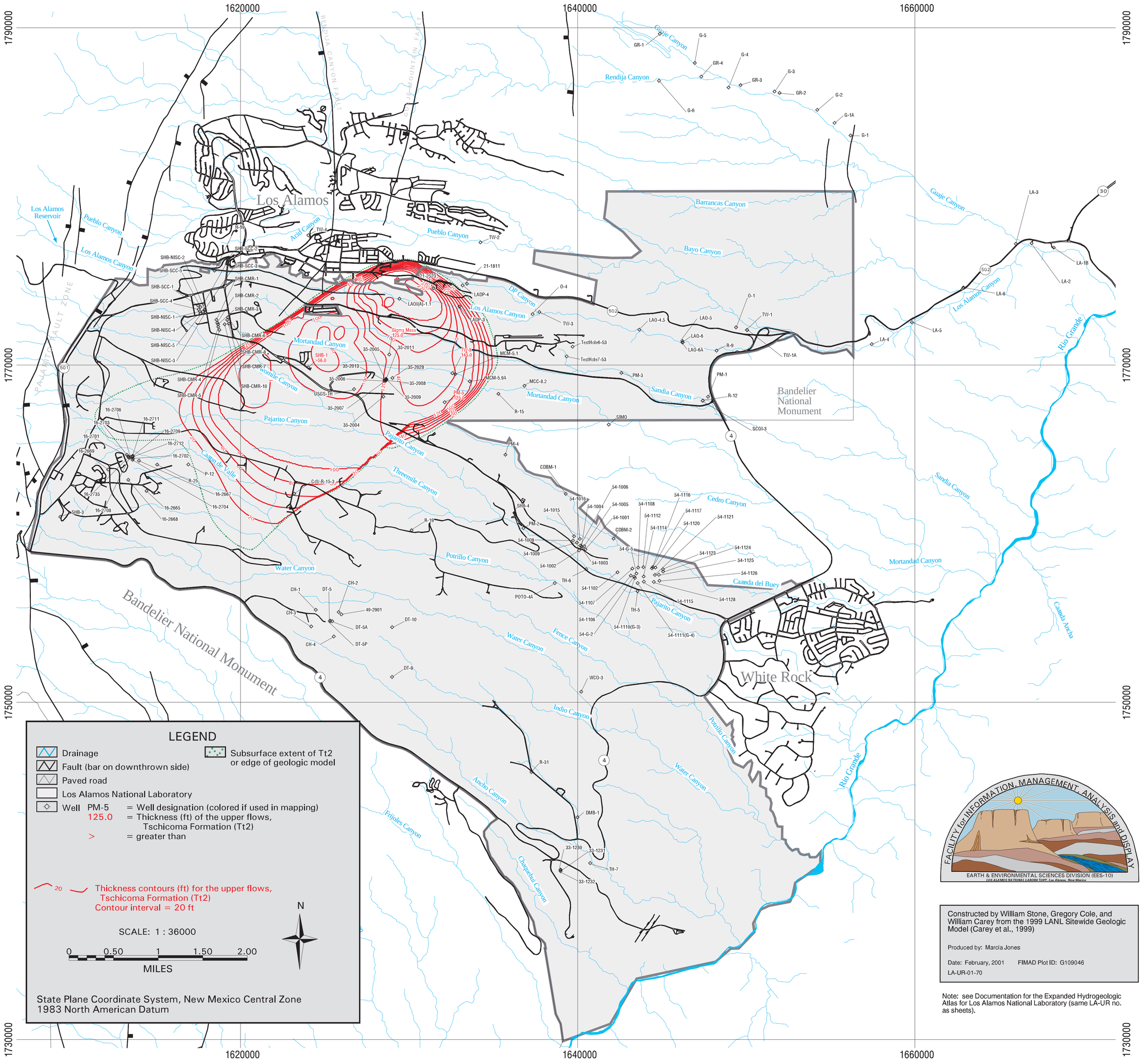
Sheet 25. Structure on top of the upper flows, Tschicoma Formation (Tt2)

Hydrogeologic Atlas for Los Alamos National Laboratory



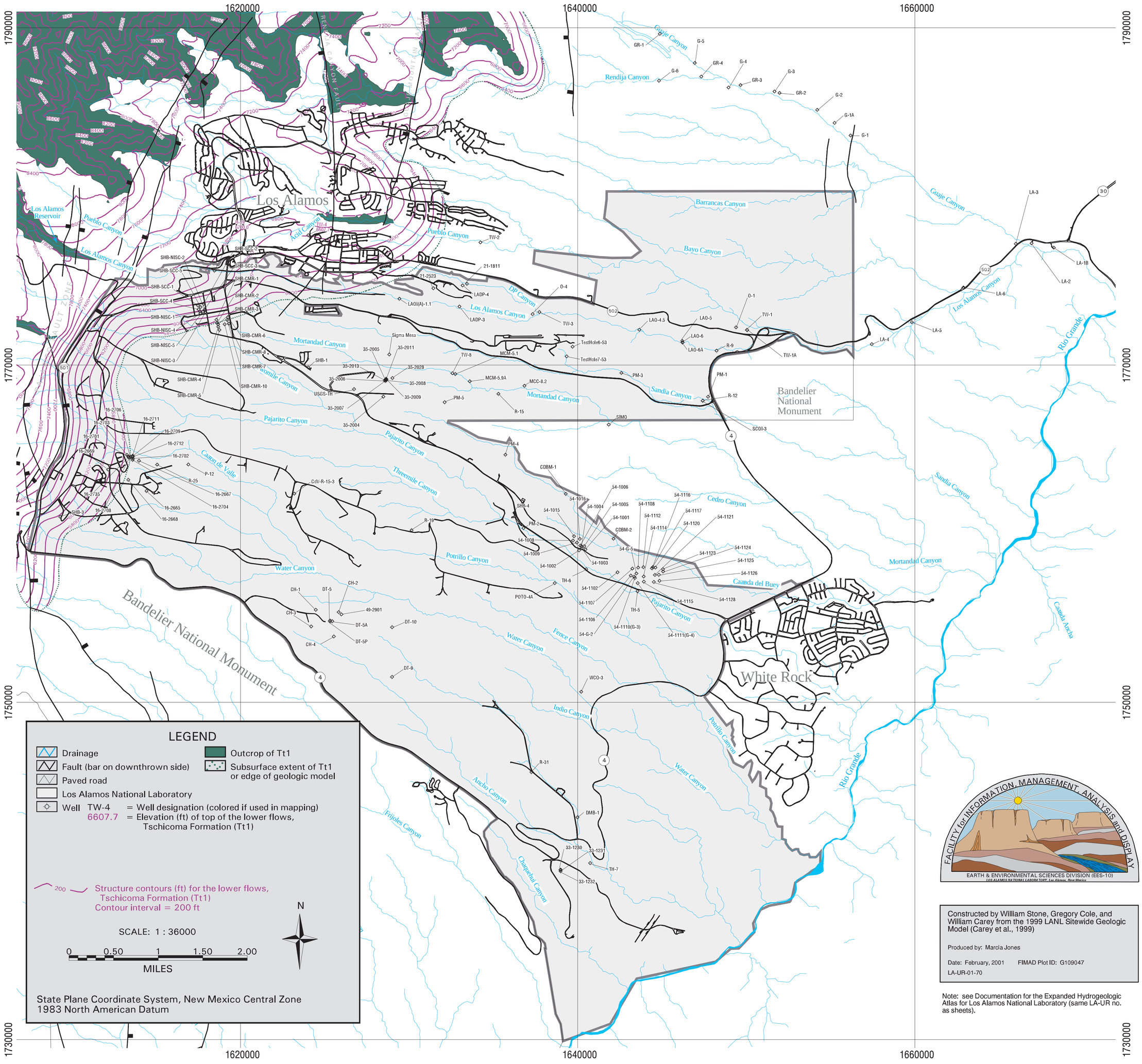
Sheet 26. Depth to top of the upper flows, Tschicoma Formation (Tt2)

Hydrogeologic Atlas for Los Alamos National Laboratory



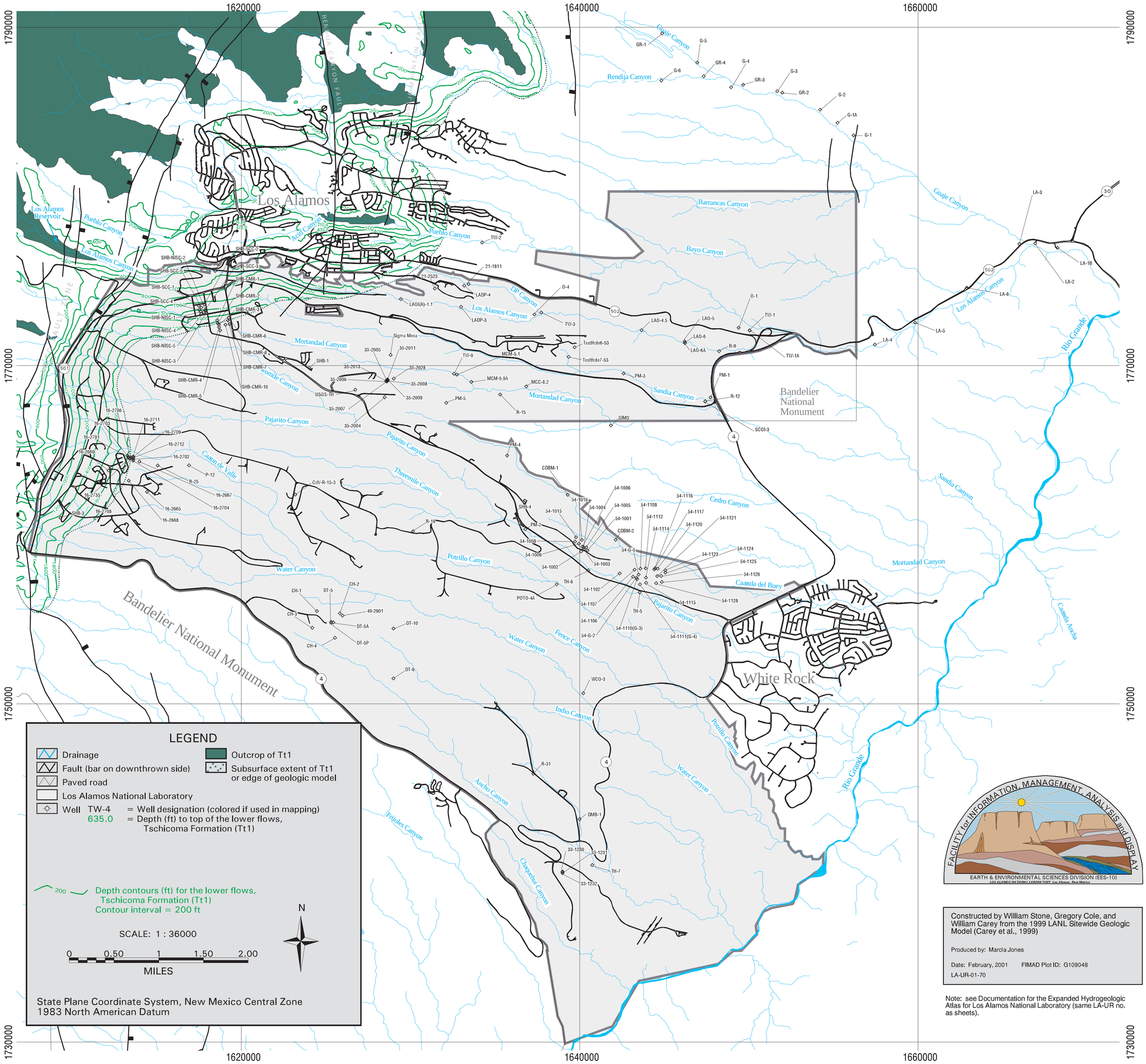
Sheet 27. Thickness of the upper flows, Tschicoma Formation (Tt2)

