SNL @ MWL 06-023

November 20, 2006

Mr. James Bearzi, Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Supplement to October 12, 2006 Notice of Intent to Sue Over Failure of the New Mexico Environment Department ("NMED"), Department of Energy ("DOE"), Environmental Protection Agency ("EPA"), Department of Defense ("DOD"), Sandia National Laboratories ("SNL"), and the Lockheed Martin Corporation to Comply with the Resource Conservation and Recovery Act ("RCRA"), for the Mixed Waste Landfill ("MWL") at Sandia National Laboratories. (42 U.S.C. §§ 6901 et seq. and as amended).

Dear Mr. Bearzi:

Much of the information below may not have been addressed in the Citizen Action New Mexico October 12, 2006 Notice of Intent to Sue Over Failure of the New Mexico Environment Department ("NMED"), Department of Energy ("DOE"), Environmental Protection Agency ("EPA"), Department of Defense ("DOD"), Sandia National Laboratories ("SNL"), and the Lockheed Martin Corporation to Comply with the Resource Conservation and Recovery Act ("RCRA"), for the Mixed Waste Landfill ("MWL") at Sandia National Laboratories. (42 U.S.C. §§ 6901 et seq. and as amended).

We are providing this information as supplement to the October 12, 2006 Notice of Intent to Sue because it indicates further deficiencies in the well monitoring program for the MWL, and the DOE/SNL Response is new evidence of deficiencies in the well monitoring program across the Sandia National Laboratories Albuquerque facility. These deficiencies create an imminent and substantial endangerment to the Albuquerque groundwater supplies.

Thank you for your attendance at the Groundwater Protection Advisory Board (GPAB) meeting of November 9, 2006. At that meeting, the GPAB offered a document to the public entitled "U.S. Department of Energy and Sandia National Laboratories Albuquerque, New Mexico- Response to Office of Inspector General Management Referral Memorandum dated June 21, 2006, Regarding Monitoring Wells at Sandia Mixed Waste Landfill. September 2006. (Response)" The Response was missing numerous pages (pp.4-9) and none of the tables, figures or attachments referred to in the Response were provided.

Citizen Action (CA) believes that the Sandia National Laboratories' (SNL) Response contains made admissions of fact by DOE/SNL to which CA would like to call your attention. The Response contains numerous legal errors with respect to the requirements of the Resource Conservation and Recovery Act (RCRA), the April 29, 2004 Consent

Order and the requirements of DOE Orders 5820.2a, 435.1, and 450.1 with respect to requirements for well monitoring systems. In CA's opinion, there are also numerous errors of fact in the Response.

Contrary to your assertion to the GPAB that there is no evidence of groundwater contamination from the Sandia mixed waste landfill (MWL), CA asserts that such evidence of contamination was provided at the GPAB meeting by Mr. Robert Gilkeson's presentation. The following is from Mr. Gilkeson's presentation:

"The contamination detected in well MWL-MW4 installed below Trench D in the Sandia Mixed Waste Landfill.

- Major ion chemistry that proves the presence of contamination. A report in November 2000 by Douglas Earp, a geohydrologist with the City of Albuquerque, brought attention to the major ion chemistry that indicated contamination from the MWL was present in the groundwater samples produced from the upper screen in well MW4 that is installed below Trench D of the MWL. In the table below, the data for chloride, nitrate, and specific conductance from the Earp report are combined with measurements in 2005 of dissolved oxygen and oxidation-reduction potential.

well no.	chloride mg/L	nitrate mg/L	specific conductance umhos/cm	dissolved oxygen %	oxidation-reduction potential millivolts
MW1	29.5	4.9	662.3	70	263
MW2	31.8	4,6	625.3	38	76
MW3	32.2	4.2	604.6	95	256
MW4	57.5	1.0	775.8	29	-128
BW1	26.7	5.6	673.4	80	278

- The water chemistry at well MW4 is very different from the other four wells at the MWL that are installed in the fine-grained sediments. The well locations are shown on page 4 and the fine-grained strata the five wells are installed in are displayed on page 5. The argument by Sandia scientists that the range of chemistry between the wells in the above list is within the range of background for wells installed at Sandia Laboratories is not applicable to the evidence that the data show "statistically significant contamination" from the MWL to be present in the water samples produced from well MW4 because of the elevated values for chloride and specific conductance. The anomalously low nitrate, dissolved oxygen, and oxidation-reduction potential in the water samples produced from well MW4 are because of chemical processes that are consuming oxygen from the water and also from nitrate ion to create an anaerobic groundwater chemistry. Organic contaminants from the MWL are the source of "fuel" for the microbial processes that cause the anaerobic chemistry.

