Revision to the Comment by Robert H. Gilkeson to the September 30, 2009 Meeting of the Northern New Mexico Citizens' Advisory Board (CAB)

- This report is a revision dated October 13, 2009 to the report that Mr. Gilkeson presented to the September 30, 2009 meeting of the CAB. The revision includes
1. Additional information on the new discovery of groundwater contamination in the regional aquifer from the large legacy waste dumps that are at many locations at the Los Alamos National Laboratory (LANL), The nature and extent of this contamination is not known at this time because reliable networks of monitoring wells have not been installed.
2. New information that Los Alamos National Laboratory (LANL) monitoring well R-46 does not produce reliable and representative groundwater samples (see page 7 of this report). Replacement of well R-46 may be necessary, and
3. New information about the bis(2-ethylhexyl)phthalate (DEHP) and other contaminants detected in LANL monitoring well R-36 (see page 8 of this report).

- **Foreword.** CAB member Mr. Peter Baston is concerned about the data quality in the original report to the CAB on September 30, 2009. All of the water quality data in the original report and in this revision are validated dated from the LANL RACER^{R} data base. The water quality data are proof that the large LANL legacy waste dumps are releasing contaminants to the regional aquifer. There is an immediate need to install reliable networks of monitoring wells to understand this groundwater contamination.

Mr. Baston is a relatively new member of the CAB and he may not be aware of the findings in many reports about the failure of LANL groundwater protection practices. There are many reports by Gilkeson starting with the June 9, 2004 report to the EMSR Committee of the CAB, four reports by the EPA Kerr Research Laboratory from 2005 to 2009, the 2005 report by the Inspector General (IG) of DOE, and the 2007 National Academy of Sciences report - *Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory: Final Report.* The reports were written because of the findings in the Gilkeson report that was presented to the June 9, 2004 meeting of the EMSR Committee of the CAB.

The set of reports by the IG of DOE, the EPA Kerr Lab and the NAS support the findings in the 2004 and 2005 reports by Gilkeson (see References). The NAS 2007 final report agreed with the Gilkeson reports about the overall failure of LANL to install usable monitoring wells. The pertinent excerpts from the NAS final report are pasted below:

- "Many if not all of the wells drilled into the regional aquifer under the [LANL] Hydrogeologic Workplan appear to be compromised in their ability to produce water samples that are representative of ambient groundwater for the purpose of monitoring." (page 49)
- "During this study the committee was presented a good deal of information suggesting that most or all wells into the regional aquifer at LANL (R-wells) are flawed for the purpose of monitoring. The committee did not disagree, but rather found a lack of basic scientific knowledge that could help ensure future success." (page 60)

The majority of the LANL monitoring wells studied in the 2007 NAS Final Report are ***still*** used for monitoring although the NAS report described the wells as "flawed for the purpose of monitoring." Indeed, one of the presentations by Mr. Gilkeson to the DOE Expert Panel will be the reasons LANL needs to replace many of the existing monitoring wells. In addition, the failure of LANL to install reliable monitoring wells in the regional aquifer continues to the present time with the new monitoring well R-46 one of several examples that Mr. Gilkeson wil present to the new Independent DOE Expert Panel.

Revised Comment by Registered Geologist Robert H. Gilkeson to the September 30, 2009 Meeting of the Northern New Mexico Citizens' Advisory Board (CAB) - Revision date October 13, 2009

- Action to be taken by the CAB.

1) **Request the Environmental Protection Agency (EPA) Region VI to independently sample the Los Alamos National Laboratory (LANL) monitoring wells R-46, R-38 and R-36 for RCRA Appendix IX constituents.**
2) **Recommend the Department Of Energy (DOE) to use Recovery Act Funds to install networks of monitoring wells at locations appropriately close to the LANL RCRA regulated units at TA-54 (MDAs G, H, and L) and at TA-16 (the 260 outfall), and at nine of the LANL legacy waste dumps. The National Academy of Sciences Final Report on the LANL Groundwater Protection Practices described the need for the monitoring wells at the nine LANL waste dumps (See page 5 and Table 4 in this report).**
3) **Request LANL to explain why analytical methods do not provide the resolution required in the New Mexico Environment Department (NMED) Consent Order for groundwater contaminants such as pentachlorophenol and beryllium (See pages 6 - 7 in this report).**
4) **Request DOE Headquarters to restore the Independent Expert Panel for the LANL groundwater issues (The CAB recommended this action at the September 30, 2009 meeting).**

Issue 1. The Headquarters Office of the Department of Energy (DOE) will convene a series of meetings in New Mexico to address issues raised by Robert H. Gilkeson on the groundwater protection practices at the Los Alamos National Laboratory. The meetings will include some persons from the original expert panel. The meetings will be open to the public. The first meeting may be in the last week of October. The number of meetings and the persons on the DOE Expert Panel has not been determined. The persons to contact at DOE are John Lehr, John Wengle, and Mark Gilbertson.

