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DATE: July 23, 1999

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Enclosed is the final External Advisory Group (EAG) Semi-Annual Report for your information. This report is being sent to you because you have received a copy of the Laboratory's Hydrogeologic Workplan and a binder for Annual Reports and Meeting Minutes. If you are not interested in continuing to receive reports, please contact me at the above address, or via e-mail at nylander@lanl.gov, or by telephone at (505) 665-4681. Regarding the EAG Semi-Annual Report, if you have any questions or comments, please contact Dr. Robert Charles by telephone at (307) 655-3128, by mail at 31 River Road, Box 904, Ranchester, Wyoming, 82839, or by e-mail at conehead@cyberhighway.net.

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Semi-Annual Report
to the
Groundwater Integration Team (GIT)
of the
Los Alamos National Laboratory
by the
External Advisory Group

July 20, 1999

Semi-Annual Report
to the
Groundwater Integration Team (GIT)
of the
Los Alamos National Laboratory
by the
External Advisory Group

External Advisory Group

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1.0 INTRODUCTION

The External Advisory Group (EAG – formerly the EEG) for the Groundwater Integration Team (GIT) of Los Alamos National Laboratory met 29-31 March, 1999, at Ghost Ranch, New Mexico. This was the second semi-annual review of activities proposed under the Hydrogeologic Workplan developed at the Laboratory. The EAG studied the "Groundwater Annual Status Report for Fiscal Year 1998" and the GIT "Action Plan" which responded to EAG recommendations from the first semi-annual report. The EAG also listened to a number of technical presentations, and met with many of the external stakeholders (NMED: representatives from the Oversight Bureau, Hazardous and Radioactive Materials Bureau and Ground Water Quality Bureau; representatives from three of the neighboring Pueblos: Santa Clara, San Ildefonso, and Jemez; and the representatives of the Citizens Advisory Board). Prior to creating this report, members of the team also reviewed the Groundwater Protection Management Program Plan (GWPMP), the Monitoring Well Installation Project (MWIP) Project Execution Plan (PEP), the Groundwater Integration Team Implementation Plan (GITIP), and interim completion reports for several wells (R-9, R-12, alluvial wells). In addition, the "Groundwater Annual Status Summary Report for Fiscal Year 1997" and the "Hydrogeologic Workplan" were revisited. The reviewing team consisted of Elizabeth L. Anderson, Robert W. Charles, Robert M. Powell, Jack D. Powers, and David C. Schafer. All participated in the review and the preparation of this document. This report summarizes the team's discussions, impressions, and recommendations.

2.0 MANAGEMENT AND GLOBAL ISSUES

2.1 Program Management

Sufficient interactions have occurred with the Los Alamos Program Management, consisting of the Program Manager and the Groundwater Integration Team, to present some impressions on management style and its effectiveness in balancing process and product. The management is to be commended for its ability to balance the interests of many internal and external stakeholders in order to show substantive progress in the technical program without abrogating its management authority. More will be said about the relationships with the external stakeholders in the following section. The overall management style is collaborative, and, whenever reasonable, compromising in its efforts to control uncertainty and manage conflict. The result is to maintain the more political behaviors of the stakeholders in abeyance while moving the project forward. This should promote completion of the project and mission as stated in the original Hydrogeologic Workplan.

Abundant communication (also dealt with in more detail below) clarifies the scheduling of activities and the reasoning behind decision making. Management skillfully uses an iterative approach to decision making. The EAG concurs that this approach is needed for such a complex technical and political program. Overall, the management style has produced effective collaborations with many organizations at the working level.

Managing these meetings to gain consensus is an effective display of leadership by the GIT. It addresses the concerns of all parties while impressing them with the need to show progress in pursuit of the mission. The EAG does not feel it has enough information to comment upon collaborations at higher levels in the administrations of the dominant parties; LANL, DOE, and NMED, in particular. However, the EAG does feel that it is important for collaborations at these levels to be ongoing and productive, thus facilitating progress toward the common goals at the level of the employees implementing the GWPMP, the Hydrogeologic Workplan, and related environmental programs. It is also important for information to flow freely from the implementation levels to upper management within these organizations and vice versa.