Hydrogeologic Atlas for Los Alamos National Laboratory



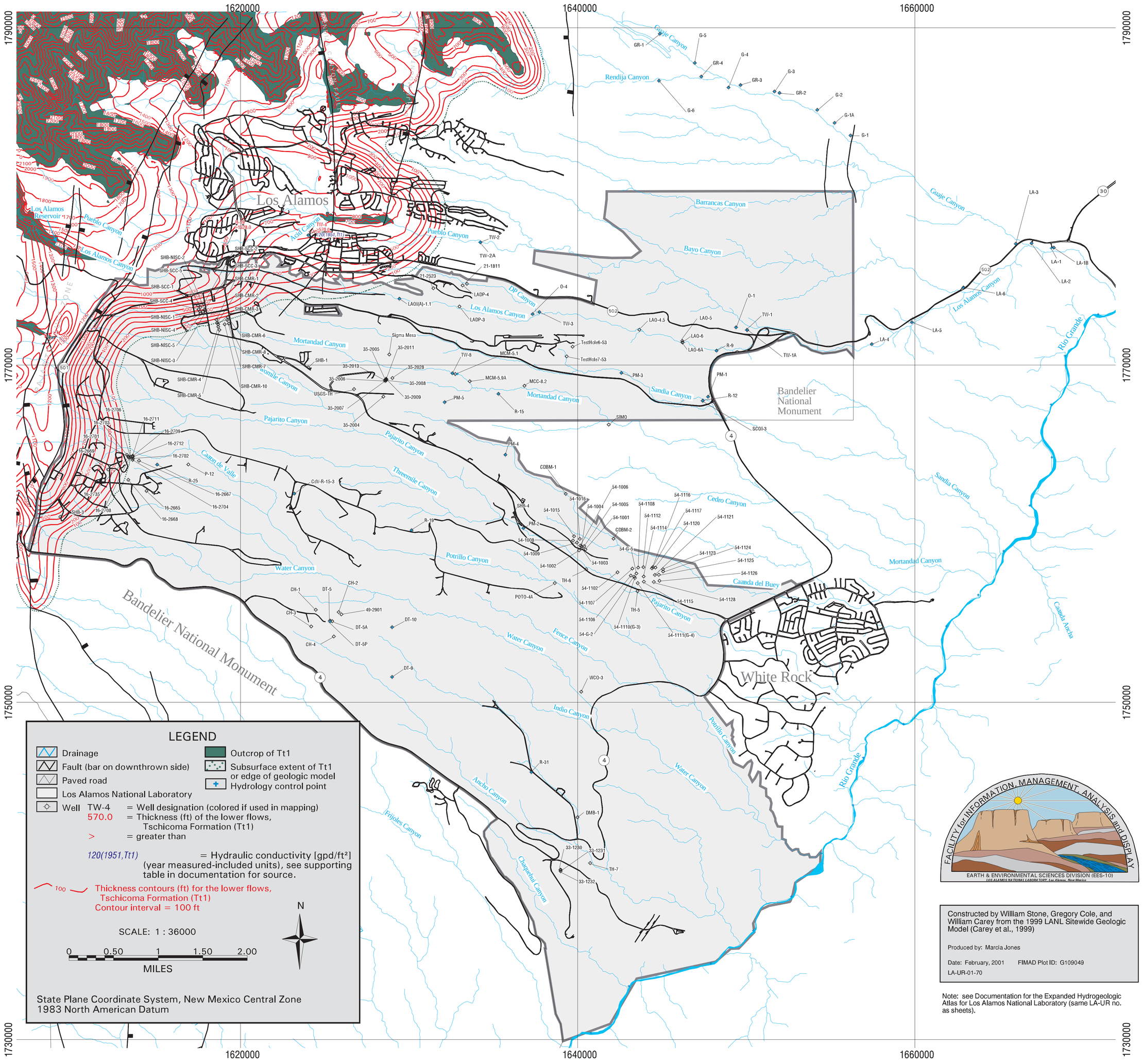
Sheet 28. Structure on top of the lower flows, Tschicoma Formation (Tt1)

Hydrogeologic Atlas for Los Alamos National Laboratory



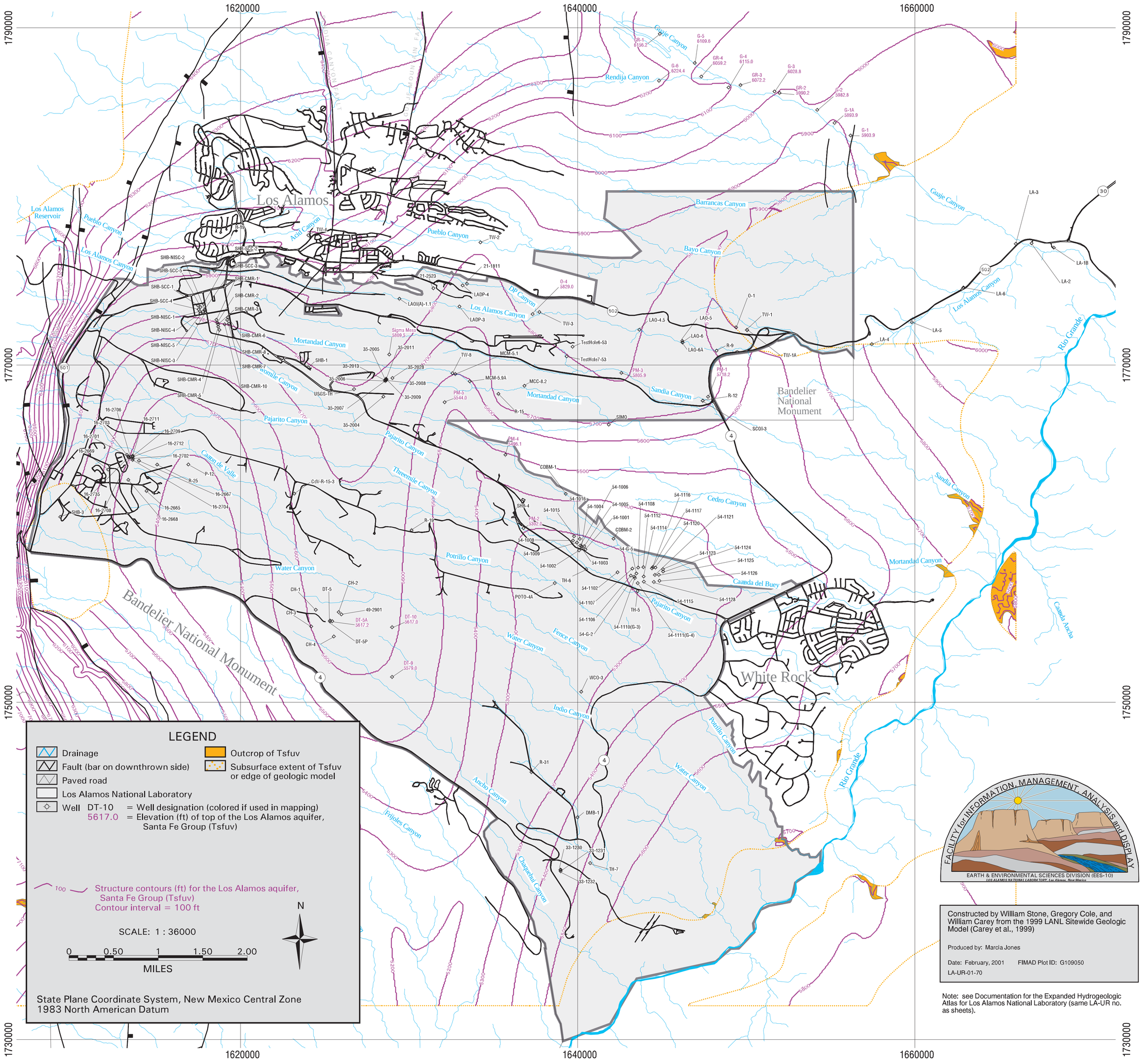
Sheet 29. Depth to top of the lower flows, Tschicoma Formation (Tt1)

