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# Memorandum

Risk Reduction & Environmental Stewardship (RRES)
Groundwater Protection Program (GPP), MS M992

To/MS: Distribution
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Phone/FAX: 5-4681/5-4747
Symbol: RRES-GPP-03-101
Date: December 15, 2003

**SUBJECT: MINUTES FROM THE GROUNDWATER PROTECTION PROGRAM QUARTERLY MEETING HELD OCTOBER 27, 2003**

Enclosed please find the minutes from Los Alamos National Laboratory's (LANL's) Groundwater Protection Program Quarterly Meeting, held on October 27, 2003. Subject to funding levels, the planned field activities for Fiscal Year 2004.

- Drill and install 5 regional aquifer wells:
  - R-1, R-28, R-33, and R-34 in Mortandad Canyon
  - R-6 in Los Alamos Canyon
- Sample wells R-2, -4, -21, -31, -5, -8, -14, -20, -32, -16, -23
- Conduct hydrologic testing
- Undertake mortandad Canyon groundwater investigation
- Make site-wide monitoring and water level measurements
- Conduct special drinking water monitoring
- Perform Groundwater discharge plan monitoring and reporting
- Perform reactive barrier monitoring in Mortandad Canyon
- Undertake well custodianship

Please review these minutes for accuracy. If you identify substantive changes that should be made, please submit your comments to me in writing or via e-mail at nylander@lanl.gov.

Enclosure: Minutes from the Groundwater Protection Program Quarterly Meeting Held October 27, 2003

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R. Warren, EES-6, MS D462
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# Los Alamos National Laboratory
# Groundwater Protection Program
# Quarterly Meeting
# October 27, 2003
# Minutes

## MEETING PURPOSE, ATTENDEES, AND AGENDA

The Los Alamos National Laboratory Groundwater Protection Program met with the New Mexico Environment Department (NMED), the Department of Energy (DOE), and stakeholders on October 27, 2003 for a Quarterly Groundwater Protection Program Meeting. The meeting was held at the Courtyard by Marriott in Santa Fe, New Mexico. Charlie Nylander (Groundwater Protection Program Manager) facilitated the meeting.

The following groups and stakeholders were represented (see List of Attendees for specific information):

NMED-Hazardous and Radioactive Materials Bureau
NMED-DOE Oversight Bureau
New Mexico Attorney General
DOE-Office of Los Alamos Operations
New Mexico Office of the Natural Resource Trustee
San Ildefonso Pueblo
Northern New Mexico Citizens Advisory Board
Concerned Citizens for Nuclear Safety
Risk Assessment Corporation
Intera, Inc.
Kleinfelder Inc.
Daniel B. Stephens
Westbay Instruments
University of California
LANL-Groundwater Integration Team (GIT)

The purpose of the Quarterly Meeting was to provide NMED, DOE, and stakeholders with information on LANL's groundwater protection efforts and present planned activities for the upcoming fiscal year. The meeting agenda was as follows:

8:30 Introduction and Agenda (C. Nylander)
8:45 Status of CY03 Wells (T. Whitacre)
9:30 R-Well Sampling Results (P. Longmire)
10:15 Break
10:30 Mortandad Canyon Groundwater Investigation (P. Longmire)
11:15 Monitoring Plan Development (B. Thatcher)
11:30 Miscellaneous Issues (C. Nylander)
12:00 Lunch
1:00 Perchlorate Methods Assessment Overview (B.Turney)
1:45 Recent Contaminant Detections Overview (B. Robinson)
2:15 Site-Wide Conceptual Model Status (B. Robinson)
3:00 Status of Groundwater Task, RACER Project (P. Shanahan)
3:45 Planned Activities for CY04 (C. Nylander)
4:00 Adjourn

5:00 Public invited to view and discuss poster presentations

### Introduction (Charlie Nylander)

Charlie Nylander (LANL) welcomed everyone to the Quarterly Status Meeting. Quarterly status meetings have been held since 1998 for NMED and stakeholders to provide an update on

hydrogeologic studies. These Quarterly Meeting also are an opportunity to ask questions of the technical staff doing the work and have discussions. A poster session with much the same information will be held this evening when more people can participate.

**Status of CY03 Wells (Tom Whitacre)** wells site-wide

Tom Whitacre (DOE/LASO) described the technical and management changes in the drilling:

- DOE has an interagency agreement with the US Army Corps of Engineers (COE) for several regional and intermediate wells in TA-16. The COE contracts the drilling services with a firm fixed price contract structure. The contract was awarded on July 11, 2003 to Kleinfelder. There are some time and materials costs in the contracts for activities of unknown duration or scope, e.g., well development, drilling deeper than expected.
- The core rig was mobilized on August 19, 2003. Big drilling rigs are from Water Development Corporation and they were mobilized on August 28.
- DOE manages the contract directly and has responsibility for Health and Safety and Quality Assurance. The contractor has approved Health and Safety and Quality Assurance plans.
- The same LANL people are involved from the technical standpoint.
- Multiple drilling systems are staged at LANL, including mud rotary, air rotary, foam, casing advance, so the contractor can respond immediately to difficult drilling conditions.
- There is an emphasis on identifying perched water zones. Every night the drill string is tripped out of the hole and the borehole sits open. The next morning, the borehole is checked for fluid accumulation. If there is water, it is sampled. A bromine tracer system is also being used in the drilling fluids. A known concentration of bromine is added to the drilling fluid and every five feet a sample of drilling fluid is collected and analyzed for bromine. If the bromine concentration has been reduced, that indicates it is being diluted by water entering the borehole. It is a promising method that has found a couple of perched zones and the regional aquifer so far. Initially, core is collected with a hollow stem auger. Additionally, the bottom of the borehole is cored every night. If water is found, a temporary peizometer is installed and in the morning the water level is measured and samples collected for analysis.
- Well development is started within 5 days after the well is installed.
- The schedule for fact sheets and well completion reports has been accelerated so that they will be delivered to NMED on time.
- DOE is responsible for "what" and the contractor is responsible for "how".

The drilling accomplishments in Calendar Year 2003 are:

- There is a commitment to complete 6 wells this calendar year: R-2, -4, -11, -26, -1, -28. Also included in the contract are 3 intermediate wells for the TA-16 Outfall 260 Corrective Measures Study.
- R-2 – Pueblo Canyon located on County land and required consideration by a number of county organizations. Total depth is 943 feet with 1 screen in the regional aquifer. 228 feet core was collected and an open hole geophysics suite was run. One damp zone was encountered, but no free water in the vadose zone
- R-4 is in Pueblo Canyon and has a total depth of 844 feet. It was completed with one screen in the regional aquifer. 243 feet core was collected and an open hole geophysics suite was run. Two perched zones were encountered and temporary peizometers were put in the well to measure water levels and collect water samples.
- R-11 is in Sandia Canyon and has a total depth of 927 feet. It was completed with 1 screen in the regional aquifer. 224 feet core were collected and an open hole geophysics suite was run. No perched water was encountered.

- R-26 is in Canyon de Valle and has a total depth of 1485 feet. It was completed with 2 screens, one in the perched zone and one in the regional aquifer. 250 feet core was collected and open hole geophysics suite was run.
- CdV-16-1(I) is located in TA-16. It has been cored to 200 feet. One perched zone was encountered and a temporary peizometer was installed.