- The microbial processes efficiently consume the organic contaminants from the MWL that may include PCE, and limit their detection in the water produced from well MW4. The improper purge-to-dry water sampling methodology is another factor that prevents the detection of the volatile contaminants. The water sampling methodology is described on page 8.

- The volatile organic contaminant toluene is commonly detected in water samples from well MW4. Sandia staff claim the toluene is from the packer that is installed between the upper and lower screen but this claim is unproven. Another organic contaminant detected in a water sample from well MW4 is trichloroethene.

- There is an immediate need to replace the packer in well MW4 and to replace the pump with a design that will produce a continuous low-flow of water from the well to prevent the current purge-to-dry water sampling procedure that strips volatile contaminants and causes other changes to the chemistry of the water samples."

Mr. Gilkeson presented information to the GPAB that the packer in well MWL-MW4 has allowed leaking to occur since June 2001. For some reason, SNL has failed to review its own data so as to realize the problem of leakage and cross-contamination that exists at well MW4. Data from the Mixed Waste Landfill Groundwater Report, 1990 through 2001, Sandia National Laboratories, Albuquerque, New Mexico (SAND2002-4098), show that in June 2001 the packer was removed from well MW4 to perform a permeability (slug) test in the lower screen. The leakage between the upper and lower screen in the well MWL-MW4 has been ongoing since the packer was reinstalled after the permeability test. The water level data in Table 3-1 in the Sandia Report SAND2002-4098 show that the water level in the upper screen in well MW4 declined 0.62 feet for measurements taken in August and September of 2001, which would translate to an annual decline of 6.6 ft/year compared to an annual decline of the water level in the upper screen of the well MW4 of 0.63 ft/year for the period before the packer was removed (See Attachment A, a true and correct copy of Table 3-1 in SAND2002-4098). Because of the leaking packer, the water level in the upper screen in well MW4 has now dropped to approximately the same level as well MW6 which is under the hydraulic pressure of the productive aquifer strata (the "Ancestral Rio Grande strata") for the region of Albuquerque.

The leaking packer that is presently installed between the upper and lower screen in well MW4 needs to be removed as soon as possible, with installation of a submersible pump and a packer above the pump to seal off the downward flow of water from the upper screen to the lower screen. Then continuously pump the lower screen in well MW4 with time-series sampling of an appropriate suite of analytes to investigate the groundwater contamination in the groundwater produced from the lower screen in well MW4. It may be necessary and appropriate to continuously pump water from the lower screen in well MW4 for a period greater than several months.

After the necessary data on groundwater contamination is gathered from the continuous pumping of the lower screen in well MWL-MW4, the preferred action would be to plug and abandon the multiscreen well MW4 and install two new wells under Trench D of the MWL. One well should sample the groundwater in the fine-grained strata near the water table and another well should have a screen installed only in the appropriate productive strata in the "uppermost aquifer" under RCRA which are the Ancestral Rio Grande strata. The upper screen in well MW4 could possibly be rehabilitated but it is not possible to rehabilitate the lower screen because the screen is installed across the contact between the fine-grained sediments and the deeper Ancestral Rio Grande strata with more than 90% of the screen length installed in the fine-grained sediments.

The fact that cross contamination has proceeded for 6 years at well MWL-MW4 is evidence of the immediate requirement for DOE/SNL to install a monitoring well hydraulically downgradient of Trench D at the RCRA point of compliance for the MWL

to monitor the uppermost aquifer which is not the fine-grained strata at the water table, but instead the coarse-grained sands and gravels in the Ancestral Rio Grande strata.

