TA-72

Young, John, NMENV

From: Danny Katzman [katzman@lanl.gov]
Sent: Tuesday, May 15, 2007 2:39 PM
To: Young, John, NMENV
Cc: Shen, Hai, NMENV
Subject: R-35 Proposed Well Design

Attachments: R35a_geophysical_log_composite2-600scale_sat_zone.pdf; R-35 Well Design2.doc; R-35a well design.pdf; R-35SC~1.pdf

R35a_geophysical_log_composite... R-35 Well Design2.doc (57 KB) R-35a well design.pdf (131 KB). R-35SC~1.pdf (49 KB)

John,

Attached are a proposed well design for R-35a, discussion of our rational for screen placement, and a schematic of select borehole data. Please review and if it looks good, respond via e-mail with your approval. If you have questions, please call Mark Everett (231-6002) or me.

Thanks,

Danny Katzman
Water Stewardship Program Manager
LANL Environmental Programs
7-6333 (ph)C:\Program Files\Qualcomm\Eudora\attach\R-35 Well Design2.doc
699-1042 (cell)
5-4747 (fax)

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Review of R-35a and R-35b Well Objectives from Work Plan

Conceptual Model	Hexavalent chromium contamination is present in the upper part of the regional groundwater system at R-11 and R-28. Natural hydraulic gradients in the area are expected to cause the contamination to move eastward with possible local northeast gradients resulting from the pumping of municipal water at PM-3. Thick Miocene basalt probably provides a lower confining bed for the vertical movement of chromium contamination, restricting the movement of chromium to the portion of the aquifer adjacent to the upper part of the well screen at PM-3. Two conceptual models of groundwater flow were presented in the "Interim Measures Work Plan for Chromium Contamination in Groundwater." According to the first conceptual model, the top of the regional zone of saturation has a poor hydrologic connection with deeper zones pumped at PM-3 because of the strong vertical anisotropy of aquifer materials. In this case, groundwater flows laterally downgradient and may not be drawn into the submerged screen at PM-3. According to the second conceptual model, natural and pumping-induced vertical gradients cause groundwater to be drawn towards the PM-3 well screen, resulting in the distribution of chromium over a greater vertical depth. The two R-35 wells are designed to test elements of these conceptual models by determining the eastern extent of chromium contamination in the vicinity of PM-3 and the vertical distribution of chromium in the interval near the top of the PM-3 well screen.
Primary Purpose	The two single-screen wells at the R-35 location will result in two well screens set at different depths in the regional groundwater system for measuring water quality and pumping responses associated with pumping at production wells, especially at PM-3. • R-35a, the deeper of the two wells, will contain a well screen that is placed within the depth interval of the upper part of the well screen (louvers) at PM-3. R-35b will contain a well screen placed near the top of the regional zone of saturation. The paired-well configuration is designed to answer the following questions about water quality: (1) is chromium contamination present in regional groundwater near PM-3, and (2) if present, does chromium in groundwater vary as a function of depth, and is it likely to be drawn into the well screen at PM-3? If chromium contamination is not present, then the R-35 wells will be used as sentry wells for PM-3. • Water levels in the paired wells will be monitored using dedicated transducers to identify hydraulic responses to pumping at production wells, especially PM-3. These data will be used to evaluate hydraulic connectivity in the regional zone of saturation between the upper portions of the regional groundwater and deeper zones corresponding to the upper screen interval at PM-3.
Hydrogeologic and Geochemical Objectives	• The objective of the shallow screen at R-35b is to further define the lateral extent of chromium contamination in the regional groundwater. The proposed location is especially important for determining if LANL-derived contamination is present in regional groundwater in the vicinity of PM-3. • The deep screen at R-35a will help define the vertical extent of chromium (and other) contamination and is especially important in the context of monitoring for potential impacts to PM-3 because it will be placed within a zone that may be a potential pathway for contamination to enter PM-3. • If chromium is not present in one or both wells, the R-35 well pair may be used as sentry wells upgradient of PM-3. • Water levels at R-35a and R-35b will be continuously monitored during pumping of PM-3 to evaluate the hydraulic connectivity in the regional zone of saturation between the water table and the upper production zone at PM-3.