The remaining Calendar Year 2003 work is:

- Two remaining wells regional aquifer, R-1 and R-28 have the following plans:
    - R-1 will be located in Mortandad Canyon near the permeable reactive barrier and upgradient of TW-8. The borehole will be cored to about 300 feet and the total depth is expected to be 1126 ft. It will be completed with a single screen in the regional aquifer.
    - R-28 is located in the middle portion of Mortandad Canyon. It will be cored to about 335 feet and then drilled to a total depth of 926 feet. The final location of the well will depend on archeological clearance, because there are many archeological sites in the area.
- The two remaining intermediate wells in TA-16 will each be about 900 feet deep, no core collected, and completed with a single screen.

Well development activities are:

- R-2 – awaiting development and hydrotesting
- R-4 – development completed, awaiting hydrotesting – about 12,000 gallons purged
- R-11 – development completed, hydrotesting completed – about 16,000 gallons purged
- R-26 – development ongoing

Reporting activities associated with well drilling and installation are:

- R-2 – Well completed 10/03
    - Fact Sheet due 11/03
    - Well Completion Report due 2/04
- R-4 – Well completed 10/03
    - Fact Sheet due 11/03
    - Well Completion Report due 2/04
- R-11 – Well completed 9/03
    - Fact Sheet due 10/03
    - Well Completion Report due 1/04R-26 – Well completed 10/03
    - Fact Sheet due 11/03
    - Well Completion Report due 2/04
- Communication
    - Weekly Drilling Update email to NMED and LANL staff
    - NMED/HWB and NMED/OB site visits
    - Well design is done in collaboration with NMED by phone conference and email
    - LA County PIIP Process for R-2. This included the Planning and Zoning Commission, meeting with stakeholders, and other meetings. Used an existing road and did not move earth for the pad.

**Status of CY03 Wells Questions, Comments, and Responses**Q: What is the purpose of the temporary peizometers in the borehole?

R: To measure the water level.

Q: What differences in the contract has led to improvements?

R: The contractor is incentivised with a firm fixed price contract. They are also interested in making the customer happy in hopes that it will lead to more work. Contracting the work out in

bigger chunks – several wells at a time – allows the contractor to spread the fixed costs out. They are working 12-hr days and have new and specialized equipment available.

Q: What was the rationale for R-26?
R; It is intended to serve as a background well for regional aquifer water chemistry.

Q: Where is the fault zone with respect to R-26?
R: The fault is to the west of R-26.

**R-Well Sampling Results (P. Longmire)**

Pat Longmire (LANL) presented a summary of geochemical investigations conducted at several R wells drilled at and near Los Alamos National Laboratory. The topics of interest include the results of groundwater (characterization) sampling and the status of residual drilling fluids.

**Characterization Sampling Results**

The wells that have been drilled and sampled in calendar year 2003 are shown in the table below. The wells were sampled after development, but have not had characterization sampling. Characterization sampling for these wells will begin in FY04.

| Well | Screens | Sampling Rounds |
|---|---|---|
| R-5 | 169, 375, 678, and 860 ft | 1 |
| R-8 | 731 and 825 ft | 0 |
| R-11 | 860 ft (?) | 0 |
| R-14 | 1217 and 1290 ft | 0 |
| R-16 | 867, 1019, and 1241 ft | 0 |
| R-20 | 1050 ft and 1333 ft | 0 |
| R-21 | 898 ft | 0 |
| R-23 | 845 ft | 0 |
| R-32 | 871, 933, and 977 ft | 0 |

The only perched zone water that was sampled was in R-23. The water was analyzed for tritium, but there was insufficient sample volume to analyze for perchlorate or nitrate. The tritium in the R-23 perched zone was 26 pCi/L and that indicates that there is a component of the water in the perched zone that is less than 60 years old.

Regional aquifer samples and results are shown in the following table. The samples were analyzed for full suite, but the conservative analytes are tritium, nitrate, and perchlorate. The perchlorate analyses are by IC method, so the detection limit is 4 ppb. Now the LC/MS/MS method can be used to re-analyze samples that are below the IC method detection limit.

| Well | Zone | Perchlorate (ppb) | Nitrate (N) (ppm) | Tritium (pCi/L) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| R-5 | Regional | | | [0.29], 0.39, 3.57 |
| R-8 | Regional | [4], [4] | 0.68, 0.5 | 16 |
| R-11 | Regional | 2.3 | 4.86 | 16 |
| R-14 | Regional | [4], [4] | [0.01], 0.05 | [0.26], [0.23] |
| R-16 | Regional | [4], [4], [4] | 0.23, 0.12, 0.23 | 0.48, [0.23], [0.23] |
| R-20 | Regional | Not analyzed | Not analyzed | 0.32, [0.19] |
| R-21 | Regional | [4] | [0.02] | Not analyzed |
| R-23 | Regional | [4] | 0.47 | Not analyzed |
| R-32 | Regional | [4], [4], [4] | 0.05, 0.57, 0.02 | [0], [-0.03], [0.39] |

Note: [ ] means not detected

Observations on the regional aquifer analytical results:

- Nitrate is within background concentrations everywhere except at R-11.
- In R-5, the regional aquifer has had a long residence time based on the activity of tritium at background levels and no detectable nitrate or perchlorate
- R-8 has tritium above background levels indicating there is a component of recent water, similar to R-9, which is about 0.75 miles east of R-8.
- One of the purposes of R-11 was to see if water from Mortandad Canyon is flowing beneath and mixing with water below Sandia Canyon. R-12 in Mortandad Canyon has elevated tritium in the perched and regional aquifer. R-11 also has elevated tritium, but it is lower than at R-12. Nitrate levels in R-11 and R-12 are similar, they are above background. The source of the nitrate is sewage effluent. The perchlorate in R-11 was analyzed by IC but with a new detector, so it could detect 2.3 ppb. The sample was sent to GEL for analysis by LC/MS/MS, but the results are pending.
- R-14 in Ten Site Canyon, a tributary to Mortandad Canyon. The regional aquifer had no detectable perchlorate or tritium and the nitrate is at background level. The regional aquifer has had a long residence time, based on the lack of tritium, nitrate, and perchlorate. Core samples from the upper 100 feet have perchlorate and nitrate. This may suggest that transport of contaminants in Ten Site Canyon was predominantly by surface water.
- In R-16, R-20, and R-32 the regional aquifer has had a long residence time based on the activity of tritium at background levels and no detectable nitrate or perchlorate.
- R-21 a sample was grabbed after well development and analyzed for perchlorate and nitrate, but not for tritium. A full suite analysis, including tritium will be done in the characterization sampling.

**Status of Residual Drilling Fluids in Wells**

It is necessary to use fluids to drill the wells. Different types of fluids are used, for example, EZ Mud is used for lubricity. The conceptual model for what happens to the drilling fluids is that microbes break down the EZ Mud, which is an organic compound and is food for microbes. In the process, the iron and manganese are reduced; sulfate is reduced to hydrogen sulfate; and organics are reduced to alkalinity. After these reactions are complete, the pre-drilling chemistry should prevail. The presence of reduced iron and manganese, hydrogen sulfate, and alkalinity indicates that the breakdown of drilling fluids is still going on. Not all contaminants are affected by the presence of residual drilling fluids.