Issue 2. Comment by Robert H. Gilkeson on the bis(2-ethylhexyl)phthalate (DEHP) and other LANL contaminants detected in the new LANL monitoring wells R-38, R-46 and R-36. The Sept. 25, 2009 Los Alamos Monitor newspaper article that is included with this report only discusses the DEHP detected in well R-46. The newspaper article did not describe all of the LANL contaminants that are detected in wells R-46 and also in wells R-38 and R-36. An incomplete list of the contaminants is in Tables 1, 2 and 3 at the end of this report.

The contaminants measured in wells R-46 and R-38 are evidence that the large LANL legacy waste dumps are contaminating the regional aquifer. However, well R-38 is located ¼-mile from MDA L and well R-46 is located 1000 feet from MDA C. These distances are too great for accurate knowledge of the groundwater contamination below and close to the two LANL waste dumps and there is an immediate need to install networks of monitoring wells very close to MDA L and MDA C.

There is also an immediate need to install networks of monitoring wells close to all of the large LANL legacy waste dumps including MDAs A, B, T, U, and V at TA-21, MDA AB at TA-49, and MDAs G and H at TA-54. There is also an immediate need to install a network of monitoring wells at appropriate locations close to the seepage pond that received liquid waste from the TA-16 260 outfall during the period from 1951 to 1996.

The Los Alamos Monitor newspaper article starts below in italics:

Contaminant shows up in regional aquifer** **By ROGER SNODGRASS

Los Alamos Monitor September 25, 2009 *www.lamonitor.com*

- *Tucked inside a routine monthly report is the first public disclosure of a potentially troubling new area of contamination in the regional aquifer below Los Alamos National Laboratory. A cover letter from Los Alamos National Laboratory to the New Mexico Environment Department was dated Aug. 29 and was published by link on a laboratory Web site last week. It calls attention to two elevated readings for the chemical bis(2-ethylhexyl)phthalate. The samples were found in the water table, some 1,300 feet below the surface, in one of the lab's new regional monitoring wells R-46.*

Associated in numerous instances by the Agency for Toxic Substances and Disease Registry webpage with ammunition plants and explosives, the chemical is also known as DEHP. "DEHP is everywhere in the environment," according to ATSDR's ToxFAQ, "because of its use in plastics, but it does not evaporate easily or dissolve in water easily." ATSDR associates DEHP with a variety of plastic products, including wall coverings, tablecloths, floor tiles, furniture upholstery, shower curtains, garden hoses and swimming pool liners. In the introductory paragraph, the fact sheet states, "In animals, high levels of DEHP damaged the liver and kidney and affected the ability to reproduce."

The letter from the laboratory and federal environmental programs managers to James Bearzi, the state's hazardous waste bureau chief, followed a meeting on Aug. 12 at which July's groundwater data was reviewed. After the meeting, the letter reported the laboratory telephoned the bureau about the findings and followed up with an e-mail on the same day. Two "unfiltered samples" of the chemical were reported, one 11 times greater than the maximum contaminant level (MCL) standard, which is six parts per billion and the other 16 times greater.

Danny Katzman, LANL's water stewardship program manager, said this week that the prompt reports are now a requirement under the Consent Order that regulates the laboratory's environmental cleanup project. "These are tools to put things on the radar screen," he said. "They are super conservative so that nothing slips through the cracks." The monthly reports on samples showing contaminant concentrations above New Mexico or federal water quality standards were a result of a detection of the pollutant hexavalent chromium in 2004 that went unreported for two years and ultimately led to fines, major changes in laboratory groundwater models, drilling and sampling methods and a large increase in the number of monitoring wells installed or planned.

Katzman said bis-2 [i.e., DEHP] had been reported previously to NMED from other locations and [DEHP] was thought to be associated with new wells or the conversion of sampling systems. "It pops up early on or goes away after a few rounds, completely or below trace levels," he said, "It's not unique to LANL," he said. "It's a condition that's fairly common nationwide" [emphasis added].

- Comment by Gilkeson. The detection of high concentrations of DEHP in properly constructed monitoring wells is **not** "a condition that's fairly common nationwide." In fact, a review of the LANL RACER[R] water quality data shows that the high concentrations of DEHP are only repeatedly detected in three of the new regional aquifer monitoring wells; wells R-36, R-38 and R-44. The analytical data are presented in Tables 1, 2 and 3 at the end of this report. The Los Alamos Monitor article did not present important information about the total spectrum of groundwater contamination in the new monitoring well R-46 and also in the new monitoring wells R-38 and R-36. The following information is missing from the newspaper article:

- 1) DEHP has not declined to levels below the EPA drinking water standard in the water samples collected from well R-46 or from wells R-38 and R-36 (see Tables 1, 2 and 3).