These philosophical observations aside, the EAG advises some additional consideration to more effort in elucidating the cost effectiveness of the program through some form of benchmarking. We concur with the cost comparisons that have occurred, but recommend a more detailed comparison with similar programs that might include work at the Nevada Test Site or similar tasks. For example, recent information suggests that deep wells are being drilled at the Nevada Test Site to a depth of 5000 feet for approximately $2,000,000 per well. Cost-per-foot comparisons of drilling techniques might be a useful benchmark (such comparisons, of course, tempered by considerations of the anticipated completed-well sample quality among the techniques). While a full benchmarking exercise does not appear warranted, more effort in this area will help relations with the funding entities internal and external to Los Alamos National Laboratory. These include LANL's Environmental Restoration Program, the Defense Programs Offices and external Direct DOE contacts.

2.2 Management of Stakeholder Issues

The EAG noted the presence of several interested parties from various offices of DOE. We felt their contributions to the meeting were helpful and constructive.

The EAG met with other external stakeholders in a separate meeting on the morning of March 30. This was a frank and open discussion and enumeration of these stakeholders' concerns. The unedited concerns are appended to this report. Following this meeting, these stakeholders met with the GIT and EAG to present the concerns and receive direct response to many of the items listed. The EAG was pleased with the open and detailed comments of the parties. The EAG congratulates NMED for its energetic and substantive response to this opportunity for self expression. NMED seems pleased with the opportunity to take sample splits and carry out independent analyses and independent sampling. They appear, however, to be schedule-limited in their ability to respond to reviews, reports, and other needs of the Hydrogeologic Workplan. The EAG feels the stakeholders were pleased overall with the opportunity to express themselves, even though some of the issues will take effort and time to resolve. We found this forum to be very valuable and recommend it be continued.

The issues addressed far transcended technical matters. Issues of culture, politics, personal, and legal import were examined in the brief time allotted. Certain time and goal incompatibilities were noted. These issues are expressed more completely in the appendix, but included:

- The involvement in planning at the earliest possible time.
- The prompt distribution of data and stakeholder database needs
- The course of action should plumes of contaminants be identified.
- The need for data from intermediate depth wells.
- The reprioritization methods for deep wells.
- The drilling method supporting these goals.
- The compartmentalization of funding for legacy vs. current waste issues.
- The time for completion of wells under construction (i.e. "parking of wells")
- The technical well site and completion decisions, including screen lengths and locations
- The methods of sample collection and analysis
- The modeling-versus-monitoring relationship and the need for modeling DQOs
- The further clarification of recharge influences to the regional aquifer
- The various LANL groups use of differing guidelines, processes and validation techniques

The management of these occasionally conflicting priorities within, or in addition to, the mission of the Hydrogeologic Workplan will have to be continuously and exhaustively addressed to obtain the needed consensus for the mission to be a success. The EAG found that, although intermediate goals are in some conflict, the overall mission objectives (as expressed in the Hydrogeologic Workplan) do not appear to be in conflict with the desires of the external stakeholders. These joint stakeholder/GIT forums should lead to better internalization of the mission by all parties. Stated differently, although the external stakeholders may disagree with some of the decisions, they trust the parties making these decisions to carefully weigh their input before decisions are made.