DOE/SNL have used purge to dry water sampling methods at well MWL-MW4 that are improper and unnecessary because the pumping test data in the Sandia report SAND2002-4098 show that the strata surrounding the upper screen in the well are capable of producing a continuous flow of water for a low-flow sampling method. During the pumping test, the upper screen in the well produced water for a period of 13.3 hours at flow rates varying from 0.5 to 4.0 L/min. The RCRA guidance for purging and sampling monitoring wells is as follows:

> "Purging should be accomplished by removing groundwater from the well at low flow rates using a pump. The rate at which groundwater is removed from the well during purging ideally should be less than approximately 0.2 to 0.3 L/min." [From page 7-8 of the RCRA Draft Technical Enforcement Guidance Document, November 1992.]

The use of high flow purging methods, where the strata can provide adequate production of groundwater to support low-flow purging and sampling methods, constitutes a violation of the RCRA guidance contained in the Consent Order for purging and sampling. This is a further failure of NMED to enforce protocols for groundwater sampling. This contributes to the misrepresentation and under-representation of the nature and extent of the contamination at SNL and Kirtland Air Force Base (KAFB).

Research by the Environmental Protection Agency that is published on page 7-8 in the RCRA Draft Technical Enforcement Guidance Document has determined that the improper sampling method used at well MWL-MW4 (and many of the other Sandia monitoring wells) can remove up to 70% of the volatile organic contaminants (VOCs) such as PCE in the water samples produced by the purge to dry sampling methodology. The Consent Order contains the requirements of the RCRA Draft Technical Enforcement Guidance Document, but NMED is not enforcing the requirements for SNL at the MWL and possibly for KAFB.

The DOE/SNL Response shows that the improper purge to dry sampling methodology is also used for collecting water samples from other monitoring wells at the Sandia National Laboratories Albuquerque facility. The examples cited in the Response include wells WYO-4 in the Tijeras Arroyo Groundwater study area, well LWDS-MW1 in Technical Area 5, and wells CWL-MW5 Upper and CWL-MW6 Upper at the Chemical Waste Landfill. The Response states that volatile contaminants are detected in the water samples collected from <u>all</u> of the four (4) wells listed above. However, our position, <u>and the position of RCRA</u>, is that the nature and extent of the volatile contaminants in the groundwater at the locations of each of the four wells is not known because of the improper sampling methodology that will strip the volatile contaminants from the water samples produced from the wells. The improper sampling methodology will also prevent the detection of many other contaminants of concern. There is an immediate need for NMED to enforce the requirement for DOE/SNL to use the appropriate low-flow water purging and water sampling methods that are required under RCRA.

There is an immediate need for NMED to perform a detailed review of the groundwater monitoring protocols for each and every monitoring well installed at both the SNL and Kirtland Air Force Base facilities. The DOE/SNL Response is an indication that the improper water purging and water sampling methods may be used routinely for the majority of the monitoring wells at the Sandia National Laboratories Albuquerque facility and at the Kirtland Air Force Base.

By RCRA definition, monitoring well MWL-MW6 is the only well installed at the MWL with a screen only in the uppermost aquifer. Well MW6 is hydraulically downgradient of the MWL but is located 500 feet distant to the west. However, the change over time in the chemistry of the water samples produced from well MW6 is statistically significant evidence under RCRA that the groundwater contamination from the MWL has reached the distant location of well MW6. The evidence of groundwater contamination in the water produced from well MW6 are in the data presented in the Sandia reports SAND2006-0391 and SAND2002-4098, and in the data on file at NMED. The data are presented in the table below.