R-22 provides an example. A plot of major cations and anions measured in four quarterly samples from screen 1. This screen straddles the water table and is not fully saturated. Screens that are not fully saturated are more difficult to develop and clean drilling fluids from. The plot

shows that the sum of the constituents (Total dissolved solids) measured each quarter increased. This is probably because as the organic carbon is broken down, the alkalinity increases. The largest increase in R-22, screen 1 was in the components of alkalinity. The increase in alkalinity is a marker of continuing breakdown of residual drilling fluids. Another marker of residual drilling fluid break down is increased trace metals, particularly iron, manganese, and sulfate. This is because as the bacteria degrade the residual drilling fluid, the iron and manganese change to reduced species and are more soluble, so their concentration in the water increases. The iron and manganese concentration in R-22, screen 1 increase over the four quarters of measurement. Sulfate has a different trend in that it initially decreases but then increases back to background levels. That is because microbes love sulfate and they reduce it to hydrogen sulfate gas. In R-22 the sulfate is less than detection in the first two quarters, then increases in the second two quarters. This is a good indicator that the screen is cleaning up and will produce good data in future years.

As a comparison, a plot of the anions and cations from screen 2 in R-22 shows that the total dissolved solids have been consistent through four quarters of sampling. The analytical results from this screen are representative of where residual drilling fluids have been removed or broken down and the water chemistry represents pre-drilling conditions.

Reviewing the status of residual drilling fluids in the R-wells that have had characterization sampling yields the following observations:

- There are 41 screens in 17 R-wells that have had 4 rounds of characterization sampling
- 13 screens in 6 wells (R-7, -9i, -12, -19, -22, -32) have chemistry that indicates that breakdown of residual drilling fluid is still actively occurring
- 4 screens in 2 wells (R-9i and R-12) are located in areas where the contaminants may be affected by the presence of residual drilling fluids
- In R-9i the contaminant that may be affected by residual drilling fluid is uranium and R-12 the contaminant is nitrate.

**Summary of Presentation**

- Geochemistry team members have evaluated post-well development and characterization groundwater samples from R-5, R-7, R-8A, R-9, R-9i, R-11, R-13, R-14, R-16, R-20, R-21, R-22, R-23, and R-32.
- Wells R-5, R-9, R-13, R-15, R-16, R-20, R-21, R-23, R-31, and MCOBT-4.4 do not contain residual drilling fluid.
- Wells R-7, R-9i, R-19, R-22, and R-32 contain residual drilling fluid and/or bentonite in well screens.
- Measurable tritium occurs at wells MCOBT-4.4, R-5, R-7, R-8A, R-9, R-9i, R-12, R-15, R-22, R-23, and R-25. These wells contain a component of groundwater less than 60 years old. **R-Well Sampling Results Questions, Comments, and Responses**

Q: What is the location of R-20?
R: East of TA-18 and upgradient of Area G.

Q: Does the analysis of uranium in R-9i indicate the source of the uranium?
R: Isotopically natural uranium.

C: The lab used to work with natural uranium early on.
R: Yes, natural uranium was used at the Lab.

Q: More work is required to determine the source of uranium in R-9i?
R: The best way to determine the source is to do absolute dating method on the water.

Q: Are you looking at the concentration of natural uranium in all the wells in Los Alamos Canyon?
R: Yes, the water from R-5 and R-7 has been analyzed for uranium. The background level for the whole Pajarito Plateau is about 1 ppb. The proposed groundwater standard for uranium currently being considered by the Water Quality Control Commission is 7 ppb.

Q: Are you still finding oxalate in the water?
R: We have not detected oxalate above the detection limit of the outside analytical labs (6 ppb). If we used our internal lab, which has a lower detection limit, we might see it.

Q: How come some wells have residual drilling fluid and others do not?
R: Usually is depends on the hydraulic properties of the rock and the types of drilling fluid used. Wells can be developed better in more permeable zones. Also, wells with single screen completions tend to clean up faster, but then much information would be lost by not having multiple screens. Using drilling fluids to drill is standard procedure. When developed properly, there is no problem with the data. There are ways to accelerate the breakdown of the fluids, by adding other substances to the well. We want to be cautious in adding more things to the well. Given the planned 50-year life of the wells, there will be good data produced from all the wells. The indications of drilling fluid breakdown are encouraging.

Q: Do the screened intervals that are fully saturated clean up better?
R: Fully saturated screens can be fully developed and there is less likely to be a problem with residual drilling fluids.

**Mortandad Canyon Groundwater Investigation (P. Longmire)**
Pat Longmire (LANL) explained the NMED had written a letter requiring additional investigation of Mortandad Canyon groundwater. A work plan had been submitted to NMED at the end of August 2003. This presentation describes the approach and work proposed in the submitted work plan. The objectives of the work plan are:

Collect data and information to:

- Determine nature and extent of contamination
- Estimate present-day human health and ecological risk
- Base corrective action decisions for PRS aggregates and groundwater
- Make recommendations for long-term monitoring

The conceptual model is a tool used to focus work in areas of uncertainty. It is based on decades of empirical observations. It is shown as a west-east cross-section that depicts the geology – alluvium, Bandelier Tuff, Puye Formation, and Cerros del Rio basalt. Contaminants entered the canyon from outfalls from TA-50 starting in 1953 and Ta-35 in the mid-1950's. There are three modes of groundwater: alluvial, intermediate, and the regional aquifer. Perched zones have been encountered in the Cerros del Rio basalt at different stratigraphic levels in two wells (MCOBT-4.4 and R-15). The lateral extent of either perched zone is unknown. The perched zone encountered in MCOBT-4.4 had 15000 pCi/L of tritium, 180 ppb of perchlorate, and nitrate. The R-15 perched zone had 378 pCi/L, low nitrate, and perchlorate. The regional aquifer in R-15 has nitrate elevated above background. How did the contaminants get there? The pathway from the surface to the perched zones is an uncertainty that will be addressed by this investigation. The conceptual model ties in infiltration, chemical processes, and transport. Predictive tools, such as modeling, will be used to interpret the data collected.

The conceptual model uncertainties are:

- Location and rate of water infiltration
- Extent and depth of strongly adsorbing, moderately adsorbing, and non-adsorbing contaminant fronts
- Presence of perched zones and role in contaminant transport
- Location of contaminants and extent of impact on regional aquifer
- Present-day risk to human health and ecological receptors

**Location and rate of water infiltration**Infiltration investigation: Location and rate of surface water infiltrating into the subsurface

- Peizometers: 6 to determine alluvial groundwater movement east of sediment traps. These will look at recharge (as required in NMED letter)
- Boreholes: 16 shallow boreholes up to 100 feet deep, core samples to measure moisture, anions, stable isotopes, contaminants. These were not required in the NMED letter.
- Alluvial Wells: 9 wells to augment contaminant distribution information; these will fill in gaps and replace wells like MCO-3 that are not currently operational. In the area west of R-15 the alluvial wells will look at an area where the concentration of strontium-90 markedly decreases. Geophysical Surveys: DC resistivity to identify potential zones of infiltration in the upper portion of the vadose zone.

**Extent and depth of strongly adsorbing, moderately adsorbing, and non-adsorbing contaminant fronts**

Core and/or water samples to measure moisture, anions, stable isotopes, & contaminants from:

- 9 alluvial wells will be sampled after development
- 16 shallow (<100 ft) boreholes, if perched zones are encountered they will be sampled
- 7 intermediate wells, three of the intermediate wells do not have locations selected yet. They will be located based on what is found in the first 4 wells.
- 4 regional aquifer wells in addition to the regional aquifer wells already in Mortandad Canyon

**Presence of perched zones and role in contaminant transport**

- Geophysical surveys and boreholes to identify potential perched water (done first). This will help guide the locations of the alluvial wells.
- 7 intermediate wells: collect core and borehole and well water samples; possible hydrologic testing. If there is limited water in the zone, it is more important to know the chemistry than to do hydrologic tests
- 4 regional aquifer wells: identify the presence of intermediate zones encountered and collect boreholes water samples

**Location of contaminants and extent of impact on regional aquifer**

4 regional aquifer wells:

- R-1 (TW-8 replacement): where canyon widens. Possibly a tracer test and a pumping test using both R-1 and TW-8.
- R-28: point between R-15 (contaminants present) and R-13 (contaminants absent), R-11 had nitrate in the regional aquifer
- R-33: sentry well for PM-5 and near MCOBT-4.4
- R-34: San Ildefonso Pueblo monitoring point between R-13 and R-22.