A number of future directions were initiated during the discussion with all parties on 30 Mar. These directions developed from discussions that were organized into four major Issue Areas:

- Common Issues
- Data Needs Issues
- Regulatory Issues
- Technical Issues

Within these Issue Areas, a number of sub-issues and concerns were discussed, and ideas were put forth for the direction of future processes to address these issues. Among these were:

- Agendas for quarterly meetings will be pre-examined by all stakeholders to develop a schedule that will address a wider variety of concerns.
- Discussions will be held at the quarterly meetings but decisions will not be demanded.
- Changes in the direction of the Hydrogeologic Workplan will be documented within annual reports.
- Validation needs for data may be examined for categorizing data as "screening" or "final" with procedures for handling each.
- Data validation should follow a set process rather than a set timetable.
- Methods for increasing funding flexibility between DP and EM will be considered.
- Multiple well completions will aid in the definition of the hydrogeologic situation at intermediate depths.
- The issue of contaminant plumes needs to be pursued within the Laboratory and DOE in order to develop a policy for their definition and disposition that is in alignment with the concerns of the external stakeholders. (See Risk Conceptual Approach below)

2.3 Action Plan for Recommendations of the EAG 23 October, 1998

The EAG found that the GIT did a thorough job responding to our comments resulting from the GIT/EAG's first meeting in August, 1998. A draft action plan was presented at the recent meeting. Since this action plan is a draft, the EAG will comment only briefly upon its content. There was general agreement with the recommendations and a number of proposed (draft?) actions have already been implemented. These include: continuing extensive communications, adding NMED representative to EAG semi-annual meeting agenda, updating well priorities, continuing review of data needs, testing Westbay™ systems, and implementing an improved data management system. Principal recommendations that need to be considered further involve use of ACL's and MCL's, relationship with other LANL entities and other stakeholders, low flow sampling, benchmarking and/or similar activities, work with intermediate zones in wells, drilling and well completion activities, and review of data needs.

2.4 Communications

There is a lengthy list of communication tools that are being used to interactively engage the multitude of stakeholders. These tools include the quarterly and semi-annual meetings; the annual reports, the Hydrogeologic Workplan, as well as many less formal communication modes. These communication tools attempt to avoid the convoluted jargon that is often associated with the esoteric specialties of the participants. To a large extent, this attempt is successful. At the recent meeting, each

speaker (and the Program Manager in particular) displayed openness and an absence of paternalism when addressing questions from the audience regardless of the background of the interlocutor. This is not to say communications are biased to what the questioner/audience wants to hear, but are successful in removing uncertainty from the process of decision making and in highlighting areas of disagreement so they may be pursued in due course.

The location of the recent meeting was an aid to communication. The sequestered nature of the meeting location (Ghost Ranch, New Mexico) helped to focus the participants upon the work at hand by temporarily severing them from the day-to-day operations of their home organizations. This also greatly enhanced the team-building aspects of the process among participants with widely variant backgrounds.

The EAG finds the Groundwater Annual Status Reports to be effective updates for the activities described in the Hydrogeologic Workplan. Objectives could be tracked from the Workplan to the First and the Second (current) annual reports. The complete list of deep wells reprioritization in the 98 Annual Report is noted. Other technical aspects of the Annual Report are covered in the next section. The presentations made at the Annual Meeting would benefit from the addition of hard copies from some of the speakers' more technical presentation materials.

The EAG semi-annual meetings are an effective communication tool. The EAG, apparently with the concurrence of some of the external stakeholders, would recommend a session, perhaps one-half to one day, that could split into concurrent technical subsessions. These could deal in more detail with drilling activities, hydrology, geochemistry, geology, or other topics. While open to all, this would enable more thorough discussions on particularized results and processes that might bog down a meeting of the whole group.

Pursuant with the overall openness of the program, there are a number of aspects of the Internet that could be used to further facilitate communications within LANL and between LANL and the various other stakeholder groups. In addition to email and the posting of analytical data, there is the potential for posting various reports and program plans for download in standardized formats (.PDF, for example); maintaining real-time status information on well completions and re-prioritizations; maintaining message boards for the posting of questions, responses, and suggestions; the development of a news group mailing list for subscribers to receive periodic updates; etc.