Well No./ Sample Date	Nitrate mg/L as N	Dissolved Oxygen %	REDOX Potential millivolts
MW6			
11-02-00	4.6	-	-
01-16-01	2.1	-	-
04-17-01	2.15	-	-
10-29-02	1.44	29.1	128
04-14-05	1.06	31.0	-60

The growing development of an anaerobic groundwater chemistry at well MW6 is proven by the low level of dissolved oxygen and the negative value for oxidation-reduction potential compared to the substantially higher level of dissolved oxygen and the positive value of oxidation reduction potential measured in the water samples produced from the background water quality well MWL-BW1 in the table above on page 2. The trend over time of nitrate to a very low concentration in the water samples produced from well MW6 is additional evidence of the arrival of groundwater contamination from the MWL. Furthermore, the decline in nitrate concentration is additional evidence of the development of an anaerobic chemistry in the groundwater produced from well MW6. Additional evidence of groundwater contamination are the large number of semivolatile contaminants that were detected in the water samples produced from well MW6 (See Attachment B, true and correct copy of Table 4-11 in Sandia report SAND2002-4098).

The groundwater contamination in the water samples produced from well MWL-MW6 require that DOE/SNL install a minimum of two monitoring wells in the Ancestral Rio Grande strata at a location as near as possible along the western side of the MWL, the hydraulically down gradient limit of the MWL that meets the "point of compliance" monitoring requirement under RCRA 40 CFR 264.95. In addition, there is a need for a monitoring well installed in the Ancestral Rio Grande strata at a location midway between the MWL and the well MWL-MW6. This midway monitoring well is also required for performing the pumping test that is required for accurate knowledge of the hydraulic properties of the Ancestral Rio Grande strata in order to calculate the time of

travel of the contaminated groundwater beneath the MWL to the supply wells of the new Mesa del Sol Subdivision. The need for the pumping test is described below.

The fact that the above data for both wells MWL-MW4 and MWL-MW6 represent "statistically significant contamination" under RCRA, and that the data were not reported to NMED by DOE/SNL as required by RCRA constitutes a violation of RCRA – (40 CFR 264.98 (g)(1)-(5) – Notify the Regional Administrator of this finding in writing within seven days and other requirements). CA believes that NMED should act in accordance with RCRA law by issuing a notice of noncompliance for both the non-reporting of the data, non-replacement of the well, and the ongoing cross-contamination of the uppermost aquifer by the leaking packer in the multiscreen well MWL-MW4. Proper fines for the violations should be levied upon DOE/SNL.

The technically incorrect use of major ion water quality data to assess the impact of the mud-rotary drilling method on contaminant data from the MWL monitoring wells. The mud-rotary drilling method was used for the installation of three of the seven monitoring wells at the MWL. At the GPAB meeting, you asserted that the intercomparison of the major ion chemistry data for all of the monitoring wells at the MWL showed no effect from the bentonite clay used in the mud-rotary drilling method, and therefore, the mud-rotary wells were reliable for the detection of contamination.

However, you should be aware that the major ion water quality data displayed on the Piper plots and the Stiff diagrams in the DOE/SNL Response are not scientifically sound or legally defensible data to make a determination that the mud-rotary monitoring wells produce water samples that are reliable for the detection of many contaminants of concern.

The Chief of the NMED Hazardous Waste Bureau approved of the mud-rotary drilling method for the installation of many monitoring wells at the Los Alamos National Laboratory (LANL). However, the EPA National Risk Management Research Laboratory (NRMRL) has written a report that describes the inability of water quality data to make a determination that the LANL mud-rotary wells produce reliable contaminant data. There is no basis for the NMED or SNL Response to now claim that such methods could be or are reliable for SNL or KAFB. The EPA NRMRL report is titled *"Impacts of Hydrogeologic Characterization Well Construction Practices,-(05RC06-001)"*. Excerpts from the EPA report are below:

> "Relative to addressing the question of whether ground-water samples are representative of the undisturbed aquifer chemistry, water quality data alone provide an unreliable indication of whether there is sustained impact to sediment sorption characteristics. The margin of error of determining, through measurements of water chemistry, what sediment minerals exist at any given point in time at a well screen is comparable to the level of uncertainty in estimating the temperature of a glass of water solely through visual observations." [from page 4 of EPA report.]
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> "For wells drilled using bentonite additives, the inability to sample and directly measure the level of residual bentonite in sediments adjacent to screened intervals

makes the representativeness of water samples for strongly sorbing contaminants uncertain." [from page 3 of EPA report.]

