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NATIONAL LABORATORY

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In Reply Refer To: ESH-18/WQ&H:00-0009
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HSWA LANL 6/m/00

Mr. John Young
Hazardous and Radioactive Waste Bureau
New Mexico Environment Department
2044 Galisteo St., Building A
P.O. Box 26110
Santa Fe, New Mexico 87505

SUBJECT: CONTAMINANT RESPONSE CRITERIA-PILOT TEST

Dear Mr. Young:

The joint LANL/DOE/NMED Response to Contamination Committee met on December 20, 1999 to conduct a "pilot test" on the Response to Contamination process proposed to NMED in our December 2, 1999 letter. The purpose of the test was to determine the appropriateness of the proposed 15 criteria, the amount and type of data necessary to evaluate the criteria, and to establish how the joint committee will develop the final rating. Regional aquifer well R-9 was the subject of the pilot test. The complete results of the pilot test are included as Attachment 1. I have also included information received from Patrick Longmire on January 3, 2000 which although provided subsequent to the meeting, adds information relevant to the decision-making process. An overall summary of the test is provided in this letter.

The priority of response to the presence of uranium in the 275-ft perched zone in R-9 was rated as "high" by the majority of the committee. The primary reasons cited for the rating were: the location of the well on the Lab boundary, the presence of a contaminant at two times the proposed Maximum Contaminant Limit (MCL), and the inability to monitor the zone in well R-9. There was a minority opinion that the rating should have been "moderate" because: the perched zone is thin, the risk to humans or wildlife is low because there is little likelihood that the water from it is being used, and that the "high" category should be reserved for cases where the risk posed is much greater.

There was consensus that re-ordering the criteria and combining some of the criteria would make the process more streamlined, while addressing all of the potential issues. The resulting list of criteria is presented in Attachment 2. One criterion, originally Criterion 9, "persistence and permanence of adverse impacts from exposure to the constituents" was deleted. The deletion was suggested because members of the committee could not reach consensus on the meaning of the criterion. However, the deletion is subject to both NMED and LANL consulting with other members of their respective staff as to the interpretation and importance of the criterion.

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Documentation of the evaluation process and rationale was suggested to be:

- LANL will a provide report summarizing the results of the committee deliberations (this letter and attachments)
- NMED will respond with a letter confirming the rating and concurrence with the documentation of the meeting.

The Response to Contamination Committee will continue the pilot testing of the process on regional aquifer well R-15 in January, and I would recommend that we meet on January 21st at 9:00 a.m. in the ESH-18 Conference Room. The continued pilot testing is considered beneficial because of the re-ordering of the criteria and to ensure the process is robust enough to address the wide range of scenarios under which this process might be used.

Thus far, the Response to Contamination process appears to work, be useful in jointly establishing the timing of a response, and Committee's use of the proposed criteria appears to consider all relevant factors for a timing decision. I look forward to conducting a second pilot test later this month.

Thank you for your participation in the joint Committee meeting. Please feel free to contact me at 665-4681 should you have any questions regarding this letter.

Sincerely,

Charles L. Nylander

Charles L. Nylander
Water Quality and Hydrology Group

CN/rm

Enclosures: a/s

Cy: Victoria Maranzille, NMED/HRMB, Santa Fe, NM, w/enc.
Chris Hanlon-Meyer, NMED/OB, Santa Fe, NM, w/enc.
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David Rogers, ESH-18, w/enc., MS K497
Patrick Longmire, EES-1, w/enc., MS D469
Don Hickmott, EES-13, w/enc., MS D462
Bill Stone, EES-5, w/enc., MS M992
Steven Rae, ESH-18, w/enc., MS K497
Ken Mullen, ESH-18, w/enc., MS K497
Gene Turner, DOE/LAAO, w/enc., MS A316
WQ&H File, w/enc., MS K497
CIC-10, w/enc., MS A150

Attachment 1:
Results of Response to Contamination Process Pilot Test
December 20, 1999