2.5 EAG Management

The mission of the EAG (formerly EEG) is in an advisory capacity, hence the name change. Although the EAG may evaluate some aspects of the activity, it primarily offers advice in decision making that may be used at the discretion of the GIT. To better accomplish this, the EAG requests the addition of two new members in the general areas of geoscience and environmental economics to supplement current expertise, as

well as to replace a former member. The addition of temporary members on an as-needed basis is also requested if a specialty is desired for a shorter time frame. Semi annual meetings of the EAG as a whole are adequate.

2.6 Development of a Risk-based Conceptual Approach During Implementation

A risk-based conceptual plan for determining the public health significance of contamination discovered in groundwater during well drilling activities should be developed by LANL in cooperation with NMED. The goal of this plan should be to reach early agreements that have been established and accepted by all stakeholders and that will guide decisions and actions following the potential discovery of contamination in groundwater on LANL property. For example, resources could be re-allocated for "plume chasing" from planned well drilling activities, should the importance of potential risk so dictate. This risk-based conceptual plan would provide the basis for decision making and should address risk issues that can be aggregated into three categories:

1. Chemicals of Concern: Chemicals of potential concern (COPCs); their toxic endpoints (if known); existing standards/criteria/RfCs/RfDs/cancer potency factors and their quality (i.e., currency of database and methods); common endpoints to predetermine appropriate additivity of risk; and identification of those chemicals that lack toxicity characterization/data and/or existing guidance levels need to be assembled. In the latter case, chemicals that lack toxicity test data may be characterized tentatively by comparison to related chemicals that have been tested. If levels of contamination (and related potential risks) and the frequency of occurrence are high, some testing may be necessary.

2. Source, Transport, and Fate: Contaminant source, transport, and fate from the area of contamination to the nearest receptors should be anticipated, even if it is only possible to use rough estimates until better refined methods are developed. Consideration of background, age, mobility, stability, the occurrence of breakdown products, other chemical alterations, and related information should be documented to the extent possible. Geochemistry and site-specific factors will be critical to these determinations, as well as knowledge of groundwater movement and potential interactions with and interceptions by receptors. All these factors will also be important to considerations of natural attenuation.

3. Exposure to Receptors: The potential for contaminants to reach receptors and the estimation of the potential exposure levels by drinking water; discharge of groundwater to surface water; and through springs to agricultural areas that might permit chemicals to be taken into the food chain through fruit and vegetable pathways or through indirect pathways such as consumption of dairy products, poultry, beef, or fish should be identified. Likewise, the COPCs that are likely to bioaccumulate should be determined. If either no COPCs are thought to bioaccumulate, or the potential for discharge of groundwater to streams or grazing and farmlands exists, these considerations may be deleted from the risk-based approach.

Finally, we recognize that considerable work is already underway that contributes significantly to this overall plan. We applaud these efforts and recognize the excellence of the work being accomplished. To expand and support these efforts, a description of risk-based approaches that have been adopted by other regulatory agencies, including the EPA and other states, particularly for similar chemicals and sites, might be instructive in the development of a solid, comprehensive risk-based plan that can be agreed to by NMED and accepted by all stakeholders. Acceptance of site-specific, alternate contaminant levels (ACLs) as an approach should be included in the plan. A risk-based approach that anticipates the possibility of finding pollutants in groundwater and can address the potential consequences can be immediately available to determine public health significance and ecological safety as the Hydrogeologic Workplan activities progress.

2.7 Data Quality Objectives (DQOs)

Early on, the DQO process was used to determine what the geoscientists would need to develop a hydrogeologic model. The objectives resulting from this process were then outlined to the drilling personnel who, in turn, utilized these objectives to develop the present method of drilling deep monitoring wells such as R-25. The EAG feels that, after an additional 5 or 6 wells have been drilled using this method, time should be allowed to review and evaluate the results.