Hydrogeologic Atlas for Los Alamos National Laboratory



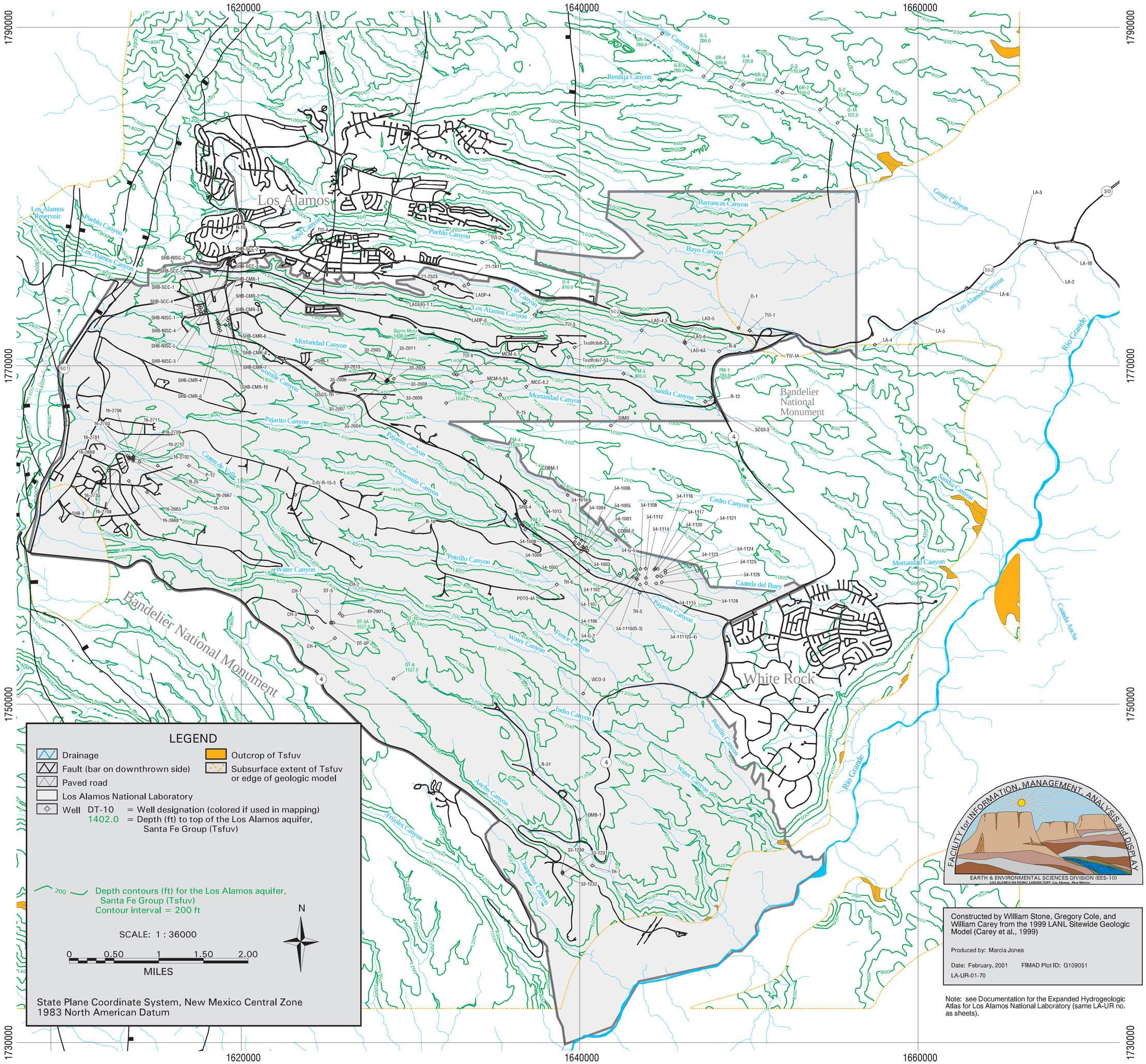
Sheet 30. Thickness of the lower flows, Tschicoma Formation (Tt1)

Hydrogeologic Atlas for Los Alamos National Laboratory



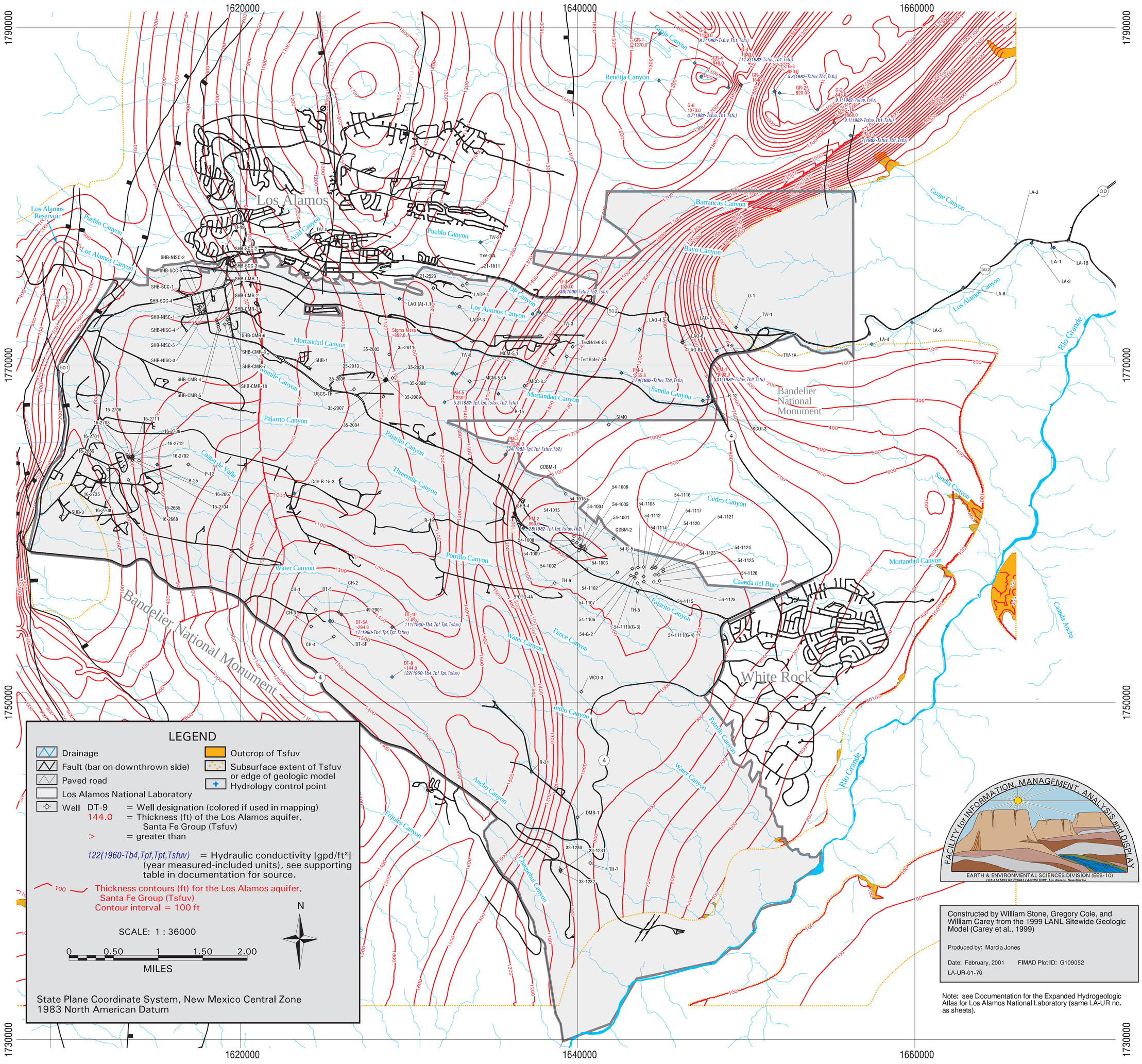
Sheet 31. Structure on top of the Los Alamos aquifer, Santa Fe Group (Tsfuv)

Hydrogeologic Atlas for Los Alamos National Laboratory



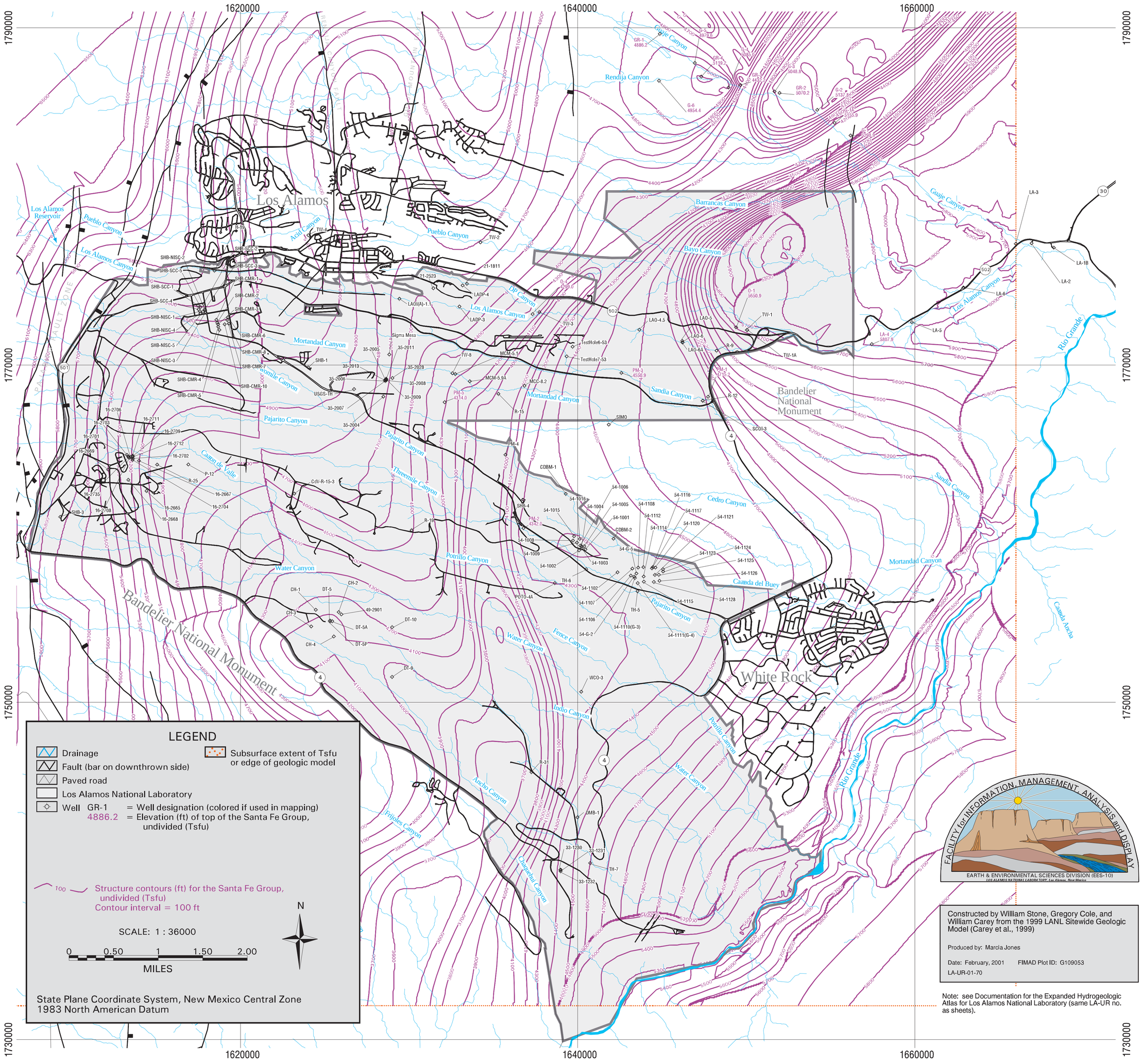
Sheet 32. Depth to top of the Los Alamos aquifer, Santa Fe Group (Tsfuv)