#	Criteria	Comments
1	Existing quality of the groundwater, including other sources of contamination and their cumulative impact on the groundwater quality	Anthropogenic impacts present in all saturated zones
2	Physical and chemical characteristics of constituents	
3	Hydrogeologic characteristics of immediate area	Unknown whether the detection of uranium in R-9 represents the front-end or back-end of a plume
4	Proximity and withdrawal rates of water supply wells	
5	Current and future uses of the water	Potential exists for use of the water from the 275-ft perched zone
6	Potential for health risks caused by exposure of humans, wildlife, vegetation or physical structures to the constituents of concern (toxicity and pathways)	Uranium more than two times the proposed MCL
7	Location with respect to the Lab boundary	Most important factor in rating this as "high"
8	Well construction issues	No monitoring access to the 275-ft perched zone in R-9
9	Schedule for drilling nearby wells	
10	Facilitate finishing an RFI report	
11	Programmatic consistency	Address the concerns of San Ildefonso and NMED
12	Budget/Priorities	
	Overall Rating	**High**

Criteria 1: Existing quality of the groundwater, including other sources and their cumulative impact on groundwater quality

Existing Data:

- The 275-foot perched zone has Na^+ -SO_4^{2-} -HCO_3- ionic composition.
- Other water quality parameters are:

Parameter	275-ft Perched Zone	180-ft Perched Zone
TDS	341 ppm	255 ppm
Phosphate	0.61 ppm	0.14 ppm
Nitrate	3.61 ppm	<0.02 ppm
Boron	<0.01 ppm	0.023 ppm
Chloride	25.5 ppm	29.2 ppm
Uranium	48.4 ppb	1.18 ppb
Tritium	106.3 ± 7.0 pCi/L	346.7 ± 12.4 pCi/L

Discussion Summary:

- The "Existing Data" should also include standards and available background for the parameters shown. It should also include water quality data from nearby wells.
- This criterion should be the first criteria evaluated in this process because it provides the information needed to determine if "contamination" is present.
- For R-9, the water quality in the perched zones is pretty good (with the exception of the uranium), but the nitrate and tritium demonstrate the anthropogenic impact on both zones.

Criteria 2: Physical and chemical characteristics of the constituents

Existing Data:

- Uranium (48.4 ppb) in lower perched zone in basalt (275 ft)
- Sample collected during drilling, analyzed by thermal ionization mass spectrometry (TIMS) at LANL

Discussion Summary:

- The evaluations under this criterion should include all constituents detected above "background". The presence of constituents above background is considered important because it indicates a release has occurred and that a pathway exists that has to be considered.

- One objective of the Hydrogeologic Workplan is to identify pathways, so the presence to a constituent above background may not result in the recommendation to do additional investigations.
- The "Existing Data" section should include information on the expected sorption behavior of the contaminant.
- Uranium is usually a sorbing metal and is considered non-conservative
- Tritium is present in all zones, indicating transport from the surface.

Criteria 3: Hydrogeologic characteristics of the immediate area

Existing Data:

- At the R-9 borehole site, two perched zones were encountered in the Cerros del Rio basalt at depths of 180 feet and 275 feet, respectively. The top of both perched layers was clay-rich rubble zone. The base of 180-foot perched zone was a massive basalt at 225 - 235 feet and the water in the zone rose 43 feet above where it was first encountered. The base of the 275-foot perched zone was a stratified, fine-grained basaltic tephra at 282 feet and the water rose 10 feet from where it was first encountered.
- The 275-ft perched zone is approximately 7 feet thick and the horizontal extent is unknown, but probably limited.
- Groundwater flow direction is unknown, but may be down-dip in an easterly direction.
- Three saturated zones were encountered in the Puye (579 ft, 615 ft, and 624 ft). These zones are within thin transmissive sand and gravel beds intercalated within a thick sequence of clay-rich tuffaceous sedimentary deposits. The water in zones at 579 feet and 624 feet rose to 524 feet and they have similar cation/anion compositions, suggesting they are hydrologically connected upgradient. These zones may have been isolated from the regional aquifer by water level declines due to pumping.
- One saturated zone, at 688 feet, was encountered in the Santa Fe Group. This is considered to be the top of the regional aquifer.

Discussion Summary:

- This criteria should include the original Criteria 3 - Quantity of groundwater and flow direction because these are aspects of the hydrogeologic characteristics. There was consensus to combine the original criteria 2 and 3.
- The "quantity of water" will be considered the entire volume of water in the saturated zone of interest.
- The contaminant (uranium) is not present in the regional aquifer, however there is a possible connection to the regional aquifer.

- There are anthropogenic constituents in all zones, so surface water has reached all the zones.
- The perched zone is thin and seems to be somewhat isolated by the clay-rich zones. However, that is at a single point and there is no information on how extensive the clayey zones are.
- At the time R-9 was drilled, the water level observations were thought to indicate an upward vertical gradient. However, that interpretation is no longer considered to be correct.
- Relative to the regional aquifer, the 275-ft perched zone probably does not contain a large volume of water.