The DQO process that was implemented and described within the Hydrogeologic Workplan is an excellent example of the use of the DQO process within the context of site characterization. It carefully, and in great detail, addresses the numerous decisions that must be made in the process of performing the hydrogeologic characterization and the factors and discoveries that impact those decisions. The Hydrogeologic Workplan DQO process is developed to not only allow, but to encourage iterative re-evaluation of each step in the decision process. It is based on four geophysical scenarios and assumes, of course, that the combination of these four scenarios is adequate to generally describe the continuum of conditions that exist upon the Pajarito plateau and, more specifically, within the boundaries of LANL. The EAG believes that these scenarios are generally adequate but should be occasionally reconsidered, in conjunction with updates of the hydrogeologic conceptual models, as actual site characterization data are obtained. The ongoing modeling efforts, when verified with field data, might also be used in this effort. If the scenarios are refined, possibly by adding new scenarios or modifying the four original scenarios, the decisions and subordinate questions (and the means for answering these questions) will also need to be re-evaluated and possibly redesigned.

Although the DQO process for the overall hydrogeologic characterization effort is basically sound, there are subordinate issues that the EAG believes could benefit from the implementation of DQO processes. These include:

1. The well completion and development process
2. The sample collection and handling process
3. The data validation process
4. The database development process
5. The model development process

The level of detail for these processes might not need to be as extensive as for the four geophysical scenarios, but should be sufficient to provide an understanding of how the decisions within these processes are being made. We believe that the implementation of these additional DQO processes by the GIT would serve to abrogate any stakeholder concerns with regard to LANL openness and overcome the impression that the various groups at LANL are using operating methods and processes independently of one another.

2.8 Recommendations and Requests

The following is a summary of the recommendations and requests that have been presented above:

1. Develop an understanding the relationships of upper management among the stakeholders.
2. Pursue some aspects of benchmarking.
3. Continue meetings between external stakeholders and the EAG.
4. Continue extensive communication efforts, including the expansion of Internet utilization.
5. Continue preparation and implementation of action plans responding to the EAG's recommendations.
6. Continue providing meeting locations that enhance focus.
7. Prepare hard copies of presenter's more technical transparencies.
8. Add some technical sessions.
9. Add EAG members for geoscience and economics expertise and, possibly temporary members in other areas.
10. Develop a risk-based conceptual plan in three categories: Chemicals of Concern, Source, Transport and Fate, and Exposure to Receptors.
11. Have EAG review LANL's risk assessment team results and future plans.
12. Develop a risk-based approach for interpreting the significance of finding on-site well contamination; as the site-specific, alternate contaminant level (ACL) approach has proven most useful for complex sites such as LANL.
13. Compare such plans to those used by other regulatory agencies (e.g. EPA) and other states.
14. Establish acceptance of site specific ACLs.

15. Reconsider the Hydrogeologic Workplan DQO scenarios when updating the hydrogeologic conceptual models.
16. Develop DQOs for processes subordinate, but essential to, the hydrogeologic characterization such as well completion, sample collection, data validation, database development, and model development.

3.0 TECHNICAL ISSUES

3.1 Data Gathering

The data gathering efforts should be guided by the use of DQO processes, as previously discussed. Within these processes, every effort should be made to ascertain that data gathering is carried out using the best available and most effective scientific techniques. For example, should it be decided to continue using borehole geophysical logging techniques, the most modern and accurate technologies should be implemented rather than the older, admittedly more familiar, technologies.

Laboratory analyses are, in general, highly standardized and most adhere to approved methodologies that provide a high level of confidence in the data. Laboratory data is, however, only as good as the quality of the samples gathered in the field. If field samples are not properly collected, preserved, and stored, then the laboratory data is of dubious value. The EAG recommends that LANL begin an active effort to coordinate and standardize these processes between and among its various environmental groups. We are aware that the missions, hence the data needs, of these groups are often distinct and require procedures within a group that are either not required or exceed the requirements of other groups. Nevertheless, standardization of methodologies across groups should be considered whenever possible. This would provide a much higher overall level of data consistency and facilitate the data entry and use of a central database for storage and modeling input.