R-35a Recommended Well Design

The recommended R-35a well installation a single-screen well with a 40-ft stainless-steel, 20 slot, wire-wrapped well screen extending from 1010 ft to 1050 ft bgs. The primary filter pack will consist of 10/20 sand extending 5 ft above and below the screen openings. A 2-ft secondary filter pack will be placed above the primary filter pack. The proposed well design is shown in Figure 1.

Information that was used to select this well design is summarized below.

R-35a Well Design Considerations

Based on work plan objectives as summarized in the table above, the R-35a well screen targets the transmissive portion of the regional aquifer in the depth interval between the top of the louvers at PM-3 and the top of the Miocene basalt. At R-35a, this initial target zone lies between a depth of 970 and 1132 ft bgs, an interval of 162 ft. The louvers at PM-3 are 1576 ft long, thus a screen placed anywhere within this initial zone of interest will sample groundwater entering the highest portion (upper 10%) of the well screen at PM-3.

Geologic Considerations – The interval from 970 and 1132 ft bgs includes, in descending order, the Pliocene Puye Formation, Miocene volcaniclastic sediments rocks of the Santa Fe Group, and Miocene basalt. The contact between the volcaniclastic rocks of the Puye Formation and the Santa Fe Group is uncertain, and it is currently placed at a depth of 880 ft; this marks the top of a 20-ft-thick sequence of reworked aphyric vitric pumice that make up >80% of the cuttings; in other nearby wells these pumiceous deposits yield ages around 7 Ma (Miocene) and are correlated to Peralta Tuff of the Jemez volcanic field.

Drill cuttings from the 970 and 1132 ft interval are dominated by mostly variably-cemented, well stratified lithic sands and gravels made up of volcanic detritus. High resistivity values in the cased-hole conductivity logs supports the interpretation that sands and gravels are major components of these strata. The amount of silts and fine sands in these strata cannot be reliably estimated because cuttings were collected from the high-pressure discharge line using relatively coarse strainers. Nonetheless, silt and fine sand can be found in the cuttings adhering to gravels and as cemented siltstone and sandstone clasts and are inferred to be present throughout the stratigraphic sequence. Although cementation is not extensive, calcite-cemented clasts of sandstone and pebbly sandstone occur intermittently in cuttings below about 900 ft depth. Also, clay-altered tuffaceous sandstones are interbedded with the sands and gravels below about 985 ft. Where present, calcite- and clay-cemented clasts preserve examples of rock textures that indicate that grain sorting in these strata is highly variable. Vertical geophysical log responses at R-35a and imaging data from nearby boreholes such as R-13 and R-28 suggests that individual beds within the regional aquifer in this area range in thickness from a few inches to up to 3 ft thick. Thus the proposed 40 ft well screen will include highly stratified strata with heterogeneous properties – this is characteristic of the aquifer in this hydrogeologic setting.

The proposed screen is located between 1010 ft and 1050 ft bgs within an interval that includes medium to coarse sands and gravels and clay-altered tuffaceous sandstones. A 40 ft screen was selected across this interval to increase the chances of capturing transmissive zones within these highly heterogeneous sedimentary deposits. The upper part of the screen interval contains mostly sands and gravels and probably represents relatively transmissive strata. The lower screen interval is mostly clay-altered tuffaceous sandstone. The clay alteration suggests the tuffaceous sandstone may have poor hydraulic characteristics, but high estimated water production and elevated molybdenum concentrations in groundwater screening data (discussed below) suggest these rocks probably contain transmissive intervals. The distribution of rock lithologies is shown in Figure 2.

Borehole Geophysics – Borehole geophysics was performed through the 10-in casing below a depth of 940 ft. Selected porosity, cased hole resistivity, spectral gamma, and elemental capture spectroscopy for rocks below the water table are shown in Figure 3. The different geophysical measurements correspond very well across this interval, particularly the multiple porosity measurements, providing confidence that the log quality is very good. Density and neutron porosity in

the proposed screen interval of 1010 ft to 1050 ft ranges between 30% and 50%, as does porosity derived from the geochemical log hydrogen spectroscopy measurement. The interval from 1010 to 1025 ft has porosities of about 30%; these porosities support the interpretation that these strata consist of relatively clean sands and gravels. The porosities of the tuffaceous sands in the lower part of the screen interval (1035 to 1050 ft) are as high as 50%; these may reflect a greater abundance of poorly compacted fine-grain material such as volcanic ash. Other geophysical logs corroborate this; for example the deep-reading cased hole resistivity log measures low resistivity (high conductivity) in the high porosity zones at 940 ft and 985 ft – indicative of finer grained material.