- 2) In addition, DEHP was not the only LANL contaminant detected in the water samples collected from wells R-46, R-38 and R-36. At a minimum, the other contaminants include benzene, toluene, acetone, antimony, nickel, tritium, chloride; nitrate and sulfate (see Tables 1 - 3).

- 3) DEHP at low levels around one part per billion is a common contaminant that may be introduced by procedures at the analytical laboratories.

- 4) However, the high DEHP levels measured in the three LANL monitoring wells are far above the low levels that commonly occur from analytical laboratory contamination.

- 5) The new LANL monitoring wells and the new sampling systems should not contaminate groundwater with DEHP. Katzman's statement that the new wells and sampling systems are the cause of contaminating groundwater with DEHP is a serious problem. The LANL monitoring wells each have a cost greater than $1 million and the expensive wells should not be a source of DEHP contamination.

- 6) The water quality data from the new monitoring well R-46 indicates that a new mineralogy is forming in the sampling zone of the well with properties to hide knowledge in the future of the presence of DEHP and other LANL contaminants in the groundwater. The anomalous chemistry measured in the water samples collected from well R-46 is described on page 7 of this revised report.

- 7) The wastes disposed of in the unlined pits, trenches, shafts and impoundments in the LANL legacy waste dumps MDA C and MDA L are a source for the DEHP and the other contaminants measured in the water samples collected from monitoring wells R-38 and R-46.

- 8) It is important for the LANL monitoring wells to provide accurate detection of DEHP. The LANL scientists and contractors should be careful not to use drilling practices, well installation methods and well sampling systems and sampling methods that cause DEHP contamination in the water samples collected from the LANL monitoring wells.

- 9) A careful study by an independent team of experts of all available information is necessary to eliminate the confusion about the source of the DEHP because of mistakes in drilling methods, mistakes in well installation and sampling methods, mistakes at the analytical laboratory, or groundwater contamination from the mixtures of wastes that are buried in the LANL legacy waste dumps and from other LANL waste disposal practices.

- 10) In addition to the careful study by independent experts, EPA Region 6 should independently collect time series water samples from LANL monitoring wells R-36, R-38 and R-46 for RCRA Appendix IX constituents and analyze the water samples in the EPA analytical laboratory. This sampling activity by EPA will reduce some of the confusion.

- 11) Wells R-38 and R-46 are located too far from the legacy waste dumps they are intended to monitor. Well R-38 is located ¼ mile from MDA L and well R-46 is located 1000 feet from MDA C. The contamination detected in wells R-46 and R-38 (see Tables 1 and 2) show the need for the immediate installation of networks of monitoring wells at very close locations to MDA C, the three RCRA regulated units at TA-54 (MDA L, MDA G and MDA H), MDA AB at TA-49 and the five LANL legacy waste dumps at TA-21 (MDAs A, B, T, U, and V).

- 12) The overall poor record of performance for the LANL groundwater protection practices is an important reason for DOE Headquarters to establish an independent team of experts to oversee operations at LANL for the next five to ten years.

- Continued from the LA Monitor Article:
Bearzi said the bis-2 reading was disturbing. "It's not quite the chromium level of concern, because they told us about this one," he said. Despite the near-universal presence of the DEHP contaminant, he noted, the environment department doesn't think it is a minor matter because of what lies above the detection point, a Cold War dump, known as Material Disposal Area C. <u>MDA C was in operation between 1948 and 1974. "A witch's brew of contamination was disposed there when it was in use," Bearzi said</u> [emphasis added]. "Plasticizers that were used with explosives were not uncommon, nor would they be unexpected." <u>MDA C would also have organic chemicals that would provide a mechanism for moving the phthalate down into the aquifer and elsewhere into the environment</u> [emphasis added]. "We're looking very strongly at MDA C as a potential source if not a major source," he said. "In a week the lab will submit a report on the latest phase of their investigation on MDA C." He added, "They're going to need to do more than just watch it."

- Comment by Gilkeson. Chief Bearzi of the NMED Hazardous Waste Bureau describes the DEHP detections as "disturbing" and he recognizes that the mixture of wastes buried in MDA C created a "witches brew" with properties to mobilize and cause groundwater contamination in the regional aquifer with DEHP, trace metals and the strongly sorbing radionuclides such as plutonium and americium. Similar mixtures of wastes with well-known properties to contaminate groundwater were buried in MDA L and the other 9 LANL waste dumps that are listed above in comment -11) on page 4. The radioactive wastes buried in the 9 LANL waste dumps are described in Table 4.