**Present-day risk to human health and ecological receptors**Surface water: sampling 2 areas of persistent water, 2 sampling events. Most persistent water is in the upper reaches. The surface water sampling will be coupled to groundwater monitoring.

- R-28: point between R-15 (contaminants present) and R-13 (contaminants absent)
- R-33: sentry well for PM-5
- Geomorphic surveys: conducted under RFI Work Plan for Mortandad Canyon

**Summary of the scope of field work in Mortandad Canyon**

- Surface Water Sampling: 2 locations
- Peizometers: 6 locations
- Alluvial Wells: 9 locations
- Shallow Boreholes: 16 locations
- Intermediate Wells: 7 locations one will be near R-15 and another will replace MCOBT-4.4
- Regional Aquifer Wells: 4 locations
- Geophysical Surveys and Boreholes. On the cross section showing geophysical survey run last year, the blue indicates areas of moisture, but there is no way to know whether it is free moisture, or bound up in the rocks. The other colors indicate drier conditions.

**Other planned investigations include:**

- Infiltration Investigation: constrain various terms of water budget to quantify deep percolation
- Colloid Investigation: evaluate potential importance of colloids in the transport of adsorbed contaminants

**Data Analysis and Interpretation**

- Guide data collection: Real-time data analysis of characterization data for up-to-date interpretation of contaminant nature and extent:Overall synthesis of data: Numerical models of fate and transport through alluvial and vadose zone to underlying regional aquifer.

**The proposed schedule is:**

- •Drilling and Field Activities: Oct 2003 – December 2004
- •Sample Collection and Analysis: July 2004 – July 2005
- •Report Preparation: July 2005 – December 2005
- •Report Submittal: December 31, 2005

**Mortandad Canyon Groundwater Investigation Questions, Comments, and Responses**

Q: Is there data from the permeable reactive barrier?
R: The monitoring points have been sampled three times. It works great when there is water in it. There have been unsaturated conditions associated with the drought. The concentration of strontium-90 is decreased 81% by the barrier. The concentration of perchlorate it <30 ppb going in, but <2 ppb coming out. The barrier removes strontium and perchlorate very effectively.

Q: Is the location of R-28 still in the conductive zone indicated by the geophysical survey?
R: It is still in the conductive zone. Based on the results at R-11, I think it should be moved further east, but stay in the conductive zone.

**Monitoring Plan Development (B. Thatcher)**

Bruce Thatcher (LANL) explained that he had some notes before starting his prepared presentation. The purpose of the presentation is to inform everyone on the status of preparing the site-wide monitoring plan. One area of improvement is the Standard Operating Procedures (SOP). Both Water Quality Hydrology and the Environmental Restoration Project have SOPs, but we are now creating a single set of SOPs for each activity.

The data management activities have been reviewed. Both the Environmental Restoration Project and Water Quality Hydrology have databases that store similar data. A recommendation has been made and accepted by the RRES Division office that no further enhancements are made to either database until a thorough analysis of both systems can be completed. After the evaluation of both systems, a recommendation will be made as to which one will go forward as

the single database system to be used by both programs. The single database may also include air and ecology data, but that decision has not been made yet.

**Initiated Interim Facility-Wide Groundwater Monitoring Plan (IFGMP) Development in June, 2003**Orient plan towards most current version of the draft NMED Consent Order (the Order)

- Developed decision flow process diagrams with involvement of DOE Oversight Bureau
- Currently developing conceptual models and sampling and analysis plans by watershed with involvement of DOE Oversight Bureau
- Plan is focused on Table 12-1 in the Order with technical justification for any deviations
- There are 3 issues on which input from NMED is desired.

**Orient Plan Towards Most Current Version of the Draft NMED Consent Order (the Order)**Detection monitoring, limited analysis (or assessment) and reporting

- Surface water measurement, sampling and analysis focused on understanding groundwater from both physical and chemical perspectives. Surface water is defined as all water except storm water.
    - Snowmelt
    - Base flow

**Developed Decision Flow Process Diagrams with Involvement of DOE Oversight Bureau**Start with watershed conceptual model

- Potential primary and secondary contaminant sources
- Geologic, hydrologic and geochemical components relative to groundwater occurrence and flow

For each watershed, conceptual model feeds process diagrams designed to develop:

- Analyte list
- Groundwater monitoring locations and frequency
- Groundwater water level measurement locations and frequency
- Surface water monitoring locations and frequency**Currently Developing Conceptual Models and Sampling and Analysis Plans by Watershed with Involvement of DOE Oversight Bureau**Watershed teams:

- Mortandad Canyon (incl. Ten Site Canyon and Canada del Buey) led by Pat Longmire
- Los Alamos Canyon/Pueblo Canyon (incl. Acid and DP Canyons) led by Danny Katzman
- Water Canyon/Canon de Valle (incl. Potrillo, Fence and Indio Canyons) led by Brent Newman
- Pajarito Canyon (Incl. Twomile and Threemile Canyons) led by David Broxton
- Sandia Canyon led by Bruce Gallaher
- "Other" Canyons (incl. Ancho, Chaquehui and North Canyons) [North Canyon incl. Guaje, Rendija, Barracas and Bayo Canyons] led by David Rogers
- Regional Aquifer Water Level Measurement team led by Elizabeth Keating
- White Rock Springs team led by David Rogers

**Plan is focused on Table 12-1 in the Order with Technical Justification for any Deviations**View Table 12-1 as an initial design. Use historical data, watershed conceptual models and decision flow process diagrams used to generate alternate design. We are looking to improve, not find fault. Want to meet the objectives with fewer wells to free up money to do more. Plan content:

- Generation of revised Table 12-1
- Technical justification for deviations
- QAPP and SOPs (by reference)

**Desired Input**Plan format and content

- Preliminary draft plan working meetings with NMED Hazardous Waste Bureau, DOE Oversight Bureau, DOE and LANL

- Propose decision processes as part of plan for:
  - Determining if screening level has been exceeded (statistics-based)
  - Passing on possible action to corrective action or operations, as appropriate

**Monitoring Plan Development Questions, Comments, and Responses**

Q: What will be done about the problems the public has with downloading information from the database?
R: Hope to improve the accessibility of the data to the public.

Q: Will Sue Kinkead still be involved in the database?
R: When there is a single system, Sue is likely to be involved in some capacity.

Q: Would you be willing to get feedback from data users as part of the evaluation?
R: feedback from data users would be very helpful.

Q: Where is the storm water addressed?
R: There is a separate plan required in the Order for storm water, following the NPDES requirements.

Q: When will the permit be final?
R: NMED is expecting to issue a draft permit in January.

Q: Where does the public get involved in the process?
R: As will be required in the Order, although the process for public input has not been decided. The monitoring plan is revised annually and it is not static.

C: It is now October 27 and the Order was supposed to be done in June. Want to see something get done on that.