Borehole Groundwater Screening Results – Groundwater screening samples were collected from the cased borehole at 20 ft intervals, and the samples were analyzed at EES-6 geochemistry for metals and anions. Selected analyses for the borehole samples are shown as a function of depth in Figure 2. Significant features of the borehole analyses include:

1. Chromium concentrations are below background (UTL = 6.62 μg/L) concentrations in all samples.

2. Molybdenum, a contaminant released to Sandia Canyon, occurs at concentrations significantly above background UTL values (3.82 μg/L) in all samples. The highest concentrations are two orders of magnitude above background in samples from 800 to 840 ft. Molybdenum concentrations generally decrease down hole.

3. Sulfate is elevated a sample at 800 ft depth (coinciding with a sample containing high Mo) and in a sample 980 ft (coinciding with a sample containing elevated chloride).

Because chromium concentrations are below background values in all groundwater screening samples, the widespread distribution of elevated molybdenum concentrations is used to guide the identification of potential groundwater pathways and for selecting the depth interval for the well screens at R-35a and R-35b. The R-35b well that is currently being drilled will target the zone of highest molybdenum concentrations that occur just below the water table. At R-35a, the well screen of 1010 to 1050 ft targets the zone that includes some of the highest molybdenum concentrations opposite the well screen at PM-3. Molybdenum concentrations in this interval are variable, ranging from 14 to 90 ppb or μg/L.

Field Observations of Water Production and Water Clarity – Qualitative observations of water production and water clarity were made by the field geologist and driller at intervals of 20 ft in the regional aquifer as the casing was advanced during drilling. These observations, summarized in Figure 2, suggest that water production increased downhole with moderate estimates of water production occurring in the proposed screen interval at 1010 ft to 1050 ft. Similarly water clarity improved with depth with the best samples produced in the lower part of the borehole, including the proposed screen interval. These observations support the geologic interpretation that the interval from 1010 to 1050 ft contains strata that are relatively transmissive, and these strata are likely to be hydraulically connected to strata intersected by the well screen at PM-3.

Young, John, NMENV

From: Young, John, NMENV
Sent: Wednesday, May 16, 2007 3:17 PM
To: 'Danny Katzman'; 'Mathew Johansen'
Cc: 'Mark Everett'; Shen, Hai, NMENV; Dale, Michael; Bearzi, James, NMENV; Cobrain, Dave, NMENV
Subject: RE: R-35 Well Design_FINAL_5-16.doc

Danny, Mat, and Mark-

NMED approves the well design, but has the following requirements:

1. Complete "zonal" sampling during the completion and/or hydrogeologic testing of the well. Isolate and collect groundwater samples from both the angular volcaniclastic gravels and the tuffaceous sands and gravels that are separated by a "silty" interval located between 1035' and 1040', and

2. Complete flow logging (e.g., spinner or heat-pulse) on the screened interval to determine the relative movement of water in the screened interval.

This information coupled with the available geochemical, geophysical, geological and observational data should provide useful information regarding the quality of the selected screened interval (1010'-1050' bgs) for monitoring.

If you have any questions or have additional thoughts please do not hesitate to call me at 476-6038.

john

-----Original Message-----
From: Danny Katzman [mailto:katzman@lanl.gov]
Sent: Wednesday, May 16, 2007 2:27 PM
To: Young, John, NMENV
Subject: R-35 Well Design_FINAL_5-16.doc

Danny Katzman
Water Stewardship Program Manager
LANL Environmental Programs
7-6333 (ph)
699-1042 (cell)
5-4747 (fax)

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Young, John, NMENV

From: Mark Everett [meverett@lanl.gov]
Sent: Friday, May 25, 2007 4:29 PM
To: Young, John, NMENV; Cobrain, Dave, NMENV
Cc: 'Danny Katzman'; 'Jean M. Dewart'; 'Mathew Johansen'; behr-andres@lanl.gov
Subject: R-35 backfilling procedure