Criteria 4: Proximity and withdrawal rates of water supply wells

Existing Data:

Water Supply Well	Distance from R-9	Average Annual Withdrawal Rate	Total Withdrawal
O-1	0.3 mile NNE	Entered service in 1997	
O-4	2.1 mile west	233×10^6 gallons (1993-1996)	7.0×10^8 gallons (1993-1996)
PM-1	0.5 mile south	88×10^6 gallons (1965-1996)	2.7×10^9 gallons (1965-1996)
PM-3	1.4 mile WSW	214×10^6 gallons (1966-1996)	6.4×10^9 gallons (1966-1996)

Discussion Summary:

- This criterion will be evaluated on a qualitative basis because a thorough quantitative analysis of the cone of influence of each pumping well would require too much time and data that are not yet available. A quantitative analysis is more appropriate after additional data have been collected.
- This criterion should be evaluated based on whether a potential exists that the contaminant could affected by pumping. One way to consider "potential" is the presence of a pumping well between the well in question and the suspected source of contamination. In the case of R-9, well O-4 is in Los Alamos Canyon between TA-21 and R-9. For R-9 a potential exists that the pumping well could affect the contaminant transport.
- The "Existing Data" should include if contaminants have been detected in the water supply wells.

Criteria 5: Current and Future Uses of Water

Existing Data:

- No known wells for water supply are completed in the 275-ft perched zone in the basalt.
- It is unknown whether the 275-ft perched zone daylights in Los Alamos Canyon and contributes to surface water flow in the canyon. If it does, then downstream wells (Otowi House, Halliday, and San Ildefonso back-up wells) could use water from this zone.
- It is unknown whether the 275-ft perched zone discharges to either Basalt Spring or LA Spring. These springs are used by wildlife.

Discussion Summary:

- There is potentially current use of the water in the 275-ft perched zone.
- There is potential for continued use of the water in the future.

Criteria 6: Potential for health risks caused by exposure of humans, wildlife, vegetation, or physical structures to the constituent(s) of concern (toxicity and pathways)

Existing Data:

- Proposed MCL for uranium: 20 ppb
- Uranium present in the 275-ft perched zone at 48.4 ppb

Discussion Summary:

- The "Existing Data" should include information for all constituents of concern (if there is more than one) and should provide toxicity information for any constituent that does not have a regulatory standard (i.e. MCL) or health advisory.
- There is potentially current exposure to the water in the 275-ft perched zone and potentially future exposure.

Criteria 7: Location of the well with respect to the Lab boundary

Existing Data:

- R-9 is located in Los Alamos Canyon, on the Laboratory boundary with San Ildefonso Pueblo

Discussion Summary:

- This is criterion weighed the most heavily for R-9.

Criteria 8: Well Construction Issues

Existing Data:

- R-9 is a single completion well in the regional aquifer

Discussion Summary:

- This criterion considers the completion of the well that the contaminant(s) was detected in. If it is constructed with a sampling port in the zone in question, then a monitoring capability already exists. If the well is completed with no sampling access to the zone in question, then another well to monitor that zone is likely to be required.
- R-9 was constructed with a single completion in the regional aquifer, so there is no monitoring capability for the 275-ft zone in that well.

Criteria 9: Schedule for drilling near-by wells

Existing Data:

Planned Well	Schedule for Drilling	Funding Source
R-12	Completed (12/99)	ER
R-5	FY00	NWT
R-11	FY04	NWT
R-8	FY02	NWT

Discussion Summary:

- This criterion will be evaluated to determine if other planned wells are in locations that can be used to evaluate the plume detected by the well in question and if those planned wells can be accelerated to address the plume.

- In the case of R-9, R-8 could be moved up to FY00 and R-5 be moved back to FY02.

Criteria 10: Facilitate finishing an RFI Report

Existing Data:

Discussion Summary:

- Evaluations of this criterion will consider whether the plume has to be defined in order to finish an RFI and whether money diverted to the plume definition will take away resources needed to complete an RFI.

Criteria 11: Programmatic Consistency

Existing Data:

- San Ildefonso and NMED have expressed concerns about the uranium in the 275-ft perched zone.

Discussion Summary:

- Evaluation of this criterion should include if the response has been consistent, maintain the focus on finishing RFI reports or plume definition.
- The Lab has been trying to foster a better relationship with San Ildefonso, so a sooner response is warranted.
- There has been persistent requests from NMED and San Ildefonso on installing an intermediate well.