The statements by Bearzi in the newspaper article also show the immediate need for the installation of networks of monitoring wells very close to all 10 of the LANL legacy waste dumps. In fact, the networks of monitoring wells should have been installed more than twenty years ago because the knowledge that the mixtures of wastes in the LANL legacy waste dumps increased the potential for the wastes to contaminate the groundwater below the dumps has been well known for more than two decades.

Indeed, the LANL scientists described the need for the networks of monitoring wells at the legacy waste dumps as documented in the 2007 National Academy of Sciences Report - *Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory: Final Report.* The pertinent excerpts from the NAS Final Report are pasted below:

- "LANL considers that 9 of its 25 MDAs have a significant potential to contaminate groundwater with radionuclides. Of the nine MDAs considered significant, the inventory for two is "unknown" (see Table 3.2) [Table 3.2 is included as Table 4 in this report). For MDA G, the tritium inventory according to Table 3.2 is about 3.6 million Ci, which is far larger than the tritium discharged from any of the liquid outfalls. A large amount of Pu-239, about 2300 Ci or 39 kg, is reported to be in MDA AB" (p. 21 in the NAS report).
- "The presence of large amounts of radioactive materials in unlined pits in the MDAs is an issue. Although the mesa tops are generally considered to be dry, this is not true yearround. Standing water has been observed in unlined pits in several locations, including MDA AB (CCNS, 2007; Levitt et al., 2005). This contact of precipitation and runoff with stored waste materials implies that a fraction of the contaminants are subject to leaching and subsequent migration. The extent of this leaching is not known (CCNS, 2007)" (p. 21 in the NAS report).

- **Continued from the LA Monitor Article:**
Robert Gilkeson, the registered geologist and citizen groundwater watchdog at LANL and Sandia National Laboratories connected a few more dots in the underground puzzle. "The R-46 well from which the elevated sample was drawn is located about 1000 ft. east of MDA C as a "nearfield" monitoring well for releases from MDA C," he wrote in an email Wednesday. "Higher levels of groundwater contamination would be expected at locations close to MDA C."

Gilkeson was in the midst of preparations for a round of briefings he was asked to provide the Department of Energy Office of Environmental Management this week. "This is evidence of serious groundwater contamination in the regional aquifer from the old legacy dump, known as MDA C located at (Technical Area 50) and close to the TA-50 liquid waste treatment plant," Gilkeson concluded, calling for expanding the network of monitoring wells at locations close to all the legacy waste areas at LANL.

- **Comment by Gilkeson.** In the early 1990s, Gilkeson was on the team that wrote the RCRA Facility Investigation Workplan for TA-21. Gilkeson was the manager of the team that wrote the RCRA Facility Investigation Workplan for TA-54. Gilkeson was the project manager for the RCRA Phase 1 drilling and sampling investigations at MDA C at TA-50, MDAs G, H, J, and L at TA-54, and MDA AB at TA-49. Gilkeson was also the Lead Contractor for the installation of the network of characterization wells installed by the <u>badly flawed</u> LANL Hydrogeologic Workplan. From his early years in the late 1980s as a technical expert investigating LANL contamination to the present time, Gilkeson has been an advocate for installing the reliable networks of monitoring wells that are required by law to gain the knowledge that is necessary to protect the precious groundwater resource from contamination by LANL operations. Gilkeson has also been an advocate for the protection of groundwater resources below Sandia National Laboratories Albuquerque Facility. Gilkeson has written many reports that describe the <u>overall failure</u> of the Department of Energy (DOE) and the New Mexico Environment Department (NMED) to protect the precious groundwater resources below both nuclear weapons facilities.

- **Comment by Gilkeson on the inappropriate detection limits for the contaminants pentachlorophenol and beryllium.** The water quality data in the LANL RACER$^{\mathbf{R}}$ data base for wells R-38 and R-46 (see Tables 1 & 2) list pentachlorophenol and beryllium as "not detected" in the collected groundwater samples. However, the RACER$^{\mathbf{R}}$ data show the resolution of the analytical method used by LANL will not detect pentachlorophenol at levels below 10 ug/L (10 parts per billion) but the EPA drinking water standard for pentachlorophenol is 1 ug/L (1 part per billion, 1 ppb). <u>The Racer$^{\mathbf{R}}$ data base shows that LANL is using inappropriate analytical methods that are not protective of public health</u>.