Due to the importance of the data gathering processes to the success of the hydrogeologic characterization effort, the EAG recommends that a special session be held during our next meeting with LANL and the stakeholders. This session should address both the managerial and specific technical aspects of the data gathering and data collection processes. The topics could include (but are not limited to):

- Management needs to integrate and standardize processes across programs.
- Core collection, evaluation, storage and subsequent testing.
- Well completions, including locations of screens, depths, development, etc. based on preliminary data.
- Ground water sampling techniques, including devices, methods, indicator parameters, storage, and chain-of-custody.
- Validation of non-standardized tests, such as partitioning determinations, geochemical modeling estimates, etc.
- Validation of analytical data for distribution to stakeholders and database entry.

3.2 Database

The EAG considers the development of the database, as discussed by the GIT in the Hydrogeologic Workplan, to be of central importance to the success of the hydrogeologic characterization and, potentially, the protection of human health and the environment. The database is needed to serve as a central focal point for the development of standardized and validated data. It is important as a vehicle for distributing data to LANL scientists and other internal and external stakeholders. The database is needed to serve as the underpinning of LANL geographic information system (GIS) visualizations and it should also serve as the primary source, perhaps the only source, of validated analytical data for the 2-D and 3-D hydrogeologic site models.

It is clear that both LANL employees and contractors, such as Harding Lawson Associates (HLA), understand the importance of the database and have put a significant amount of time and effort into conceptualizing its development and operation. However, the organization, implementation and current status of the development of the database is still somewhat unclear to the EAG. We note that the Hydrogeologic Workplan and other documents indicate that the database will be developed within FIMAD, an Oracle/ArcInfo-based system. However, the FY97 Annual report indicates that 173,000 records of historic environmental data have been entered into a Microsoft Access database. Although we are not database experts, it is not clear to the EAG how this information will be accessible via FIMAD. The EAG would also like to better understand the rationale behind the HLA recommendation to manage the Hydrogeologic Workplan database separate from the ER database.

We note, with some concern, from the FY98 Annual Report that there is very little funding for development of the database and, at current funding levels, it will not be a comprehensive database. The EAG would like to see this funding issue addressed and would be interested in assisting the GIT in conveying the importance of this aspect of the Hydrogeologic Workplan to the appropriate funding programs.

3.3 Modeling

3.3.1 Geologic Modeling Activities

The approach to the geologic model seems appropriate and effective. It appears that substantial progress has been made over the last three years. We were particularly pleased to see solid teamwork among modelers and the geology team. There was an attempt to predict stratigraphic markers in wells. We would like to see a prediction for future wells (R-7, etc.).

3.3.2 Geochemical Modeling Activities

Geochemical modeling is proceeding with calculations that seem to at least verify observations in the wells that have been drilled. For instance, calculations of uranium concentrations in R-9 seem to validate the observed concentrations (p. 39 Interim Completion Report for Characterization Well R-9, as well as the presentation at the annual meeting). The EAG would like to see more of these calculations including distribution of species, activity coefficients, compound formation, affinity calculations, etc. Clearly, some of this has been initiated. It would also be useful to further verify the surface complexation modeling studies by carrying out sorption isotherm experiments using fresh core materials from the zones of interest. This combination of complexation modeling, observed concentrations, and isotherm evaluations would be very effective for increasing confidence in the modeling results and the calculation of retardation factors and sorption capacities. We are not trying to rush the work, but are as interested in the overall implications as the on-site investigators. Perhaps review of this work could be done in a technical forum subset in a subsequent meeting. The draft completion reports (for R-9 and R-12), although not completely digested by the EAG, summarize the abundant data gathered in all areas, including geochemical data. There is abundant evidence of computational interpretations of the data. There appears to be great energy and inspiration displayed by the geochemists interpreting the data. EAG would like to know how this is being developed into an overall geochemical model for the Pajarito system.