**Miscellaneous Issues (C. Nylander and J. Arends)**

Funding for FY04. The Lab has requested increased funding. The funding sources for the Groundwater Protection Program are National Nuclear Security Administration (NNSA), Environmental Management (EM), and Laboratory General and Administrative Budget (G&A). Congress is working on a budget and until it is passed the Lab is working under a continuing resolution. This means that we begin the year operating with the same funding as last year. The requested and continuing resolution budgets are:

| | **Target Request** | **CR Constrained** |
|---|---|---|
| NNSA | $10 million | $4.5 million |
| EM | $50-100 million (depending on PMP) | |
| Lab G&A | $7 million | $1.5 million |

Hopefully the continuing resolution will be over soon. We are working, but are limited to the constrained budget, which is allocated per quarter. That means we are only working with a quarter of the constrained budget.

There is an ambitious amount of work for this year, including the Mortandad Canyon groundwater investigation and the other regional aquifer. We are looking forward to working with San Ildefonso Pueblo to put a regional aquifer well on pueblo land.

Joni Arends (Concerned Citizens for Nuclear Safety) discussed analytical results for cesium-137 from sampling spring 4A in Pajarito Canyon. In June 2002, Concerned Citizens for Nuclear Safety (CCNS) and The RadioActivist Campaign (TRAC) did preliminary sampling on public lands around LANL. In 2003, conducted more sampling along the river. This is when CCNS spring was discovered (spring 2B). Dennis McQuillan at NMED has done work to show a possible pathway from near R-5 to CCNS spring. The chemistry of the CCNS spring is different than other springs. In April and May this year, CCNS and TRAC did more sampling with LANL and NMED observers. The sites sampled were the CCNS spring along the Rio Grande and Spring 4B in Pajarito Canyon. Samples of water and moss were collected. TRAC has written a report on the sampling and results. The moss from spring 4B had 2.4 to 5.8 pCi/kg of cesium-137. Two water samples were collected: one from the spring and one from the pool in Pajarito. They were large samples and long counting times were used. We believe these results indicate that:

- More work on travel times is needed
- More participation from citizens, Santa Fe City and County is important
- More resources spent to evaluate the connection between TW-1 and the spring.

**Miscellaneous Issues Questions, Comments, and Responses**

Q: If the continuing resolution is not over in 6 months, do you get the full amount?
R: They could wait 6 months and then give us the $10 million and we will be expected to do all of the work planned for the year. But it happens both ways; they could decide that all the money is not necessary. We do expect to get the money. The experience with NNSA over the past two years is that they have come up with more money.

C: Pat Longmire (LANL) said that with computer modeling of possible chemical reactions, he could reproduce the results that Dennis McQuillan reported. However, the same result could come from mixing and water-rock interactions. Modeling is like testing multiple hypotheses. A line of evidence against the pathway scenario is the different chemistry in R-16. I think more sampling is needed.
R: Is the modeling available, we would like to see it.

C: Would be pleased to share the modeling. Pat Longmire (LANL) took the spring chemistry and modeled to see what would create the existing chemistry. Did not look at flow paths.

C: The report on the internet does not have these analytical results.
R: Ken Mullen at LANL was sent the results for review. LANL has previously detected cesium in that spring.
C: The Water Quality and Hydrology Group has monitored that spring for decades and had only one detection of cesium, which we consider an analytical outlier. Would like to see repeated detections.

Q: Were the samples from Spring 4B also analyzed for uranium and perchlorate? The NMED did analyze for uranium and perchlorate and we could provide those results to you.
R: Norm Buske from TRAC only works on radionuclides.

**Perchlorate Methods Assessment Overview (B.Turney)**

Billy Turney (LANL) explained that the EPA method for measuring perchlorate in water is Method 314, which uses ion chromatography (IC). Method 314 employs conductivity to detect perchlorate. However, conductivity is not specific to perchlorate and as a result, the method can

yield false positive results when the actual perchlorate concentration are in the low parts per billion (ppb) range.

In October 2001 LANL conducted a performance evaluation study of Method 314. In this study, water samples spiked with known concentrations of perchlorate were sent to different laboratories for analysis by Method 314. The conclusions of this performance evaluation study were:

- Method 314 does not produce reliable results in environmental groundwaters at low-ppb levels.
- High bias and false positive rates occurred with real groundwater samples at low-ppb levels.
- Consensus was reached among LANL, General Engineering Laboratories (GEL), DOE, and NMED/OB that the Method 314 Minimum Detection Level (MDL) is 4 ppb and the Practical Quantitation Level (PQL) is 12 ppb.

A new analytical method for measuring perchlorate in water became available in November 2001. The new method uses liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS). The method is more perchlorate-specific than Method 314 and claimed to have lower detection limits:

- MDL = 0.25 ppb
- PQL = 0.5 ppb

LANL conducted a performance Evaluation study of the LC/MS/MS method in November 2001. The study used Aculabs in Golden Colorado and consisted of submitting environmental groundwater samples from 3 sites (Locations A, B, and C) that were spiked with perchlorate concentrations of 1, 2, 3, 4, and 5 ppb. The analysis did not measure the correct concentration of perchlorate in any of the spiked samples, except for those containing 5 ppb of perchlorate. Aculabs found calibration standards discrepancy and an electronics problem, so the samples were reanalyzed in December 2001. Spike recovery was used to gauge the accuracy of the LC/MS/MS performance evaluation study. The results were:

| | Recovery Control Limits | Analysis Recoveries | Recoveries within Control Limits |
|---|---|---|---|
| Original | 75% to 125% | 45% to 563% | None |
| Re-Analysis | 75% to 125% | 45% to 159% | 80% |

Soon after, Aculabs went out of business. However, General Engineering Laboratories (GEL) started to offer perchlorate analysis by LC/MS/MS. Another Performance Evaluation study was conducted in May/June 2003. The study was conducted at GEL in Charleston South Carolina. GEL said the MDL is 0.05 ppb and the PQL is 0.20 ppb. The study used spiked environmental groundwaters from 8 sites and de-ionized water. The objectives of the 2003 Performance Evaluation Study were:

- Determine if the method works in environmental groundwater samples
- Verify the method detection limit of 0.05 ppb
- Verify the Practical Quantitation Limit of 0.2 ppb
- Determine whether perchlorate is present in LANL area and regional groundwater samples.

The spike perchlorate concentrations for the 2003 performance evaluation study were:

| Objective | Spike Concentration |
|---|---|
| Unspiked | 0 ppb |

| | |
|---|---|
| Approximately MDL | 0.05 ppb |
| Greater than the MDL, but less than the PQL | 0.10 ppb |
| Approximately PQL | 0.20 ppb |
| Greater than the PQL | 0.50 ppb |

The samples that were submitted for the 2003 performance evaluation study were:

| **Source** | **Spike Perchlorate Concentration (ppb)** | | | | | **Trip Blank Collected** | **Field Blank Collected** | **Equipment Blank Collected** |
|---|---|---|---|---|---|---|---|---|
| | **0** | **0.05** | **0.1** | **0.2** | **0.5** | | | |
| A | √ | √ | √ | √ | √ | √ | √ | √ |
| B | √ | √ | √ | √ | √ | | √ | |
| D | √ | √ | √ | √ | √ | √ | √ | √ |
| E | √ | √ | √ | √ | √ | √ | √ | |
| F | √ | √ | √ | √ | √ | √ | √ | |
| G | √ | √ | √ | √ | √ | | √ | |
| H | √ | √ | √ | √ | √ | | √ | |
| I | √ | √ | √ | √ | √ | √ | √ | |
| DI water | √ | √ | √ | √ | √ | | | |