Hydrogeologic Atlas for Los Alamos National Laboratory



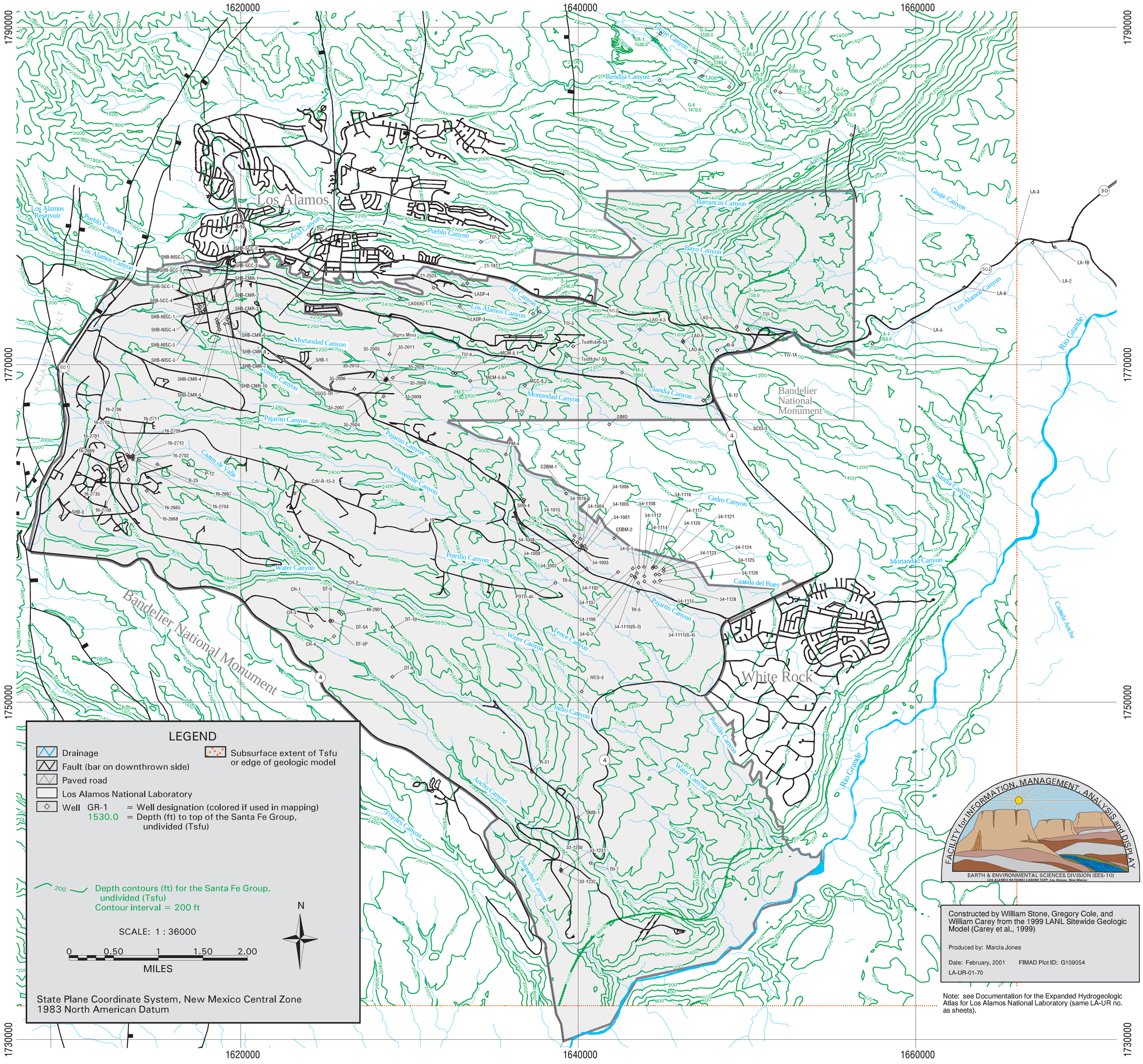
Sheet 33. Thickness of the Los Alamos aquifer, Santa Fe Group (Tsfuv)

Hydrogeologic Atlas for Los Alamos National Laboratory



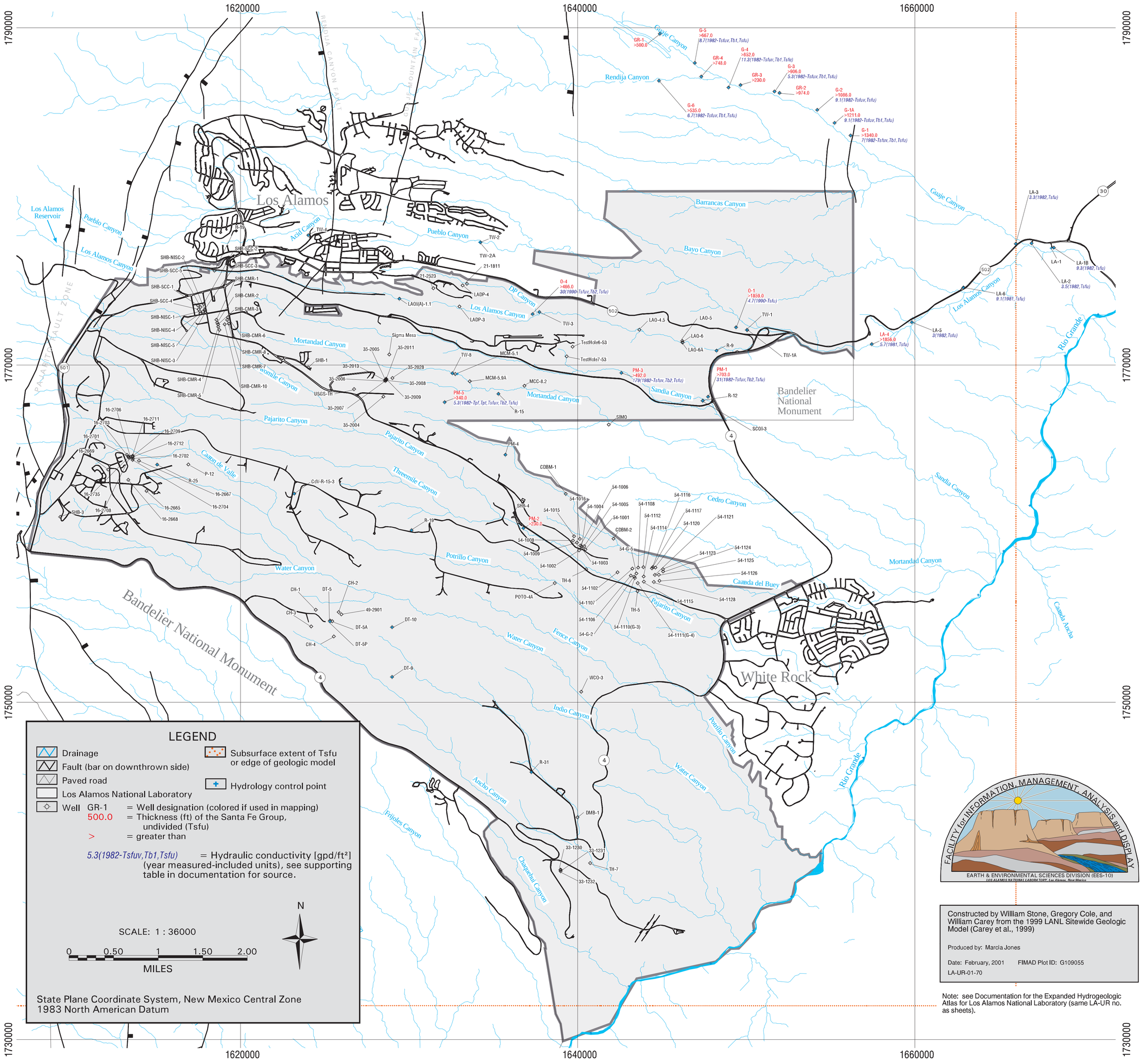
Sheet 34. Structure on top of the Santa Fe Group, undivided (Tsfu)

Hydrogeologic Atlas for Los Alamos National Laboratory



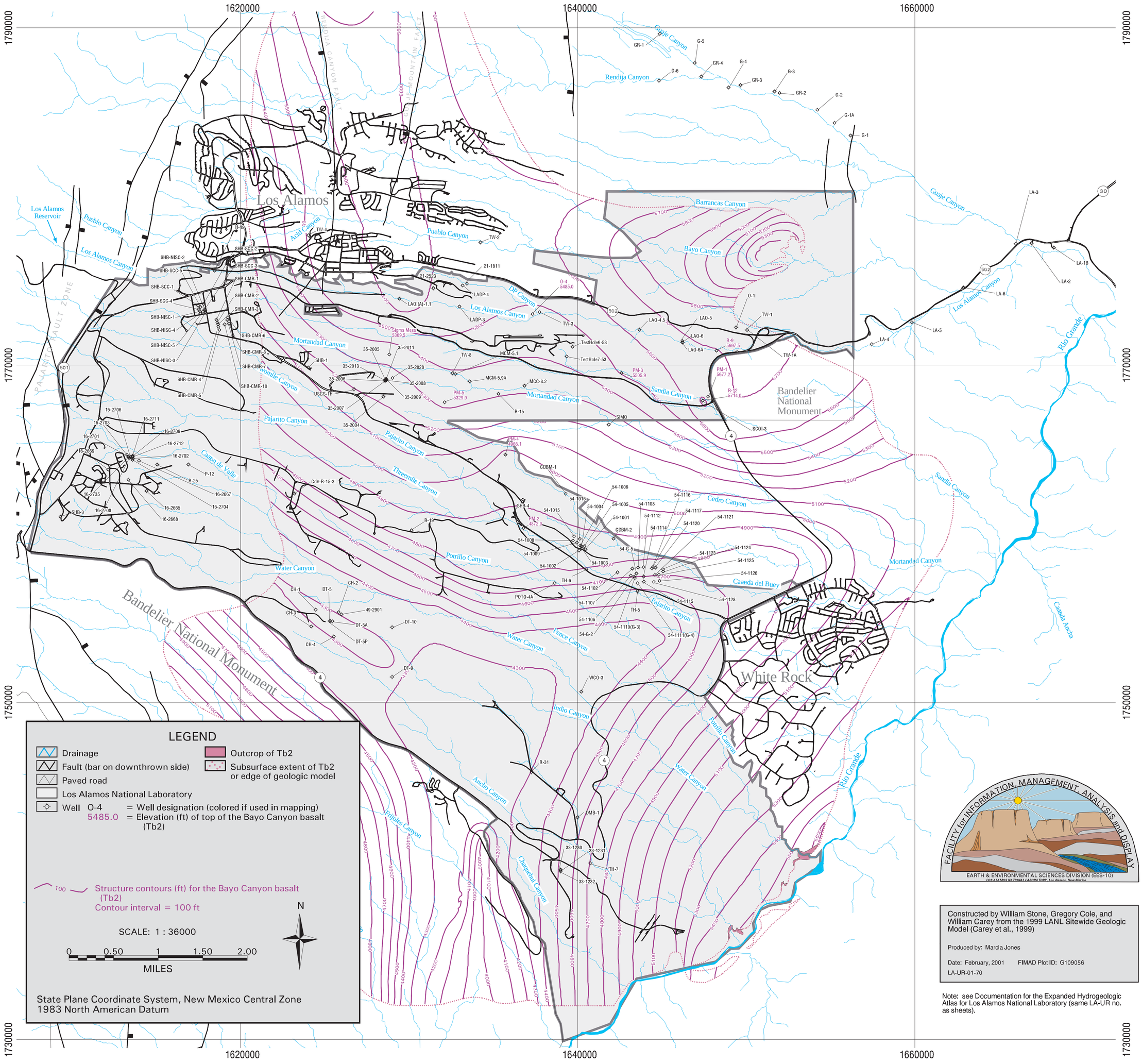
Sheet 35. Depth to top of the Santa Fe Group, undivided (Tsfu)