Criteria 12: Budget/Priorities

Existing Data:

-

Discussion Summary:

- Evaluation of this criterion will consider the timing of resources and competing priorities for resources. It could also consider that the response is likely to be a phased effort, so that the resources needed in the first (planning phase) would not be as much as in the implementation phase.

Attachment 2
Response to Contamination Criteria

Additional information received from Patrick Longmire on January 3, 1999

Criteria 1. Background Values (based on Spring 9B discharging from basalt in White Rock Canyon, sampled on 08/18/97) R-9 275 ft zone sampled on 10/16/97. Dissolved concentrations are reported for inorganic analytes, whereas tritium activities are based on non-filtered groundwater samples.

TDS = 169.4 ppm; phosphate (as PO4) = <0.02 ppm; nitrate (as NO3) = 1.78 ppm, NMWQCC std = 44 ppm (as NO3) or 10 ppm as N; boron = 0.009 ppm, NMWQCC std = 0.75 ppm; chloride = 1.84 ppm, NMWQCC std = 250 ppm; uranium = 0.00013 ppm (0.13 ppb), EPA proposed std = 0.020 ppm; tritium = <0.3192 pCi/L, EPA std = 20,000 pCi/l.

There are no wells nearby that are completed in this zone. Intermediate well POI-4 in Pueblo Canyon incountered groundwater at 159 ft bgs and TD of well is 185 ft.

Criteria 2.Concentrations of oxalate in the 275 ft zone are 3.03 ppm and background groundwater concentrations of oxalate are < 0.02 ppm. Oxalate stands out as an anthropogenic (man-made) solute at R-9 in the saturated zones.

Oxidizing conditions most likely dominate at R-9 (275 ft zone) because reducing agents such as sulfide, ammonium, and methane are not present. Uranium is probably stable in the oxidized form (U(VI)) rather than the reduced form (U(IV), which forms very insoluble solids under reducing conditions. Dissolved concentrations of U(IV) rarely exceed 1 ppb between pH values 6.5-9.

Adsorption of a contaminant onto aquifer material is quantified by measuring or calculating a distribution coefficent (Kd) for the contaminant of concern. The Kd is the amount of contaminant sorbed onto a solid divided by its dissolved concentration. This the same as the mass of adsorbate (U)/mass of adsorbent (solid)/mass of dissolved species (U)/volume solution) (Kd has units of volume/mass, ml/g or L/Kg). Based on the concentration of non-filtered uranium (0.112 mg/kg U) divided by the concentration of dissolved uranium (0.0484 mg/L), the effective Kd for U at R-9 is equal to 2.31 L/Kg or ml/g. This calculated Kd is typical of U(VI) complexes reported in the literature.

At R-9 (275 ft zone), uranium in the VI oxidation state is predicted to be stable as the dissolved complex UO2(CO3)3-4, which does not adsorb completely onto aquifer material. Uranyl (U(VI)) carbonate species have Kd values typically less than 5 ml/g. Uranium (VI) aqueous carbonate complexes are predicted to dominate at R-9 because of the high dissolved carbonate concentrations (110 ppm). URANIUM (VI) CARBONATE SPECIES DO NOT ADSORB COMPLETELY ONTO AQUIFER MATERIAL AT pH VALUES GREATER THAN 7. URANIUM (VI)
SPECIES ARE CONSIDERED AS SEMICONSERVATIVE ADSORBATES UNDER ALKALINE pH
CONDITIONS. Groundwater in the 275 ft zone at R-9 has a pH value of 8.79.

More sorption investigations are required to determine the mobility of uranium at R-9. At R-9, it is thought that uranium (VI) is less mobile than tritium, nitrate, sulfate, and chloride (Kd values are close to or equal to zero), but is more mobile than Sr-90, Am-241, Pu-238, and Pu-239,240.

Attachment 2
Response to Contamination Criteria

#	Criteria
1	Existing quality of the groundwater, including other sources of contamination and their cumulative impact on the groundwater quality
2	Physical and chemical characteristics of constituents
3	Hydrogeologic characteristics of immediate area
4	Proximity and withdrawal rates of water supply wells
5	Current and future uses of the water
6	Potential for health risks caused by exposure of humans, wildlife, vegetation or physical structures to the constituents of concern (toxicity and pathways)
7	Location with respect to the Lab boundary
8	Well construction issues
9	Schedule for drilling nearby wells
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