The results of the 2003 Performance Evaluation Study in de-ionized water were "perfect" for analytical chemistry. The slope was 0.95, indicating a slight depression in results. The spikes came in right except for the higher numbers. The overall results were:

| Source | Result (ppb) | MDL | PQL | $R^2$ | Slope |
|---|---|---|---|---|---|
| DI Water | 0 | 0.05 | 0.2 | 0.998 | 0.95 |
| A | 0.32 | 0.05 | 0.2 | 0.97 | 0.99 |
| B | 0.28 | 0.05 | 0.2 | 0.98 | 0.98 |
| D | 0.66 | 0.05 | 0.2 | 0.98 | 0.94 |
| E | 0.21 | 0.05 | 0.2 | 0.96 | 0.86 |
| F | 0.12 | 0.05 | 0.2 | 0.99 | 0.75 |
| G | 0.17 | 0.1* | 0.4* | 0.89 | 0.76 |
| H | 0.23 | 0.1* | 0.4* | 0.93 | 0.94 |
| I | 0.17 | 0.05 | 0.2 | 0.95 | 0.86 |

*Samples were diluted, resulting in higher MDL and PQL

In the analysis of the environmental samples, a couple of sample sites the lab had to dilute the samples resulting in higher MDL and PQL. Most had an MDL of 0.05 ppb and a PQL of 0.2 ppb. In the QC samples, all blanks came back non-detect, so we don't expect to find false positives. The spike recoveries on the environmental groundwater samples were:

| Spike Value | Within Control Limits | Outside Control Limits |
|---|---|---|
| <PQL | 44% | 56% |
| >PQL | 87% | 13% |

As part of the evaluation, the isotopic ratio was examined. The ratio $cl^{35}/cl^{37}$ in nature is 3. It would be expected that in perchlorate, there would be three $cl^{35}$ to one $cl^{37}$. When the isotopes are plotted, the chlorine is below the theoretical ratio. The isotopic ratio is one more piece of evidence that indicates if the method is working or not.

Three types of sample preparation clean up columns have been used:

- Hydrogen-Barium-Silver
- Barium-Barium
- Hydrogen-Barium-Barium

The Hydrogen-Barium-Barium column was selected for all future samples because it produces the most representative data.

The historical LC/MS/MS performance evaluation data for LANL can be summarized as:

| Groundwater Site | Analytical Laboratory | Analysis Date | Reported Value (ppb) |
|---|---|---|---|
| A | Acculabs | Dec-01 | 0.3 |
| | Acculabs | Jan-02 | <0.25 |
| | Acculabs | Jan-02 | <0.25 |
| | Acculabs | Jan-02 | 0.3 |
| | Acculabs | Jan-02 | 0.3 |
| | GEL | Jun-03 | 0.3 |
| | GEL | Jun-03 | 0.33 |
| B | Acculabs | Dec-01 | 0.5 |
| | Acculabs | Jan-02 | <0.25 |
| | GEL | Jun-03 | 0.49 |
| | GEL | Jun-03 | 0.29 |
| E | Acculabs | Dec-01 | <0.25 |
| | GEL | Jun-03 | 0.19 |
| | GEL | Jun-03 | 0.12 |
| D | Acculabs | Dec-01 | 0.67 |
| | GEL | Jun-03 | 0.60 |
| | GEL | Jun-03 | 0.65 |
| DI Water | Acculabs | Dec-01 | <0.25 |
| | GEL | Jun-03 | <0.25 |
| | GEL | Jun-03 | <0.25 |

The conclusions from the performance evaluation studies are:

- QC blanks results were all non-detect – indicates that the method is generally free from contamination and that random false positive results are not expected.
- Sample analytical preparation addresses some analytical interferences, but low bias persists.
- Chlorine isotopic data demonstrate that such data may provide a useful and accurate means to discriminate false positive signals from perchlorate signals. The performance evaluation isotopic results have a low bias.
- Perchlorate appears to be ubiquitous.

Future directions in perchlorate analysis:

- Interferences still exist that result in low bias at increasing concentrations.
- LANL will begin using the LC/MS/MS method for routine analyses of perchlorate if the next round of performance evaluation samples:
    - Containing known concentrations of other ions and perchlorate show acceptable (± 25%) recoveries

reviewed to this point

- Isotope ratios fall within 5% of 3.066

**Recent Contaminant Detections Overview (B. Robinson)**
Bruce Robinson (LANL) said that an effort was made this year to use the monitoring data collected to identify areas where groundwater exceeds applicable standards (EPA MCL or DOE DCG) in the past several years. The sources of the data are:

- Chapter 5 of the "Environmental Surveillance at Los Alamos during 2002" (LA-UR-03-5492)
- Recent measurement in R-wells
- Interpretation of historical data

These data were also used to refine the conceptual model.

Effluent discharge locations
There is a map in Chapter 5 of the "Environmental Surveillance at Los Alamos during 2002" (LA-UR-03-5492) that shows the locations of effluent discharges. Some are operational, but most are past sites of discharges. The types of discharges are sanitary, radioactive treatment, outfalls in areas using high explosives, and other industrial NPDES-permitted outfalls. The effluent discharge sites have the potential to impact groundwater. Many of these sites are no longer operating or the contaminant concentrations in the effluent have been reduced significantly.

Nitrate and Perchlorate
These are the most mobile contaminants. They are non-adsorbing and have transport times to the regional aquifer are on the order of decades. The concentrations at depth are considerably lower due to dispersion and dilution. The distance of transport within the regional aquifer is probably small, whereas transport in the shallower groundwater is on the order of kilometers. The exact vadose zone pathways within any canyon are unknown and the maximum plume concentrations in groundwater are uncertain. Maps showing the locations of perchlorate and nitrate show that Pueblo Canyon and Mortandad Canyon have perchlorate above 4 ppb and nitrate above 10 mg/L in the alluvial and intermediate depth groundwater. There are some indications of impact on the regional aquifer in these canyons as well.

Tritium
Tritium is very common in groundwater due to Laboratory operations and to nuclear testing fallout worldwide. However, activities of tritium approaching the MCL of 20,000 pCi/L are not common. Mortandad Canyon alluvial (>20,000 pCi/L) and intermediate perched (15,000 pCi/L) groundwater is the only location on the Laboratory that exceeds or comes close to the MCL. Past emissions were much higher in Mortandad and Los Alamos canyons. Tritium has a short half-life (12 years) so activity of tritium in groundwater will decrease due to radioactive decay.

Strontium, plutonium, and americium
These radionuclides adsorb onto aquifer materials and are less mobile. The radionuclides of interest are strontium-90, plutonium-239, plutonium-240, and americium-241. Maps showing the occurrence of these radionuclides above the DOE drinking water level of 4 mrem/year and the EPA MCL for beta emitters demonstrate they are only present in alluvial water. Strontium-90 is present in alluvial water of DP, Los Alamos, and Mortandad Canyon. Plutonium and americium are present in the alluvial groundwater in Mortandad Canyon.

Time series plots of the activity of adsorbing radionuclides show that the center of mass travels slowly down-canyon and remains near the alluvium/bedrock contact. The strontium-90 in Los Alamos Canyon alluvial groundwater time series shows that the location of the peak strontium

activity has moved an insignificant distance in 10 years. The plutonium in Mortandad Canyon alluvial groundwater time series shows a consistent pattern over time. There is not a discernible movement in alluvial groundwater. Movement of plutonium is likely to be by sediment and surface water rather than by alluvial groundwater.