Hydrogeologic Atlas for Los Alamos National Laboratory



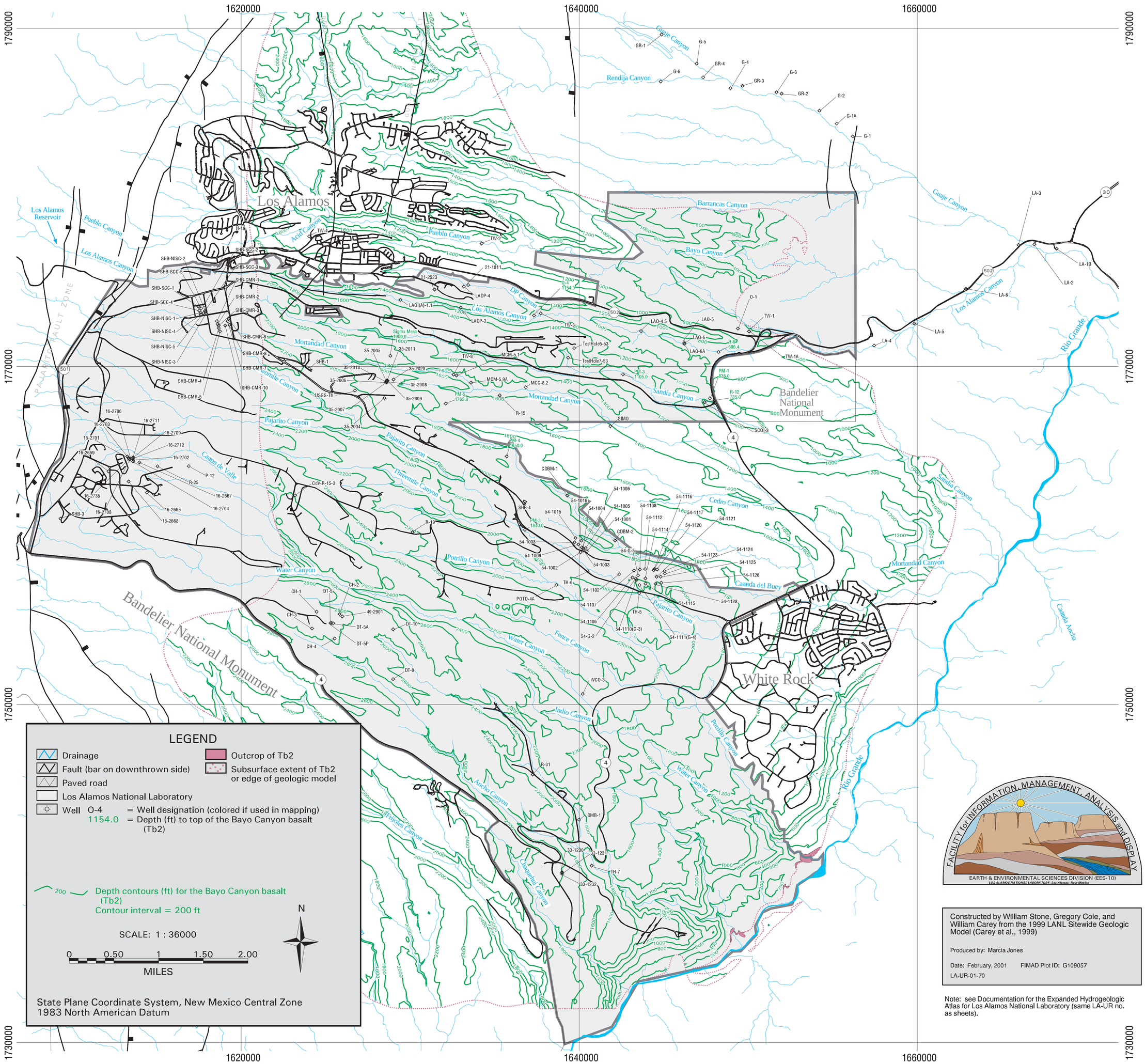
Sheet 36. Partial Thickness of the Santa Fe Group, undivided (Tsfu)

Hydrogeologic Atlas for Los Alamos National Laboratory



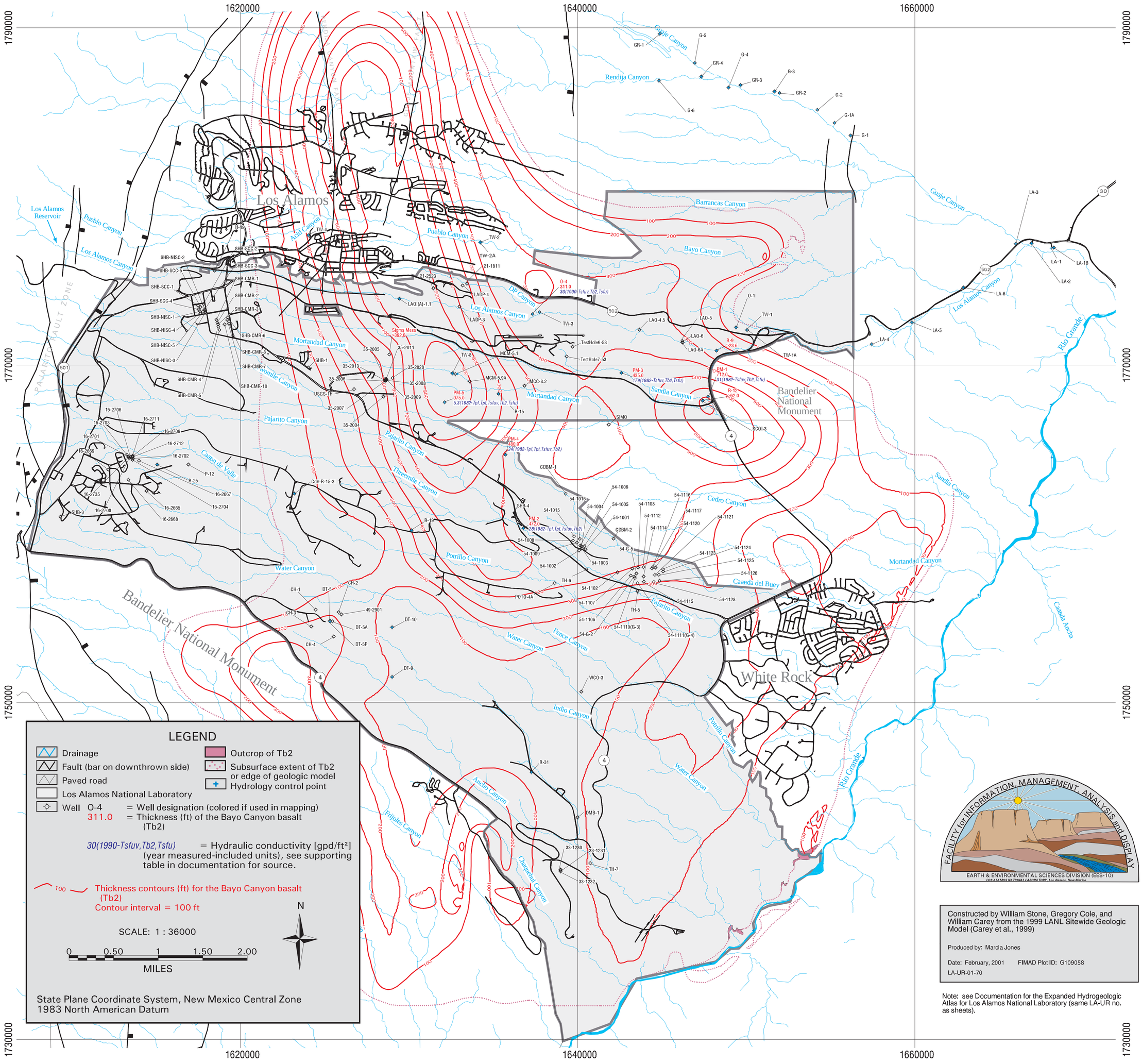
Sheet 37. Structure on top of the Bayo Canyon basalt (Tb2)