Similarly, The Racer$^{\mathbf{R}}$ data base shows the resolution of the analytical method for beryllium to be 5 ug/L (i.e., 5 micrograms per liter or 5 parts per billion) and this resolution is above the EPA drinking water standard of 4 ug/L (4 parts per billion).

The poor detection provided by the LANL analytical method for pentachlorophenol is a concern because pentachlorophenol was detected at levels above the drinking water standard in water samples collected from wells R-22 (the badly flawed detection well located east of MDA G) and R-16 (the badly flawed sentry well for the Santa Fe Buckman well field). The two defective monitoring wells should have been replaced more than five years ago.

It is important for the CAB and the public to understand that the NMED Consent Order requires LANL and DOE to use analytical methods that provide accurate detection of contaminants at levels far below the EPA drinking water standards (i.e., the regulatory cleanup levels). The pertinent excerpt from the Consent Order is pasted below:

> - The Respondents shall submit a list of analytes and analytical methods to the Department, for review and written approval as part of each site-specific investigation, corrective action, or monitoring work plan. The detection limits for each method shall be less than applicable background, screening, and regulatory cleanup levels. <u>The preferred method detection limits are a maximum of 20 percent of the cleanup, screening, or background levels. Analyses conducted with detection limits that are greater than applicable background, screening, and regulatory cleanup levels shall be considered data quality exceptions and the reasons for the elevated detection limits shall be reported to the Department. These data cannot be used for statistical analyses</u> [emphasis added] (p. 187 in the Consent Order).

The Consent Order requires LANL to use an analytical method that will provide accurate detection of pentachlorophenol in water samples at 0.2 ug/L (e.g., 20% of the 1 ug/L EPA drinking water standard. However, Tables 1 - 3 show that the analytical method used for pentachlorophenol will not detect pentachlorophenol at concentrations below 10 ug/L, a level of detection that is 10 times greater than the EPA drinking water standard.

In addition, the Consent Order requires LANL to use an analytical method that will provide accurate detection of beryllium in water samples at 0.8 ug/L (e.g., 20% of the 4 ug/L EPA drinking water standard. However, Tables 1 - 3 show that the analytical method used for beryllium will not detect beryllium at concentrations below 5 ug/L, a level of detection that is greater than the EPA drinking water standard of 4 ug/L.

Pentachlorophenol and beryllium may not be the only LANL contaminants where the necessary analytical methods are not used. A comprehensive review of the LANL analytical methods is necessary. The fact that the appropriate analytical methods are not being used is based on the analytical results presented in the RACER$^{\mathbf{R}}$ data base. A review of the accuracy of the RACER$^{\mathbf{R}}$ data base should also be performed.

<u>The apparent use of inappropriate analytical methods that may hide knowledge of contamination is a serious issue that the CAB should investigate</u>.

- Comment by Gilkeson on the anomalous chemistry in the water samples collected from monitoring well R-46. The concentrations of nitrate and sulfate are at constant levels in the regional aquifer and should show very little change between sampling events. For example, Table 3 shows that the sulfate and nitrate concentrations show very little change for successive sampling events at monitoring well R-36.

However, Table 1 shows that the water samples collected from monitoring well R-46 show a large decline for nitrate and a gradual decline for sulfate. The marked decline to low nitrate concentrations and the gradual decline in sulfate concentrations are evidence that a new reactive chemistry is being formed in the sampling zone surrounding the well screen. The most likely cause of the new mineralogy is that a mistake in drilling or installing the well has contaminated the sampling zone surrounding the well screen with organic agents that are a fuel for microbial reactions. The microbial reactions are causing a decline in the amount of nitrate and sulfate that is in the groundwater in the sampling zone surrounding the well.

The low oxidation-reduction potential (ORP in Table 1) measured in most of the water samples collected from well R-46 is also evidence of the microbial reactions that are forming a new reactive chemistry. In addition, the overall decline over time in the measured concentrations of DEHP, acetone, toluene, dissolved zinc, nitrate and sulfate are all evidence of the progressive formation of a new reactive mineralogy in well R-46. The new mineralogy has well known properties to prevent detection of many LANL contaminants. The properties were described in the reports by Gilkeson (June 9, 2004 and May 20, 2005 reports to the CAB), the 4 reports to the CAB by the EPA Kerr Lab (2005 to 2009) and the National Academy of Sciences 2007 Final Report.

A careful study is necessary of all available information for monitoring well R-46 to identify the mistakes in drilling, well installation and well sampling that are the cause of the development of a new reactive mineralogy in the zone surrounding the well.

It is important for EPA Region VI to perform independent sampling of well R-46. The well should be continuously pumped for a period of possibly 24 hours with continuous monitoring of water quality parameters and the collection of a time-series set of water samples that are analyzed for Appendix IX constituents in the EPA analytical laboratory.