High Explosives
High explosives are found in the western part of the Laboratory, mostly associated with past operations in TA-16. RDX (> 2ppb) and barium (>1 mg/L) are present in alluvial groundwater. RDX is present in intermediate perched groundwater and perhaps in the regional aquifer. Current investigations are ongoing to see how far from the source and how deep the high explosives are in the groundwater. RDX was detected in the regional aquifer in R-25. The concentration of RDX in the lower screens (regional aquifer) is declining over time, while the concentration in the upper screens (intermediate perched) has remained consistent. The original measurement of RDX significantly decreased. The well was open during installation, which may have allowed the cross-contamination between groundwater zones. Believe the later sampling events are closer to representative of the pre-drilling water chemistry. However, with the data available now, there is no definitive answer as to the presence of RDX in the regional aquifer.

Evolution of contaminant concentrations
The tritium in R-12 has been stable over time. After initial well development and characterization sampling, if the results are consistent that may be a case where monitoring less frequently after the first year or two of sampling is appropriate.

Other recent findings:

- R-22 drilled near MDA G. Initial sampling detected Tc-99, but very near the detection limit. TC-99 has not been detected since the initial sampling except in equipment and field blanks.
- Offsite sampling of San Ildefonso Pueblo water and Buckman well field show evidence of naturally occurring uranium.
- White Rock spring sampling resulted in perchlorate values below the ion chromatography detection limit of 4 ppb. Analytical methods with lower detection limits are undergoing testing.

Conclusions:

- The most rapid groundwater pathway is the alluvial groundwater. Intermediate and regional aquifer pathways are slower.
    - Little evidence exists for large transport distances not associated with the shallow pathways.
- Mobile contaminants have impacted the regional aquifer in some locations, but at lower concentrations than the intermediate or alluvial groundwater
- Adsorbing contaminants are present only in the alluvial groundwater, and travel slowly down canyon.
- Many sources have been eliminated or significantly reduced.

**Recent Contaminant Detections Overview Questions, Comments, and Responses**

Q: What is the distance between LAOI and LA-3?
R: About 2 miles.

Q: The tritium pattern is different between the screens. Are the screens packed off and hydraulically isolated from each other?

R: They are packed off and isolated from each other.

Q: Is there the means to estimate how many flushings are represented?
R: The sampling is not just taking the water out of the well, but the water that came down the well.

Q: Was the well surged?
R: It was developed 3 times and over 120,000 gallons were removed. The water in the borehole kept rising and we could not get water into the lower screens. There is much higher tritium in the upper saturated zone. It may be a leaky system to the regional aquifer.

**Site-Wide Conceptual Model Status (B. Robinson)**
Bruce Robinson (LANL) described the site-wide conceptual model from the poster presentation. Groundwater occurs in the alluvium and it travels through the alluvium because the alluvial water is perched on the underlying bedrock. Water seeps in deeper in the subsurface and the second level of groundwater is the perched intermediate. Eventually water reaches the regional aquifer.

Alluvial travel time of non-adsorbing contaminants is 300 m/yr. Tracer tests in Mortandad Canyon had considerably higher travel time (7 km/yr), but it varied considerably as it went down canyon. The alluvial groundwater has rapid travel times. When a contaminant is added to a canyon, it moves on the order of km/yr unless it is absorbed. If a slug of tritium were released in Los Alamos Canyon, it would require more frequent monitoring than quarterly to track. Strontium would move much less quickly. Alluvial groundwater transport is a mechanism whereby contaminants from a source show up considerable distances away.

Vadose zone transport time varies based on location in dry (mesa or canyon) or wet (canyon) area. From a dry mesa, the travel time is 1000 or 10,000 years to go 100 meters. In a wet canyon, it takes decades to go through 100 meters. Canyons that received effluents are where we focus.

Profiles of contaminant concentration with depth in Mortandad Canyon show a front of nitrate moving down 300 ft. The distance that a contaminant has moved combined with moisture content is the basis for estimating the infiltration rate. In Mortandad Canyon, the infiltration rate is 100-400 mm/yr. In Bandelier Tuff, although fractured, is very porous. Water probably percolates through the rock whereas in the basalt, the flow is predominantly in fractures. At the Los Alamos Canyon low-head weir, the transport times in the basalt are much faster, < 1 year. The hydrogeology is the key contributing factor to travel time.

Model predictions of travel times in the vadose zone show long travel times except in the canyons. Pueblo and Los Alamos canyons travel times of 5, 10, and 20 years in some segments and >100 years in other segments. It is faster where the Bandelier Tuff is thin or absent and that is where the regional aquifer impacts are seen, such as in O-1. Transport along Pueblo Canyon seems to occur on the surface or near surface to where the Bandelier Tuff is absent and then to the regional aquifer. There is uncertainty associated with the modeling predictions. The uncertainty is seen in plots with low end and high end, and calibrated to observations. The low-head weir data has been a very good calibration point for the basalts.

What we want to know is what rate and direction contaminants that reach the regional aquifer go. The gradients are 3-dimensional. In the west there is significant recharge and the gradients are lateral and down. In the east there is significant discharge, so the gradients are lateral and up.

Water supply pumping also affects the gradients because the pumping is at a rate that would pull contaminants toward a water supply well. In a model simulation, the length of time it takes a particle of water at the water table to leave the system is 30 years to 30,000 years. If the particle is close to a water supply well, in the capture zone, the time is closer to the 30 years. Further away from a water supply well, the travel time is closer to the 30,000 years.

Present and future risk assessment can use these types of studies to point to what locations are most important to minimize risk to people and should be addressed first. The work to date suggests the following priorities:

- Wet canyons with historic discharges
- Vadose zone with unfavorable hydrogeology: thin Bandelier Tuff and thick Cerros del Rio basalts.
- Contaminants released close to a water supply well.

**Site-Wide Conceptual Model Status Questions, Comments, and Responses**

Q: How does S Site fit into the conceptual model?
R: There is the natural undisturbed state and then there are modifications. There was lots of water containing high explosives added to the canyon. There was enhanced infiltration that percolated over decades. Natural conditions close to the Pajarito Fault zone are different than in other locations.
C: Don't want to downplay the importance of a wet mesa top.
R: Wet areas that have been disturbed by asphalt or other modifications also have higher flux. Further west, the Bandelier Tuff is more welded and acts more like the basalts. Ribbons of saturation are seen in the more welded western mesas. While drilling the recent Canon de Valle borehole intercepted a thick fracture.

Q: Is there regional aquifer water level data over a long time period?
R: Over a period of a few years in the R-wells.

Q: How do you determine which water level measurements are the result of perturbing the system by pumping?
R: Those compiling the water level map screen the data points. If the measurement were taken when a nearby well was pumping, it would cause a depression that was only a temporary effect.

Q: Are the short pathways between the alluvial groundwater and the regional aquifer based on data from the new wells or from other studies?
R: Around O-1, there was reason to believe the fast pathway. In Mortandad canyon, on a different scale, couldn't put a finger on exactly where that pathway is. Mortandad may be the smallest scale that we can work at when looking at pathways.

Q: It looks like the County wastewater treatment plant is in the worst place possible. Do you see effects from the wastewater treatment plant?
R: The County did grading in the canyon to enhance infiltration of effluent. There was a marked increase in the nitrate concentration in O-1 right after that.