3.3.3 Hydrologic Modeling Activities

The information made available to the EAG at the March meeting was largely general and conceptual in nature. During the information presentations, we received very little detailed information on specific model configurations, input parameters and output results. Therefore, it is difficult for us to evaluate the effectiveness of the models generated to date and the appropriateness of the input parameters selected. It would be unfortunate if the principals have to wait until 2002 or 2003 to get significant modeling results from this effort. We feel the current personnel are quite capable of producing tentative results in a more timely fashion.

In general, however, the process that has been taken thus far seems appropriate. The use of finite element modeling codes is probably essential given the size and complexity of the area being modeled and the need for both saturated and unsaturated zone modeling. The use of the Finite Element Heat and Mass Transfer (FEHM) code seems appropriate due to the history of it's use at LANL and the Nevada Test Site. For much of the modeling, the use of codes other than finite element would probably be inefficient, if not impossible.

The segmented approach of breaking the site into three pieces (material disposal areas, canyons and regional aquifer) is a good one. It allows modeling to proceed simultaneously in several areas, i.e., regional scale modeling can proceed, with the addition of source terms after they have been established. The segmented approach

also makes each modeling task less formidable than it might otherwise be. The conceptual models proposed for these three areas seem well reasoned and appropriate, to the extent that we can discern. The iterative approach of using the models as predictors and then modifying the conceptual model based on observed versus predicted data is a good one.

We concur with the plans to further refine the regional scale model and also create a more detailed submodel of the Pajarito Plateau. The proposed installation of stream flow gauging stations should help in obtaining valuable model calibration data.

In the future, as model reports are generated, it would be helpful if this information could be provided to the EAG for review. We are particularly interested in predictions about hydrologic conditions in succeeding wells. First predictions may be widely variant from observations, but this only provides data for model improvement. As predictions come to fruition with model evolution, many of the potential objections to method, interpretations, etc. will wane.

Although given in a separate presentation, the EAG was pleased to see attempts to identify and quantify recharge to the hydrologic system. As we understand it, most of the recharge appears to be off-site, with the mountain region to the west providing significant recharge. Stream flow recharge appears to be minor. Well R-31 will help elucidate some of these issues. We recognize the difficulty in exactly defining these parameters, but applaud this first attempt to do so. Previously, statements addressing recharge only expressed where it did not occur.

3.4 Drilling Activities

3.4.1 Drilling Approach

The first success story, well R-25, has been recently completed to a depth of 1942 feet. The planned depth was originally 1550 feet. The drilling cost, per foot of hole, showed a marked reduction compared to wells R-9 and R-12. While the cost per foot has improved, continuous efforts need to be made to further reduce the cost per foot of drilling. Because the costs are still somewhat high, several issues should be pursued in the future to continue to reduce drilling costs. These issues are as follows:

1. Data quality objectives should be evaluated continually to make sure that we are getting the right data, evaluating it properly, and using all that is verifiable.
2. Much of the drilling cost is associated with the need to carefully seal and sample individual perched zones on the way to the regional aquifer. With the option of installing Westbay™ equipment, it may be practical to use a faster drilling method to construct the borehole (sampling to the extent possible while using the faster drilling method) and do the detailed zone sampling and piezometric head measurements after the well is completed.
3. LANL drilling costs should continue to be compared with those at other sites, such as the Nevada Test Site, to aid benchmarking as presented above.

4. Other drilling contractors should to be involved in this process and should have an opportunity to bid on the work, particularly after about 5 or 6 wells have been established.
5. Faster drilling methods than are currently being used for the R-series wells should be considered for "plume chasing".