John and Dave,

This e-mail is a follow-up to our conversation earlier today. We are building R-35a and R-35b and wish to request a variation from the Consent Order. The Order requires all annular backfill material to be emplaced via the tremie pipe method. All materials within the regional aquifer and all grouts (cement and bentonite) will be tremied in place. The variation we are requesting is within the Cerros del Rio basalt (~260'~600') which is well above the regional aquifer. What we propose to do is use the drill casing (10" ID) as the conduit to emplace the chips through the basalt interval. We will have a tag line downhole to provide frequent depth measurements ensuring that the material does not bridge and we will hydrate the bentonite in-place every 10'. If this variation from the Order is acceptable to you, please respond with your concurrence.

Thanks,

Mark Everett, PG
Drilling Project Lead
EP-WSP
LANL
(505) 667-5931 (o)
(505) 231-6002 (c)

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Young, John, NMENV

From: Danny Katzman [katzman@lanl.gov]
Sent: Thursday, May 31, 2007 3:15 PM
To: Young, John, NMENV; Mark Everett
Cc: Shen, Hai, NMENV; David E. Broxton
Subject: RE: R-35b Proposed Well Design

thanks John!
d

At 02:36 PM 5/31/2007, Young, John, NMENV wrote:

Mark and Danny,

Start construction of R-35b following the plan and information provided.

john

From: Mark Everett [mailto:meverett@lanl.gov]
Sent: Tuesday, May 29, 2007 6:18 PM
To: Young, John, NMENV
Cc: Shen, Hai, NMENV; katzman@lanl.gov; 'David E. Broxton'
Subject: R-35b Proposed Well Design

John,

Attached is our proposed well design for R-35b. included is a discussion of our rationale for picking the proposed interval and supporting documentation. Please review, and if it looks good, respond via e-mail with your approval. If you have questions, please call Danny (699-1042) or me (231-6002) to discuss.

Thanks,

Mark Everett, PG
Drilling Project Lead
EP-WSP
LANL
(505) 667-5931 (o)
(505) 231-6002 (c)

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Danny Katzman
Water Stewardship Program Manager
LANL Environmental Programs

7-6333 (ph)
699-1042 (cell)
5-4747 (fax)

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Review of R-35a and R-35b Well Objectives from Work Plan

Conceptual Model	Hexavalent chromium contamination is present in the upper part of the regional groundwater system at R-11 and R-28. Natural hydraulic gradients in the area are expected to cause the contamination to move eastward with possible local northeast gradients resulting from the pumping of municipal water at PM-3. Thick Miocene basalt probably provides a lower confining bed for the vertical movement of chromium contamination, restricting the movement of chromium to the portion of the aquifer adjacent to the upper part of the well screen at PM-3. Two conceptual models of groundwater flow were presented in the "Interim Measures Work Plan for Chromium Contamination in Groundwater." According to the first conceptual model, the top of the regional zone of saturation has a poor hydrologic connection with deeper zones pumped at PM-3 because of the strong vertical anisotropy of aquifer materials. In this case, groundwater flows laterally down gradient and may not be drawn into the submerged screen at PM-3. According to the second conceptual model, natural and pumping-induced vertical gradients cause groundwater to be drawn towards the PM-3 well screen, resulting in the distribution of chromium over a greater vertical depth. The two R-35 wells are designed to test elements of these conceptual models by determining the eastern extent of chromium contamination in the vicinity of PM-3 and the vertical distribution of chromium in the interval near the top of the PM-3 well screen.
Primary Purpose	The two single-screen wells at the R-35 location will result in two well screens set at different depths in the regional groundwater system for measuring water quality and pumping responses associated with pumping at production wells, especially at PM-3. • R-35a, the deeper of the two wells, will contain a well screen that is placed within the depth interval of the upper part of the well screen (louvers) at PM-3. R-35b will contain a well screen placed near the top of the regional zone of saturation. The paired-well configuration is designed to answer the following questions about water quality: (1) is chromium contamination present in regional groundwater near PM-3, and (2) if present, does chromium in groundwater vary as a function of depth, and is it likely to be drawn into the well screen at PM-3? If chromium contamination is not present, then the R-35 wells will be used as sentry wells for PM-3. • Water levels in the paired wells will be monitored using dedicated transducers to identify hydraulic responses to pumping at production wells, especially PM-3. These data will be used to evaluate hydraulic connectivity in the regional zone of saturation between the upper portions of the regional groundwater and deeper zones corresponding to the upper screen interval at PM-3.
Hydrogeologic and Geochemical Objectives	• The objective of the shallow screen at R-35b is to further define the lateral extent of chromium contamination in the regional groundwater. The proposed location is especially important for determining if LANL-derived contamination is present in regional groundwater in the vicinity of PM-3. • The deep screen at R-35a will help define the vertical extent of chromium (and other) contamination and is especially important in the context of monitoring for potential impacts to PM-3 because it will be placed within a zone that may be a potential pathway for contamination to enter PM-3. • If chromium is not present in one or both wells, the R-35 well pair may be used as sentry wells up gradient of PM-3. • Water levels at R-35a and R-35b will be continuously monitored during pumping of PM-3 to evaluate the hydraulic connectivity in the regional zone of saturation between the water table and the upper production zone at PM-3.