Hydrogeologic Atlas for Los Alamos National Laboratory



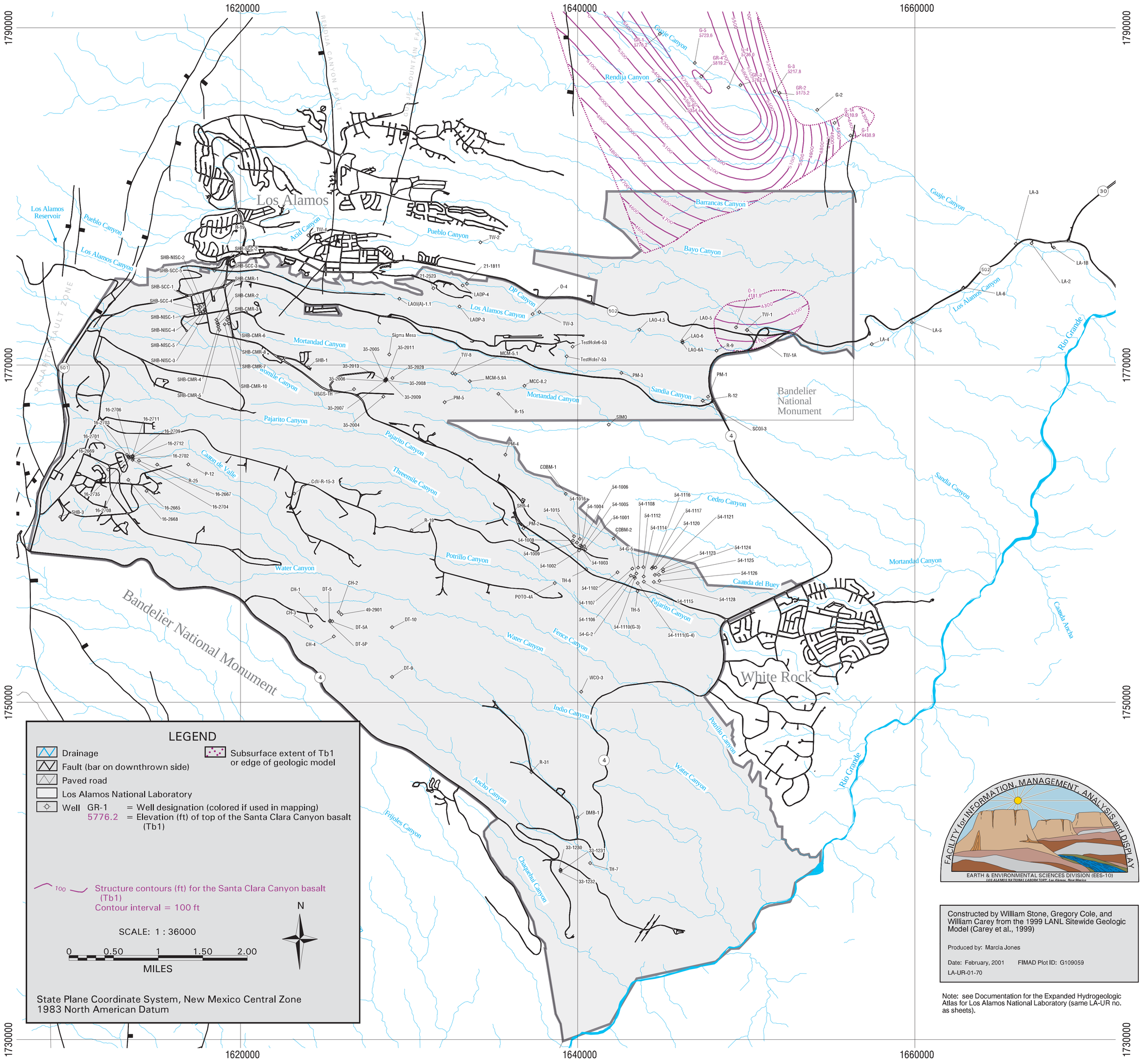
Sheet 38. Depth to top of the Bayo Canyon basalt (Tb2)

Hydrogeologic Atlas for Los Alamos National Laboratory



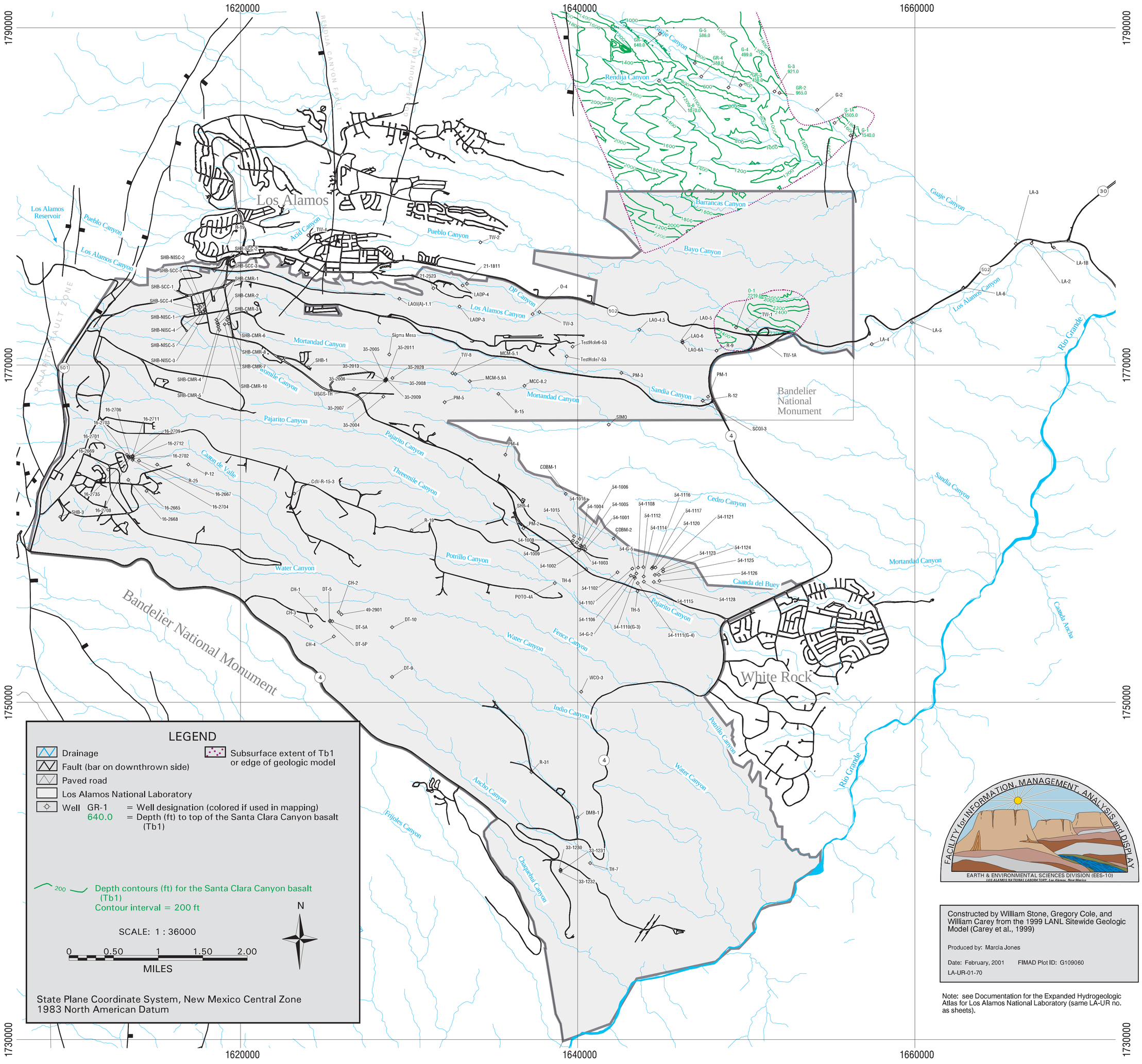
Sheet 39. Thickness of the Bayo Canyon basalt (Tb2)

Hydrogeologic Atlas for Los Alamos National Laboratory



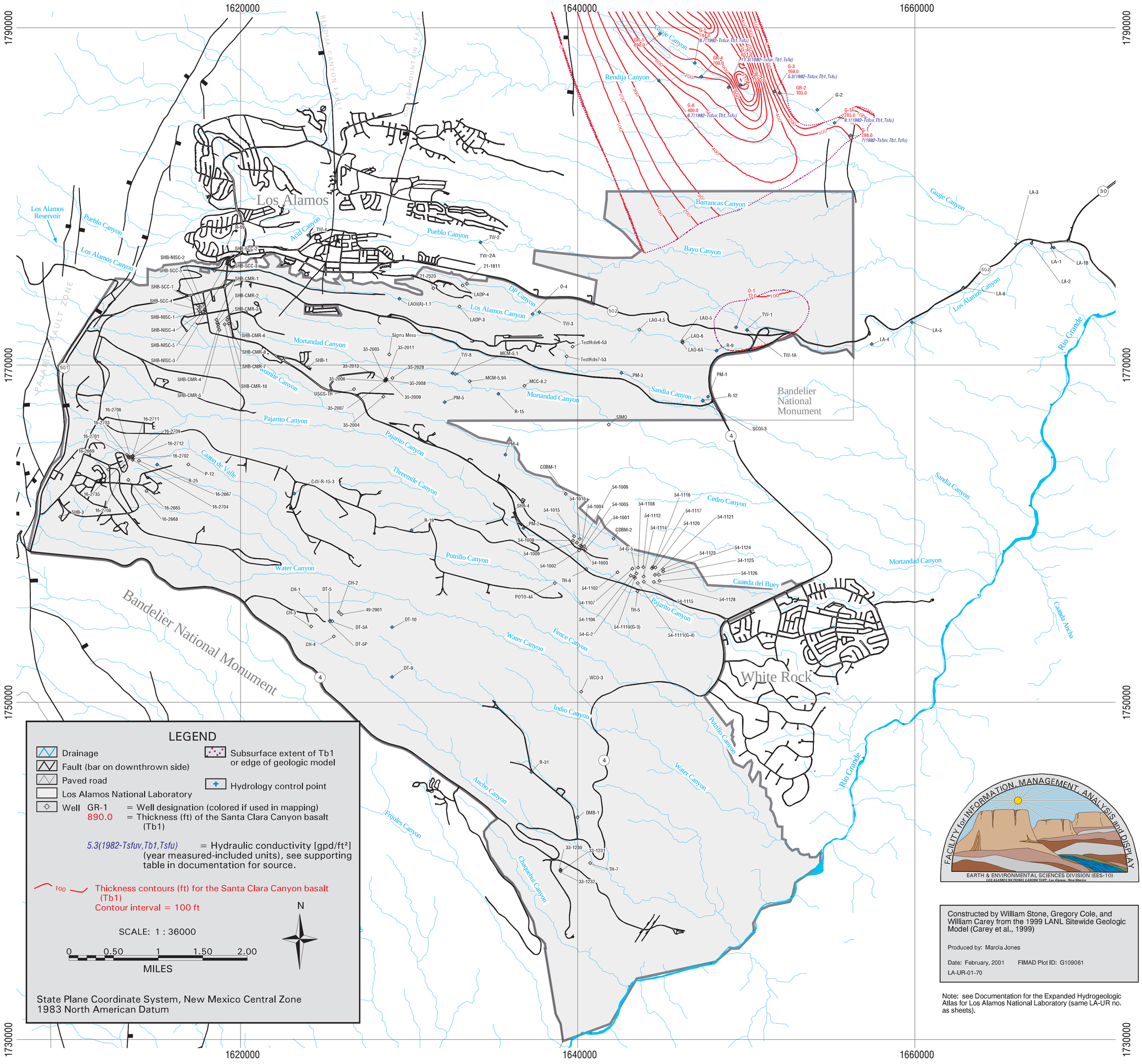
Sheet 40. Structure on top of the Santa Clara Canyon basalt (Tb1)