- Comment by Gilkeson on the DEHP and other contamination in the water samples collected from monitoring well R-36. In the newspaper article, Katzman made the statement that the DEHP contamination was thought to be associated with new wells. .. "It pops up early on or goes away after a few rounds, completely or below trace levels," However, a review of the DEHP contamination measured in the new monitoring wells installed in the regional aquifer with the correct casing advance drilling methods shows that high levels of DEHP above the EPA drinking water standard were only measured in the three monitoring wells R-36, R-38 and R-46. Furthermore, the analytical data in Tables 1, 2, and 3 show that DEHP contamination measured in the three wells has remained above the EPA drinking water standard of 6 ug/L up to the most recent sampling events. The data in Tables 1, 2, and 3 indicates that the DEHP contamination measured in LANL monitoring wells R-36, R-38 and R-44 is because of contamination from LANL historical and possibly present operations.

Monitoring well R-36 is located in Sandia Canyon approximately 5000 feet east of monitoring well R-28. The hexavalent chromium plume is present at well R-28 at concentrations greater than 400 ug/L which is more than 4 times greater than the EPA drinking water standard of 100 ug/L. The chromium concentrations measured in well R-36 are not much greater than 10 ug/L and are far below the EPA drinking water standard.

Nevertheless, the LANL contaminants that are detected in the water samples collected from monitoring well R-36 include bis(2-ethylhexyl)phthalate (DEHP), acetone, toluene, nitrate, sulfate, chloride and tritium. DEHP is the only contaminant that exceeds the EPA drinking water standard. The marked decline that has occurred in the measured concentrations of DEHP, acetone and toluene in the water samples collected from well R-36 is a concern. Accordingly, EPA Region VI should also collect time series samples from LANL monitoring well R-36 for RCRA Appendix IX constituents.

Contact Robert H. Gilkeson with questions or comment.
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Table 1. Water Quality Data in RACER[R] for Regional Aquifer Monitoring Well R-46

-	03-11-09 FILT / UNF	05-13-09 FILT / UNF	06-17-09 FILT / UNF	08-10-09 FILT / UNF
- DEHP (ug/L)	NL / 11.1	NL / 96.4, 77.4	NL / 39.2, 20.8	NL / 39.1, 26
- benzene (ug/L)	NL / < 1U	NL / < 1U	NL / < 1U	NL / < 1U
- acetone (ug/L)	NL / < 10U	NL / 64.1, 60.3	NL / 19.5, 16.8	NL / 34.5, 20.1
- toluene (ug/L)	NL / < 1U	NL / 10.9, 10.6	NL / 6.37, 3.3	NL / 4.58, 3.05
- antimony (ug/L)	< 2U / < 2U	2.65 / 6.88 J	2.41 / 4.52	5.29 / 3.93
- nickel (ug/L)	0.79J / 1.5J	1.36J / 3.9	3.43 / 4.39	2.86 / 3.37
- zinc (ug/L)	3.6 J / 6.9 J	12.9 / 26.7	12.7 / 19.1	8.41 / 15.8
- nitrate (ug/L)	365 / NL	492, 428 / NL	60.2 / NL	120 / NL
- sulfate (ug/L)	1970 / NL	2100, 2070 / NL	1860 / NL	1850 / NL
- ORP (mV)	NL / 45.2	NL / 232	NL / 111	NL / 43.7
- chloride (ug/L)	1690 / NL	1840, 1810 / NL	1690 / NL	1650 / NL
- pentachloro-phenol (ug/L)	NL / < 11.1 U	NL /<11.4U,<10.6U	NL /<11.1U (2)	NL / <10.4U, <10U
- beryllium (ug/L)	< 5 U / < 5 U	< 5 U / < 5 U	< 5 U / < 5 U	< 5 U / < 5 U

All of the data in Table 1 is from the LANL RACER[R] water quality data base

- **FILT** analysis on filtered water sample
- **UNF** analysis on unfiltered water sample
- **DEHP** bis(2-ethylhexyl)phthalate
- **ug/L** micrograms per liter or parts per billion
- **NL** not listed in the RACER data base
- **J** estimated concentration because of uncertainty in the analytical results
- **U** the constituent was not detected in the sample at the concentration value listed in the RACER data base. For example, < 10 U means the constituent or contaminant was not detected at a resolution of 10 ug/L for the analytical method. The constituent or contaminant may have been present in the water sample but at a concentration of less than 10 ug/L.
- **ORP** Oxidation Reduction Potential – a measure of the presence or absence of oxygen in the groundwater and related chemical processes. Low ORP values indicate a loss of oxygen from the normally highly oxygenated groundwater.
- **mV** millivolts