R-35b Recommended Well Design

We recommend that R-35b be installed as a single-screen well with a 20-ft stainless-steel, 20 slot, wire-wrapped well screen extending from 825 ft to 845 ft bgs. The primary filter pack will consist of 10/20 sand extending 5 ft above and below the screen openings. The 10/20 sand size is consistent with that used at other regional wells and has been shown to work well in combination with the slot

size to adequately filter the fine-grained particles found within the regional aquifer. A 2-ft secondary filter pack will be placed above the primary filter pack. The proposed well design is shown in Figure 1. Information used to select this well design is summarized below.

R-35b Well Design Considerations

Based on work plan objectives, as summarized in the table above, the R-35b well screen is placed near the top of the regional zone of saturation to assess the eastern extent of chromium contamination found at shallow levels of the regional groundwater system at wells R-11 and R-28. The R-35b location is especially important for determining if LANL-derived contamination is present in regional groundwater in the vicinity of municipal supply well PM-3. R-35b is paired with the deeper R-35a well to determine if contaminants are present in the upper portions of the aquifer near the water table and if there are vertical gradients in contaminant concentrations and hydraulic pressures in this area. Together, R-35a and R-35b serve as up gradient sentry wells for the detection of chromium and other contaminants approaching PM-3. The R-35a well screen from 1010 to 1050 ft depth targets a transmissive zone opposite the upper part of louvers at PM-3.

Geologic Considerations – For the purposes of this investigation, the upper part of the regional groundwater system extends from the water table at a depth of 786 ft depth to the top of louvers at PM-3 at a depth of 970 ft. This interval includes, in descending order, the Pliocene Puye Formation and Miocene volcaniclastic sediments of the Santa Fe Group. The contact between the Puye Formation and the Santa Fe Group is uncertain, and it is currently placed at the top of a 20-ft-thick sequence of reworked, crystal-poor, vitric pumice-rich deposits at a depth of 880 ft. In nearby wells these pumiceous deposits yield ages around 7 Ma (Miocene) and correlate to Peralta Tuff of the Jemez volcanic field.

Drill cuttings from 786 to 970 ft depth are dominated by variably-cemented, well-stratified lithic sands and gravels made up of volcanic detritus (Fig. 2). The amount of silts and fine sands in these strata cannot be reliably estimated because of the nature of the cuttings collection process. Nonetheless, silt and fine sand can be found in the cuttings adhering to gravels and as cemented siltstone and sandstone clasts and are inferred to be present throughout the stratigraphic sequence. Well-sorted pea gravels and a minor interbedded silt bed occur in the interval between 920 and 940 ft depth (Fig. 2); these pea gravels are subrounded to rounded and may represent an unusually thick stack of channel deposits within the Puye Formation. The interval between 900 and 935 ft is also notable in that it is comprised of well-rounded volcanic gravels that contain a few percent Precambrian quartzite and granite (Fig. 2); these deposits likely represent axial river deposits equivalent to the Hernandez Member of the Chamita Formation. Although cementation is not extensive, calcite-cemented clasts of sandstone and pebbly sandstone occur intermittently in cuttings below about 900 ft depth in rocks of the Santa Fe Group. Vertical geophysical log responses at R-35a and imaging data from nearby boreholes such as R-13 and R-28 suggests that individual beds within the regional aquifer in this area range in thickness from a few inches to up to 3 ft thick. Thus the proposed 20-ft well screen will include highly stratified strata with heterogeneous properties – this is characteristic of the aquifer in this hydrogeologic setting.