Hydrogeologic Atlas for Los Alamos National Laboratory



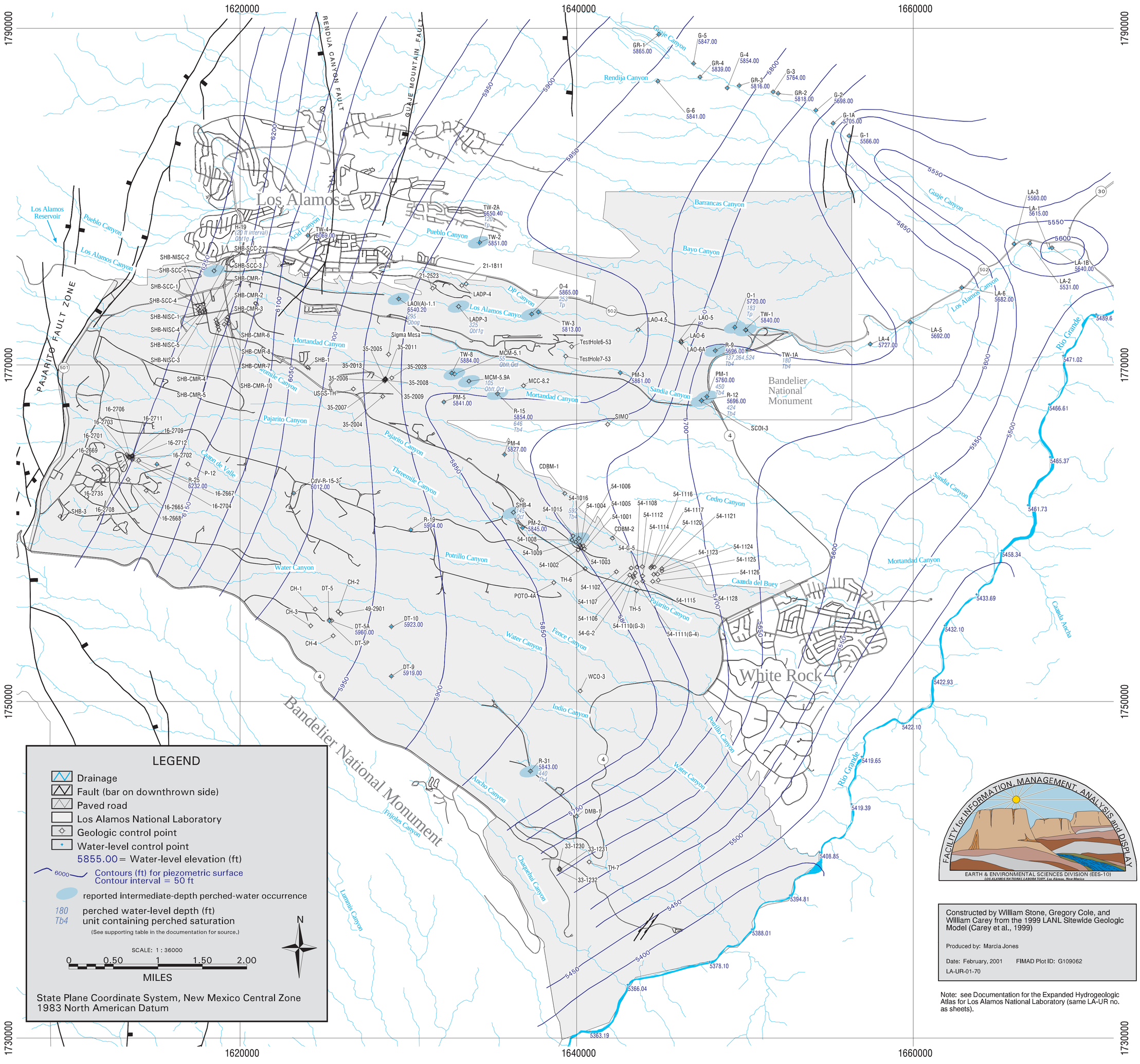
Sheet 41. Depth to top of the Santa Clara Canyon basalt (Tb1)

Hydrogeologic Atlas for Los Alamos National Laboratory



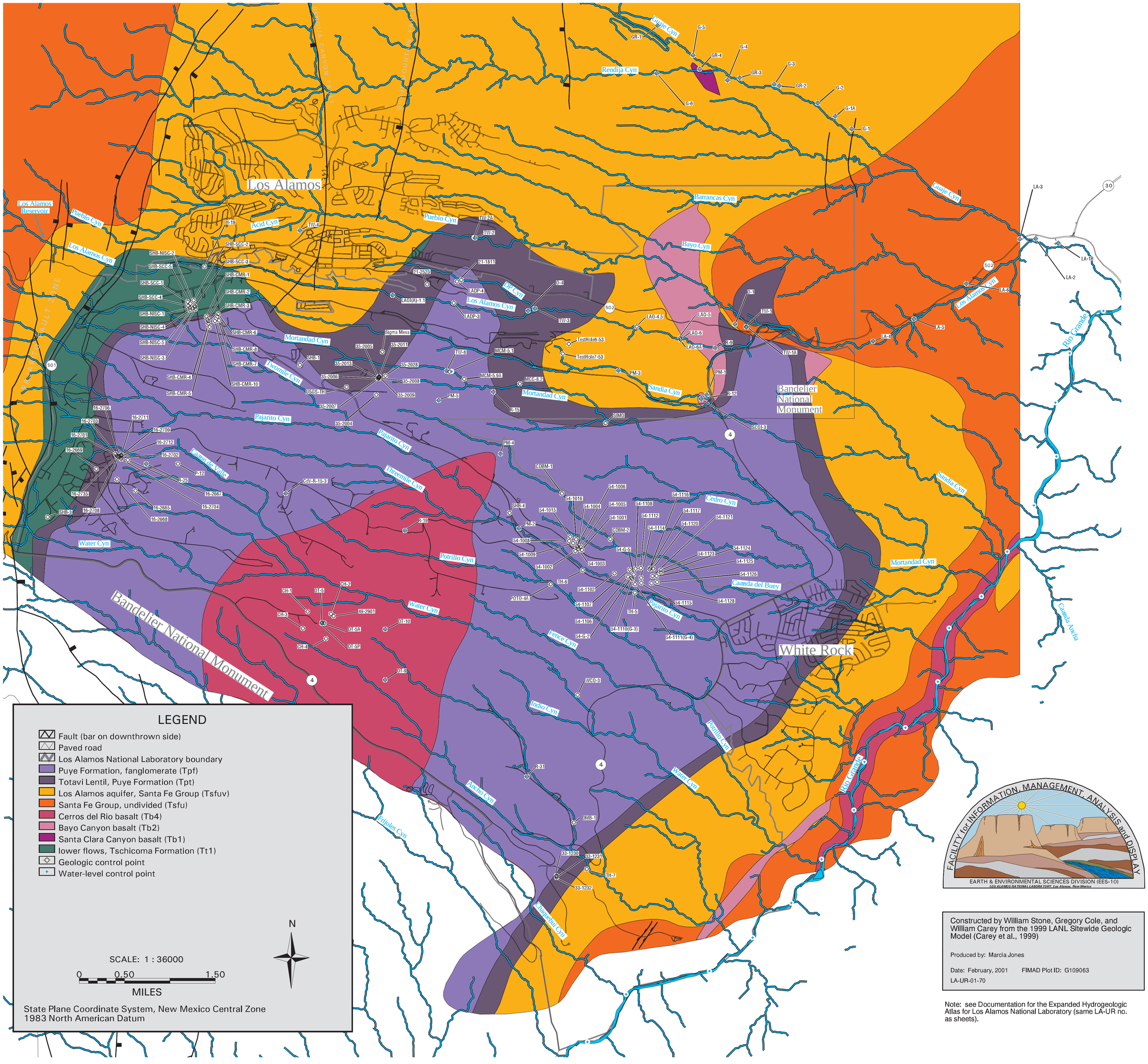
Sheet 42. Thickness of the Santa Clara Canyon basalt (Tb1)