Q: On a field trip with David Broxton (LANL), he pointed out that the top is dipping a different way. Have you seen the affect of that?
R: In the modeling we have used alternate configurations of the geology. As you go deeper you really only have the borehole data. The alternatives are consistent with the data, but they

suggest a different picture. However, the contaminant distributions do not suggest very different behavior.

Q: Are there wells in Water Canyon south of the 260 outfall?
R: There are no regional aquifer wells in Water Canyon south of the 260 outfall. However, the three intermediate wells that are being installed this year will help define the gradients.

Q: A front of tritium was discussed. If there were enough wells, could you see the turning of the front?
R: That was deeper geology being referred to.

C: You could sample at Frijoles for contaminants.
R: We sample every year for high explosives at the visitors center and the Rio Grande.

Q: Couldn't you sample at Frijoles upper crossing?
R: Sampling at the upper crossing is worth looking at.

**Status of Groundwater Task, RACER Project (P. Shanahan)**
Peter Shanahan (Risk Assessment Corporation) explained that the Risk Assessment Corporation (RAC) is composed of individuals. RAC has been contracted through Colorado State University to conduct an independent analysis. This analysis is called: Risk Analysis, Communication, Evaluation, and Reduction (RACER). The emphasis is on credibility and public participation. An Independent and Comprehensive Risk Assessment for Public Health and the Environment and the Development of a Risk-Informed Decision Analysis Framework for the Los Alamos National Laboratory and Vicinity.

The project approach is a process that starts with data collection and evaluation. There is stakeholder input from any party with interest, from the Lab, community, NMED. The data collection and evaluation is used to develop a site conceptual exposure model. This is expected to be completed in February for present day risk. The next step is to develop a site conceptual exposure model for prospective risk. LANL could use it the make decisions about how to reduce risk. We are working on how to prioritize risk components, how to rank risk. The kinds of decisions that can be made are remediation decisions.

The key project tasks are:
✓Workplan
→Conceptual approach
→Stakeholder involvement and communication
→Data identification and management
→Risk assessment (just starting)
O Decision criteria (not started yet)
O Decision analysis and framework (not started yet)
→Response to peer review and stakeholder comments

Stakeholder communication includes preparing reports. The reports that have been completed are:

- Perchlorate in groundwater
- Overview of groundwater issues

The current focus of the groundwater segment of RACER is:

- Development of measurements database
- Development of site conceptual exposure model
- Development of risk calculator
- Development of screening procedures and background levels

The overall risk assessment process is making calculations of data in three databases. The databases are:

- Measurements database containing concentrations and physical parameters. It contains LANL and NMED data. It is the data table that the calculator will use for screening procedures. Also have comparisons to automate the process.
- Data Evaluations database containing spatial averaging, development of data distributions, screening, and selection of analytes
- Site Conceptual Exposure Model database containing sources, source areas, exposure scenarios, and exposure parameters. This is an Access database that is currently being set up and populated with data.The databases are accessed by the Risk Calculator, which integrates concentration, fate and transport process, and exposure scenarios to develop a risk number.

The site conceptual exposure model defines a "source" as the primary source of contaminants in the environment. Releases from sources are called "source areas". Transport from "source areas" is to "geographic area of exposure". The exposure pathway is how the public is exposed to the geographic area of exposure, the source area, or the source. An example is the TA-16 area. The source is the 260 outfall. The source area includes the soils at the outfall (now remediated); canyon sediments; alluvial aquifer; and the regional aquifer at R-25. The geographical area of exposure includes the down-gradient supply well, springs, and canyon sediments.

An example exposure pathway is: groundwater (public supply), with perchlorate, nitrate, tritium, ingested by an adult resident at a rate of 2 L/day.

The risk calculator computes the risk to the public over a large regional geographic area.

For the contemporary risk assessment there will be no modeling. It will only use existing data. The data will have to be interpolated to come up with estimates of exposure on a grid. This process is helpful in identifying data gaps. The current day risk assessment will be completed for all media. Risk for groundwater will be where the public or biota are exposed: springs, water supply wells (private and public), and the Rio Grande.

The risk calculator will take different risk with different media combined to develop the total risk from all exposure pathways. There will be holes in this, but we want to prepare a systematic way to assess risk. Will have likely exposure scenarios – we have been interviewing community members about behaviors such as the amount of hiking, what vegetables they eat, etc. We have visited schools and there will be some science fair projects on this. We are hoping to have an interactive tool to allow people to calculate risk from their own behaviors.

The prospective risk assessment needs to consider future transport and attenuation, future supply wells at arbitrary locations, and the effects of remedial actions. Modeling will be used in the prospective risk assessment. Models are required to forecast future concentrations at exposure points. The approach to modeling:

- Need to develop independent models
- Need simple models for computational efficiency

- Will examine different levels of model complexity

Possible approaches to modeling are:

- Use existing LANL models
- Simplified flow model with USGS MODFLOW (possibly transport model with EPA MT3D)
- Travel time approach:
    - Particle tracking from sources to exposure points
    - Capture-models for supply wells
- Two-dimensional or three-dimensional travel-time calculations? 2-D may be too conservative.

The RACER project can be reached at www.racteam.com.

**Status of Groundwater Task, RACER Project Questions, Comments, and Responses**

Q: In the exposure pathways, are there other members of the exposed public other than adult males?
R: At another forum this question was asked and the answer was that all age groups are included.

Q: Isn't all the data from a single day in 2001?
R: We will look at the best data and we are working on getting a qualified database. Groundwater has trends and it does not change so much that you can't use data collected at a different time. But the data must be qualified.

Q: Will you use data from springs further south?
R: Yes, the coverage shown on the map is dated. We are working on getting GIS coverages.

Q: Are accidents included in the risk assessment?
R: Comments have been received on this and we have been talking about it.

Q: The modeling code is important; it is the conceptual model that drives the model. How will you handle radically different scenarios for how contaminants get between points?
R: We must consider uncertainty, but how we will do that has not been nailed down yet.

C: Don't want to suggest non-independence, but it you use the LANL model as one set of predictions they could be compared to another set of predictions from other model(s). This would serve as a very detailed peer review for the work done at LANL.
R: Want to call Elizabeth and ask for the model.

C: The point on uncertainty is important. The uncertainty estimates should be posted.
R: If we come up with uncertainties, they will be posted.

Q: Since you are using LANL data, will people believe it?
R: Those are the only data that are available and they are better than no data. We are actively trying to get other data.

**Planned Activities for CY04 (C. Nylander)**

Charlie Nylander (LANL) described the planned activities for FY04. The field activities are:

- Drill and install 5 regional aquifer wells:
    - R-1, R-28, R-33, and R-34 in Mortandad Canyon

  - R-6 in Los Alamos Canyon
- Sampling of R-2, -4, -21, -31, -5, -8, -14, -20, -32, -16, -23
- Hydrologic testing
- Mortandad Canyon groundwater investigation
- Site-wide monitoring and water level measurements
- Special drinking water monitoring
- Groundwater discharge plan monitoring and reporting
- Permeable reactive barrier monitoring in Mortandad Canyon
- Well custodianship

The planned analysis and reports are:
- Regional aquifer modeling
- Information management
- Hydrogeologic Workplan Final Report
- Well completion reports
- Hydrologic testing reports

**Los Alamos National Laboratory**
**Groundwater Protection Program**
**Quarterly Meeting**
**October 27, 2003**
**Minutes**

**Participants**

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