The proposed screen is located between 825 ft and 845 ft bgs within an interval of medium to coarse sands and gravels that include the pea gravels described above. Overall, these rocks have lithologic characteristics that are expected to be highly transmissive of groundwater, and they should be representative of flow paths in the uppermost part of the regional groundwater system. The stratigraphic sequence encountered in the R-35 boreholes and the inferred piedmont and axial fluvial depositional setting are such that the lateral continuity of individual beds is expected to be highly variable. Thus, the silty material between about 830 and 835 ft within the proposed screen interval is

not considered a significant hydrologic feature and should not adversely impact the performance of the well.

Borehole Geophysics – Data from borehole geophysical logs collected at R-35a, located about 30 ft to the west, were used to assess the placement of the well screen at R-35b. The interval from the water table (786 ft depth) to 940 ft depth was logged through 10-in and 12-in drill-casing strings; below 940 ft logs were collected through the 10-in drill casing. Schlumberger performed an integrated log analysis using as many of the processed logs as possible (using ELAN – Elemental Log Analysis program) to model the near-wellbore lithology, mineralogy, and pore fluids. Results of this analysis, presented in Figure 3, indicate most of the rocks below the water table to a depth of 910 ft are quite porous and should be productive of groundwater. ELAN porosity estimates across the proposed screen interval of 825 ft to 845 ft range between 35% and 45%. Schlumberger's evaluation suggests there is not much clay in these rocks, although clay content is difficult to characterize with the limited logs available in the interval where there are two drill-casing strings.

Borehole Groundwater Screening Results – Groundwater screening samples were collected from the R-35b borehole at 10 ft intervals from 820 to 890 ft as the drill casing was advanced, and the samples were analyzed at EES-6 geochemistry for metals and anions. Selected analyses for the borehole samples are shown as a function of depth in Figure 2. Significant features of the borehole analyses include:

1. Detectable total dissolved concentrations of chromium range between 1 to 2 μg/L in all borehole samples; these concentrations are below background (upper tolerance limit [UTL] = 6.62 μg/L) values for regional groundwater.

2. Molybdenum, a contaminant released to Sandia Canyon, occurs at concentrations significantly above background (UTL = 3.82 μg/L) in all samples. The greatest concentrations are two orders of magnitude above background in samples from 820 to 850 ft. Dissolved molybdenum concentrations in this interval range from 77 to 160 ppb or μg/L and generally decrease down hole.

3. Sulfate is elevated in a sample at 830 ft depth (9.53 mg/L), coinciding with a sample containing the highest molybdenum..

Because total dissolved chromium concentrations are below background values in all groundwater screening samples, the widespread distribution of elevated molybdenum concentrations is used to guide the identification of potential groundwater pathways and for selecting the depth interval for the well screen at R-35b. The proposed well screen (825 to 845 ft depth) targets the zone where the greatest concentrations of molybdenum were found in borehole samples.

Field Observations of Water Production – Qualitative observations of water production were made by the field geologist and driller at 10 to 20 ft intervals within the regional aquifer as the drill casing was advanced. These observations, summarized in Figure 2, suggest that water production increased down hole and that the proposed screen interval overlaps the zone with the highest water production. Other factors, discussed below, may influence the relative scale of the observations. However, the water production observations support the geologic interpretation that the interval from 825 to 845 ft contains strata that are relatively transmissive and likely represent groundwater pathways in the upper part of the regional aquifer in the vicinity of PM-3.