Hydrogeologic Atlas for Los Alamos National Laboratory



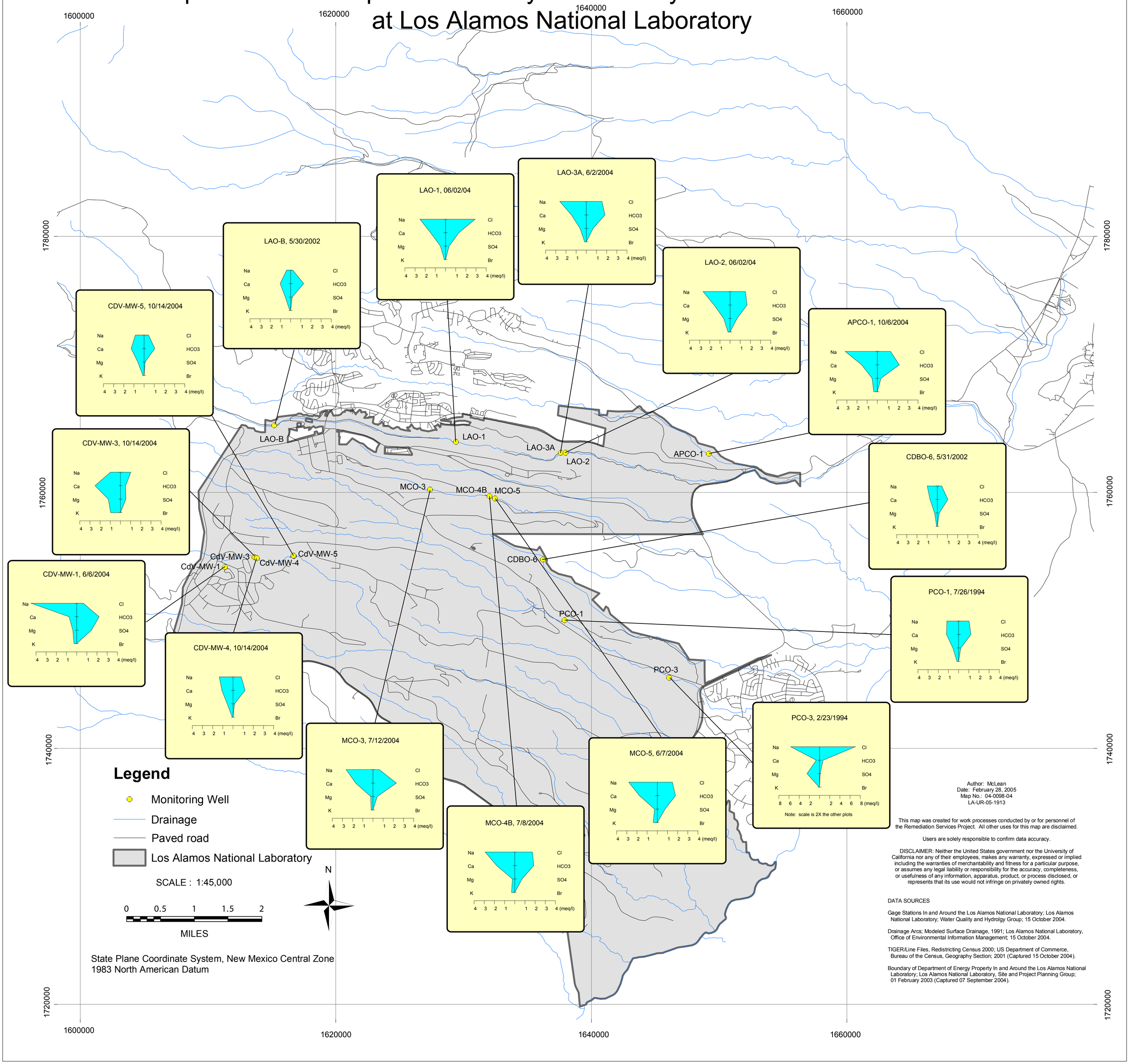
Sheet 43. Regional Piezometric Surface for the Los Alamos Area

Hydrogeologic Atlas for Los Alamos National Laboratory

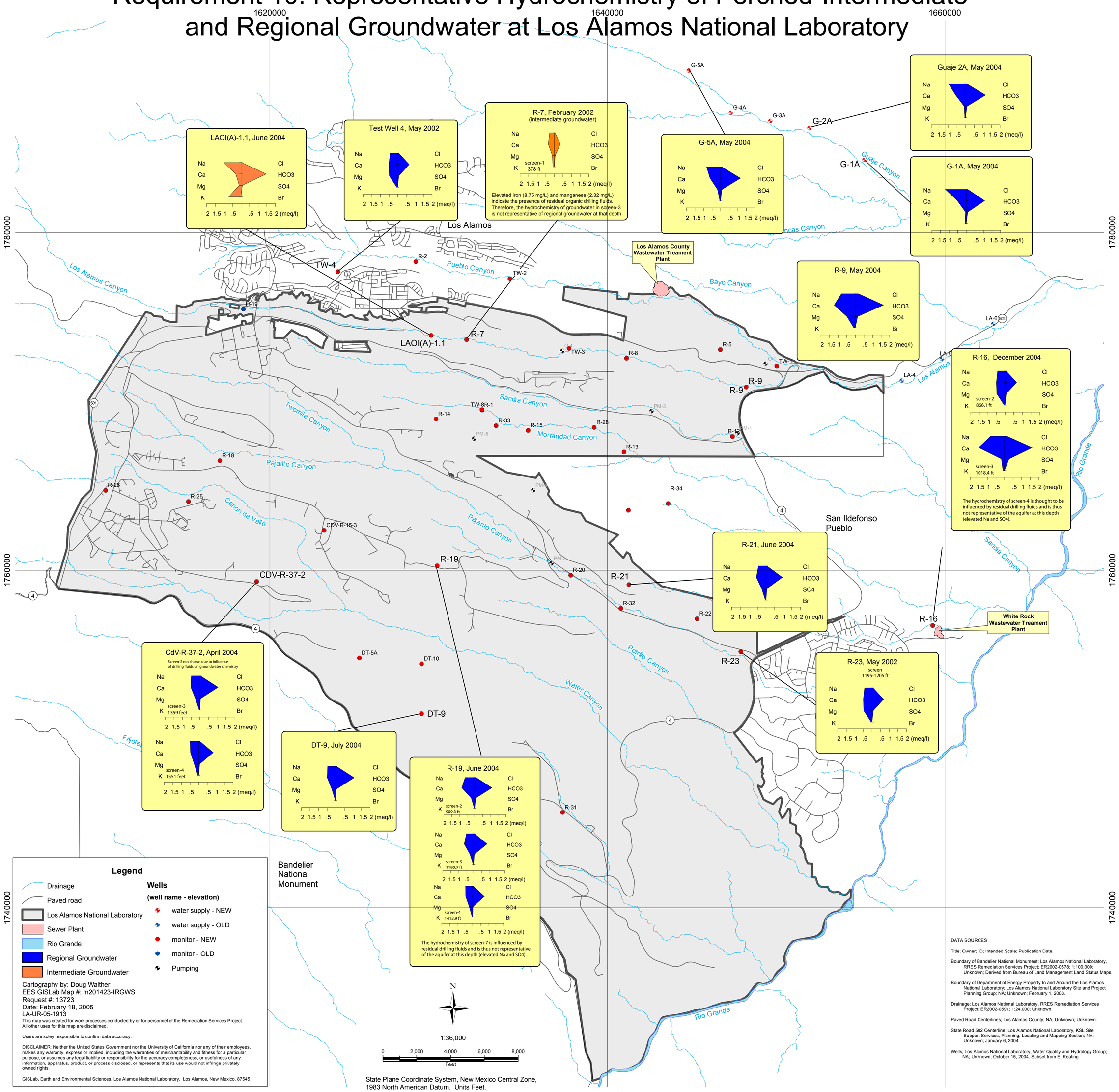
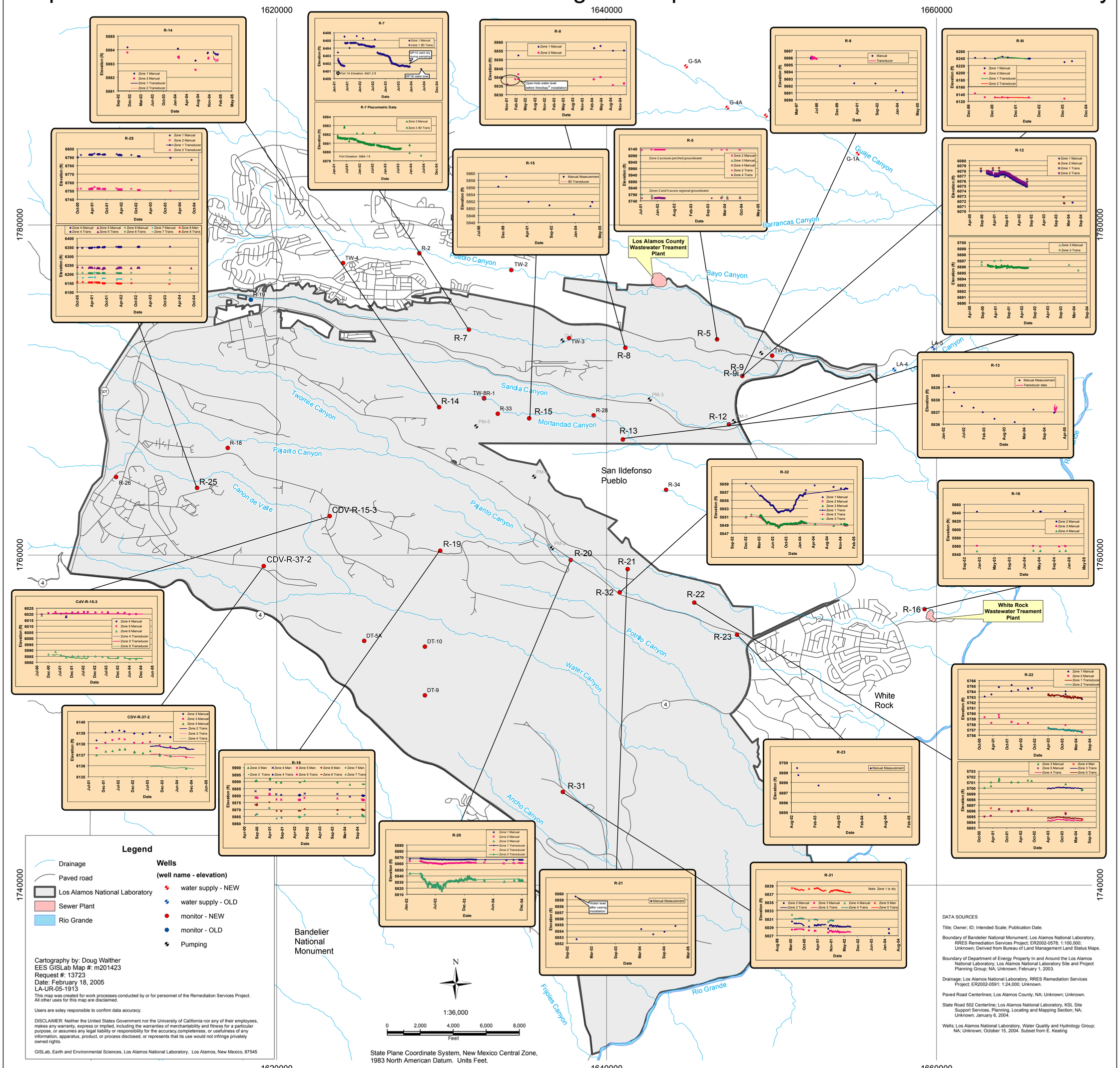


Sheet 44. Geology at the Regional Piezometric Surface for the Los Alamos Area

Requirement 10: Representative Hydrochemistry of Alluvial Groundwater at Los Alamos National Laboratory



Requirement 10: Representative Hydrochemistry of Perched-Intermediate and Regional Groundwater at Los Alamos National Laboratory



Requirement 11: Groundwater Level Data in the Regional Aquifer at Los Alamos National Laboratory