3.4.2 Casing and Screen Design

The EAG would like the opportunity to review the design of the stainless steel screens and casing installed in the deep monitoring wells. The great length of casing and screen sections installed in these wells places tremendous stress on the well components. It is essential that the screens and casings be designed not only to withstand the installation forces but also to have an adequate safety factor so that the risk of failure in future installations is minimal. The EAG has unique experience in designing and installing profile wire screens in ultra-deep boreholes and would like the opportunity to review the designs.

Some of the well screens installed in R-25 were not designed adequately for the installation depth. It is possible that some of these screens may have been damaged slightly during installation. The degree of deformation that occurred may have been exacerbated by the light weight construction. Failure risks such as this can be minimized in the future by careful design of the well components.

3.5 Recommendations and Requests

The following is a summary of the recommendations and requests that have been presented above:

1. Data gathering efforts should utilize DQO processes and a special session discussing these efforts should be held.
2. Database issues should be clarified and funding issues for database development should be given a high priority
3. The geologic model should be used for preliminary predictions of stratigraphic boundaries.
4. An overall geochemical model should be developed.
5. Additional hydrogeologic modeling results should be presented.
6. The segmented approach to site modeling should be continued.
7. Review of hydrologic modeling reports is requested by the EAG.
8. The locations and rates of recharge should continue to be defined.
9. Improvement of drilling cost analyses as part of benchmarking should continue.
10. Review of the design of stainless steel screens installed in the deep monitoring wells is requested by the EAG.

APPENDIX: OUTLINE OF RAW COMMENTS BY EXTERNAL STAKEHOLDERS

Key
R = regulatory
T = technical
C = communication

Unresolved Issues

Parking wells – **T**

Cost drilling/Info – **T**
(rebidding)

Format of quarterly meeting –**C**
- should: working session – too large

Schedule of drilling – **C**

Prioritization of drilling (county of LA – 10 parcels) clean – **C**
- delay in doing prioritized work
- coordinate with canyons

Plume chasing – **R**
- how
- when
- funding

Funding – **R**
- regimented funding DP vs. ER
- HGWP vs. Canyons Focus Area (changing priorities)

Sampling of supply wells (numbers frequency and analytes) – **T**

Stakeholder database needs – **C**

Use or misuse of large screened wells – **T**
- brought up before

Intermediate wells – **R**

Scope of influence of outfall 260 – **T**

Drilling rebid/reevaluation – **T**

Modeling not substitute for monitoring – **T**

Structure data needs for modeling, DQOs for modeling – **T**

Technical calls at drill site by wrong person – **T**

Info from downhole logging – **T**
- for multiport system especially

Temporary PVC in R-9 and R-12 – **T**

Decision to use Barber rig – **T**

Cochiti – **C**

Recharge from Jemez needs clarification – **C**

Dry mesas regarding no transport of waste – **T**

R-25: remediation/treatment – **T**

Share more info about contamination of aquifer – **C**
- visibility of program within the Lab

Guaje info – **C**

Quality of historical data – **C**
- collection methods
- analysis methods
- reporting
- validation

GIT size: too many cooks – methods of approval – **C**

Data collection – distribution delays (clearing house internally for data) – **C**
- data which has not gone through regulators
- compartmentalization
- search mechanism

Individual meetings with CAB, State – **C**

Positive Issues

Scientists

Communications
- upper management should know (LANL, NMED)

Progress

Unresolved issues partly non LANL (Barber)

Spirit of cooperation

Prioritization scheme

Iterative nature

Geochemistry

EEG formulation

Data exchange improving

Hydrogeologic Workplan is a plus
- well thought out

Nylander

Teamwork within LANL

CAB appreciation (membership)

Pueblo involvement

Stakeholder involvement

Web site (address)

Database improvement
- read and understand

Change in upper management (Canepa)

Collection Coordination

Data – validation issues (timely?)

Process issues agreement leading to release within LANL

Sharing procedures intra LANL

Data release externally