- Preliminary list of contaminants detected in LANL monitoring well R-46

- DEHP (Bis(2-ethylhexyl)phthalate)	EPA DWS = 6 ug/L
- Acetone	There is no EPA DWS for acetone
- Toluene	EPA DWS = 5 ug/L
- Antimony	EPA DWS = 6 ug/L
- Nickel?	There is no EPA DWS for nickel

- **EPA** Environmental Protection Agency
- **DWS** Drinking Water Standard

Table 2. Water Quality Data in RACER[R] for Regional Aquifer Monitoring Well R-38

-	02-06-09	05-01-09 (11:40 AM)	05-01-09 (12:32 PM)
	FILT / UNF	FILT / UNF	FILT / UNF
- DEHP (ug/L)	NL / 7.33 J, 6.14 J	NL / 7.38 J, 7.09 J	NL / 35.6, 3.3 J
- benzene (ug/L)	NL / 23.8, 6.34	NL / 1.8, 1.53, 1.4	NL / 1.93, 1.81, 1.6
- acetone (ug/L)	NL / 7.48 J	NL / < 10 U	NL / < 10 U
- toluene (ug/L)	NL / 7.06, 1.46	NL / 1.7, 1.62, 1.5	NL / 2.02, 1.9, 1.8
- antimony (ug/L)	< 1.4U / < 2.4 U	0.82 J / 0.89 J	
- nickel (ug/L)	16.3 / 19.7	27.5 / 30.1	
- zinc (ug/L)	69 / 86.5	37.2 / 44.2	
- nitrate (ug/L)	610 / NL	630 / NL	
- sulfate (ug/L)	2970 / NL	2990 / NL	
- ORP (mV)	NL / 237	NL / 90	
- chloride (ug/L)	2800 / NL	2560 / NL	
- pentachloro-phenol (ug/L)	NL /<11.5U, <10.4U	NL/ <10.6U, <10.5U	NL / <22U, <11.1U
- beryllium (ug/L)	< 5 U / < 5 U	< 5 U / < 5 U	

All of the data in Table 2 is from the LANL RACER[R] water quality data base

- **FILT** analysis on filtered water sample
- **UNF** analysis on unfiltered water sample
- **DEHP** bis(2-ethylhexyl)phthalate
- **ug/L** micrograms per liter or parts per billion
- **NL** not listed in the RACER data base
- **J** estimated concentration because of uncertainty in the analytical results
- **U** the constituent was not detected in the sample at the concentration value listed in the RACER data base. For example, < 10 U means the constituent or contaminant was not detected at a resolution of 10 ug/L for the analytical method. The constituent or contaminant may have been present in the water sample but at a concentration of less than 10 ug/L.
- **ORP** Oxidation Reduction Potential – a measure of the presence or absence of oxygen in the groundwater and related chemical processes. Low ORP values indicate a loss of oxygen from the normally highly oxygenated groundwater.
- **mV** millivolts

- Preliminary list of contaminants detected in LANL monitoring well R-38

- DEHP (Bis(2-ethylhexyl)phthalate) — EPA DWS = 6 ug/L
- Benzene — EPA DWS = 5 ug/L
- Toluene — EPA DWS = 1000ug/L
- Acetone? — There is no EPA DWS for acetone
- Nickel — There is no EPA DWS for nickel

- **EPA** Environmental Protection Agency
- **DWS** Drinking Water Standard

Table 3. Water Quality Data in RACER[R] for Regional Aquifer Monitoring Well R-36

- (ug/L)	03-12-08 FILT/UNF	05-12-08 FILT/UNF	08-12-08 FILT/UNF	02-05-09 FILT/UNF	04-28-09 FILT/UNF	08-05-09 FILT/UNF
- DEHP	NL / 46.7J	NL / 59.1	NL / NL	NL / 12.2J	NL / 9.4J	NL / 10.7J, 8.1J
- benzene	NL / < 1U	NL / < 1U	NL / < 1U	NL / < 1U	NL / < 1U	NL / < 1U
- acetone	NL / 4.26J	NL / 9.02	NL / < 5U	NL / <10U	NL / <10U	NL / <10U
- toluene	NL / 17.5	NL / 11.2	NL / 8.78	NL / 4.62	NL / 2.72	NL / 0.48J
- chromium	8 J / 11.9	8.8 J / 12.2	7.5 / 9.7	6.2 / 7.9	4.7J / 11.6	NL / NL
- nickel	2.4 / 4.7	3.7 / 7	< 2.5U / 3.5J	1.7J / 2.2	1.4J / 1.66J	1.76J / 1.88J
- zinc	91.1 / 151	66.5 / 127	58.9 / 74	71.3 / 78.1	75.3 / 77.8	73.6 / 73
- nitrate	2380 / NL	2230 / NL	2220 / NL	2400 / NL	2300 / NL	2400 / NL
- sulfate	6710 / NL	6500 / NL	6840 / NL	7080 / NL	7410 / NL	6850 / NL
- chloride	6040 / NL	5860 / NL	5840 / NL	5820 / NL	5950 / NL	5545 / NL
- pentachlorophenol	NL/<11.1U	NL / <11U	NL / NL	NL / <11U	NL / <10.6U	NL / <10.7U
- beryllium	< 5U / < 5U	< 5U / < 5U	< 5U / < 5U	< 5U / < 5U	< 5U / < 5U	< 5U / < 5U
- ORP (mV)	NL / NL	NL / 340	NL / 244	NL / 207	169 / NL	376 / NL
- H-3 (pCi/L)	NL / 21	NL / 20.8	NL / 13.7	NL / 19.9	NL / 20.1	NL / 20.1