Other Zones Considered for the R-35b Well Screen – In addition to the interval selected, two deeper zones of strata were considered candidates for the R-35b well screen; both zones were rejected for similar reasons. One zone occurs from 900 to 935 ft in axial river deposits, and the other zone occurs from 950 to 980 ft in volcanic sands and gravels near the top of the PM-3 louvers. These two zones were considered potential screen intervals because their lithologic characteristics suggest that both two zones might have good hydraulic properties. However, three of four field observations of water production spanning these two zones, as measured in the R-35a borehole, yielded poor results. Additionally, the porosity of these two zones ranges from 20 to 35%; this is somewhat lower than the 35 to 45% porosities of the 825 to 845 ft interval selected for the well screen. Finally, an important goal of the R-35b well screen is to characterize the chemical and hydraulic characteristics of groundwater potentially moving near the water table and possibly above the zone within the PM-3 louvers. In particular, vertical connectivity within regional aquifer will be examined by comparing water level responses to pumping from PM-3 at shallow (R-35b) and deep (R-35a) observation wells. Both the 900 to 935 ft and the 900 to 935 ft intervals are considered to be too deep (114 to 194 ft below the water table) to meet the objectives for a shallow well screen at R-35b.

A shallower screen in the interval from 800 to 820 ft was also considered a candidate for the R-35b well screen. This interval is comprised of lithic sands and gravels, and combined R-35a and R-35b borehole groundwater analytical data suggest this zone also contains high dissolved molybdenum concentrations – similar to those in the selected screen interval from 825 to 845 ft. However, two features of this zone were considered problematic. First, water production in this interval was poor, particularly when compared to the good production found in the selected screen interval from 825 to 845 ft. The poor water production may be related in part to difficulty in air lifting water near the water table, with greater lifting efficiencies occurring with increased submergence of the drill casing. The issue about water production cannot be resolved with the available information; this uncertainty is avoided by placing the screen slightly deeper (825 to 845 ft) where all of the factors considered for screen placement were considered favorable. R-35b is potentially located more than a kilometer down gradient of infiltration pathways to the regional water table, and it is not necessary for the well screen to be at the water table for monitoring for contaminants. Contaminants are likely to disperse laterally and vertically as groundwater moves long distances across dipping, stratified, heterogeneous sediments of the aquifer. The dispersed nature of molybdenum contamination found in borehole water samples from R-35a and R-35b support this view. A secondary consideration for the 800 to 820 ft interval is that it might result in a well with a short service life. R-35b is located about 100 m from PM-3 in an area where the water table is declining at a rate of about 1 ft/y; declines may be greater at R-35b because of its close proximity to PM-3. Because of uncertainties associated with water-level declines near a pumping municipal supply well, the slightly deeper screen in the 825 to 845 ft interval seems prudent, particularly when the deeper screen interval (825 to 845 ft) addresses the technical goals of the well.

Young, John, NMENV

From: Mark Everett [meverett@lanl.gov]

Sent: Friday, June 15, 2007 12:37 PM

To: Young, John, NMENV; Shen, Hai, NMENV; Dale, Michael; Cobrain, Dave, NMENV

Cc: riggs@lanl.gov; 'Danny Katzman'; 'Jean M. Dewart'; behr-andres@lanl.gov; 'Michael Alexander'; 'Johansen, Mathew'; 'Tom Whitacre'

Subject: Weekly R-35 status (6/14/07)

Dear All:

The following is a summary of activities at regional well R-35 since last Thursday, June 7th. Well construction at R-35a continues. The bentonite now fills the annulus to 845' bgs. After several attempts to fill the annulus with bentonite grout we have determined that using bentonite chips will provide less potential loss to the formation. We have switched to using bentonite chips and will continue with the use of chips up through the basalt (~260' bgs).

DRILLING

Interval drilled	drilling has been completed
Drilling method	N/A
Fluids used	municipal water for backfilling at R-35a

CONSTRUCTION

Casing/backfill interval	stainless steel well casing is set with the top of the 40' screen at 1010' bgs. Annulus filled to 845' bgs
Grout loss	1200 gallons of high-solids bentonite grout was lost to the formation with the bottom of the 12" drill casing at 840' bgs

DEVELOPMENT

Quantity of water removed	N/A
Parameters	N/A

OTHER

Geophysics run	N/A
Well design	both well designs approved
Hydrologic testing	N/A

ISSUES

Unusual occurrences	none

Detection of groundwater

LOOK AHEAD

Planned activities	Complete well construction in R-35a and R-35b

Mark Everett, PG
Drilling Project Lead
EP-WSP
LANL
(505) 667-5931 (o)
(505) 231-6002 (c)

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