All of the data in Table 3 is from the LANL RACER[R] water quality data base

- **FILT** analysis on filtered water sample
- **UNF** analysis on unfiltered water sample
- **ug/L** micrograms per liter or parts per billion
- **DEHP** bis(2-ethylhexyl)phthalate
- **NL** not listed in the RACER data base
- **J** estimated concentration because of uncertainty in the analytical results
- **U** the constituent was not detected in the sample at the concentration value listed in the RACER data base. For example, < 10 U means the constituent or contaminant was not detected at a resolution of 10 ug/L for the analytical method. The constituent or contaminant may have been present in the water sample but at a concentration of less than 10 ug/L.
- **ORP** Oxidation Reduction Potential – a measure of the presence or absence of oxygen in the groundwater and related chemical processes. Low ORP values indicate a loss of oxygen from the normally highly oxygenated groundwater.
- **mV** millivolts
- **H-3** tritium
- **pCi/L** picocuries per liter

- Preliminary list of contaminants detected in LANL monitoring well R-38

- DEHP (Bis(2-ethylhexyl)phthalate) EPA DWS = 6 ug/L
- Toluene EPA DWS = 1000ug/L
- Acetone? There is no EPA DWS for acetone
- Tritium EPA DWS = 20,000 pCi/L
- Nitrate EPA DWS = 10,000 ug/L
- Sulfate EPA Secondary DWS = 250,000 ug/L
- Chloride EPA Secondary DWS = 250,000 ug/L

- EPA Environmental Protection Agency
- DWS Drinking Water Standard

- **Table 4. Table 3.2 from the NAS 2007 Report – Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory.**

TABLE 3.2 Nine of 25 Principal Material Disposal Areas at LANL

Material **Disposal Area (MDA)**	**Location (Technical Area)**	**Period of Operation**	**Key Radionuclide Inventory**
- A	**21**	**1944-1978**	**Up ~ 701 Ci, Am ~ 1.5 Ci**
- B	**21**	**1945-1952**	**Pu ~ 6.22 Ci, Sr-90 ~ 0.285 Ci, Cs ~ 0.005 Ci**
- T	**21**	**1945-1986**	**Pu ~ 182 Ci, Am ~ 3740 Ci, U ~ 6.9 Ci**
- U	**21**	**1948-1976**	**Unknown (Am, Cs, Pu, tritium, Sr, U)**
- V	**21**	**1945-1961**	**Unknown (Am, Cs, Pu, Sr-90, U, tritium)**
- AB	**49**	**1959-1961**	**Pu ~ 23,000 Ci (includes ~ 20,600 Ci of Pu- 241, which has a 14.4-year half-life, and ~ 2300 Ci of Pu-239, which has a 24,000-year half-life), U ~ 0.246 Ci**
- C	**50**	**1948-1974**	**Tritium ~ 20000 Ci, Sr-90 ~ 21 Ci, U ~ 25 Ci, Pu ~ 26 Ci, Am ~ 145 Ci**
- G	**54**	**1957-1997***	**Am ~ 2360 Ci, Cs ~2810 Ci, Tritium ~ 3,610,000 Ci, Pu ~ 16,000 Ci, Sr-90 ~ 3500 Ci, U ~ 124 Ci**
- H	**54**	**1960-1986**	**Tritium ~ 240 Ci, Pu ~ 0.0267 Ci, U ~ 75.2 Ci**

*** (Parts of MDA G remain active today for disposal of radioactive wastes as "Area G")**

- Ci = Curies of radioactivity

- Pu = plutonium, Am = americium, Sr = strontium, Cs = Cesium, U = uranium

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