"With respect to screens where bentonite-based additives were used, it is possible that even trace amounts of residual bentonite that remain following development may render ground-water samples non-representative for highly sorbing constituents. This situation would be difficult to accurately characterize. Therefore, the quality of samples for constituents such as isotopes of americium, cerium, plutonium, and radium obtained from these screens will likely remain uncertain even after re-development." [from page 7 of EPA report.]

"It is also likely that the inability to fully remove the additives which were used during drilling has reduced the hydraulic conductivity of many of the impacted screened zones." [from page 15 of EPA report.]

"Strive to drill boreholes using no bentonite or organic additives within screened intervals." [from page 15 of EPA report.]

"At locations determined to be critical to the detection monitoring program, consider replacement of wells that were drilled using bentonite or that exhibit impacts due to organic additives with wells installed without additives in the screened zones, if needed to meet the DQOs for that monitoring location." [from page 15 of EPA report.]

The scientifically unsound defense by NMED and SNL of the mud-rotary drilling method raises a concern with CA that there may be many mud-rotary monitoring wells across the Sandia National Laboratories Albuquerque facility and the nearby KAFB. Any and all of the mud-rotary monitoring wells at the two facilities require replacement because contaminant data from the mud-rotary wells are not protective of the Albuquerque groundwater resource.

The three mud-rotary monitoring wells at the MWL are wells MW2, MW3, and BW1. The other factors that require the replacement of the three wells are described below.

Well MWL-MW3. The turbidity at well MW3 for groundwater sample collection on 04/07/06 was reported at 76.2 NTUs (See Attachment C). This level is more than 70 NTUs above the permissible limit of 5 NTUs under the RCRA Draft Technical Enforcement Guidance Document cited for performance in the April 29, 2004 Consent Order between SNL and NMED. The reason for the high turbidity is that the well is going dry and the high-flow water sampling methodology is disaggregating the sediments in the sump of the well. The low water level in the well and the high turbidity in the water samples are an indication that the well is no longer useful for its intended purpose. "In the event of a well or piezometer failure, or if a well or piezometer is any way no longer usable for its intended purpose, it must be replaced with an equivalent well or piezometer." (Consent Order, p.63). CA asks that NMED require DOE/SNL to replace well MWL-MW3.

Well MWL-MW2. Well MW2 was installed with the intended purpose of providing a hydraulically downgradient monitoring well. Well MW2 was installed 125 feet distant to

the north of the MWL. Like well MW1 it is cross gradient to the MWL. Well MW2 fails to meet its intended purpose because it is at the wrong location. Furthermore, well MW2 is plugged by the bentonite clay drilling mud from the mud-rotary drilling method and does not meet requirements to produce representative water samples. The data from well MWL-MW2 is still being presented in the 2006 Sandia Groundwater Monitoring Report (SAND2006-0391) as being hydraulically downgradient of the MWL and as if it is reporting data for a hydraulically downgradient monitoring well. This is fraudulent reporting under RCRA and there should be criminal penalties assessed under RCRA. Wells that do not meet their intended purpose are to be replaced according to the April 29, 2004 Consent Order between SNL and NMED. NMED should require replacement of well MWL-MW2.

Well MWL-BW1. Well BW1 had water levels so low when it was tested on 4/4/06, from the ongoing decline of the water table, that the pumping system would not produce a sufficient flow of water to meet the sampling needs from the well. A portable pump was dropped down inside the well. The portable pumping system only produced two gallons of water before the pump went dry. The portable pump flexible casing, which still contained water in it, was pulled from the well. The pump intake was placed in a bucket that contained de-ionized water. The de-ionized water was used with the pump to force out the water collected from the well to meet sampling needs. The Field Measurement Log shows that "5 gallons of de-ionized water was put through the pump tubing releasing ground water for sampling" (See, Attachment D- The Field Measurement Log).

Well BW1 is incapable of producing reliable and representative water quality data as a well that is hydraulically upgradient of the MWL. Wells that do not meet their intended purpose are to be replaced according to the April 29, 2004 Consent Order between SNL and NMED. NMED should require replacement of well MWL-BW1. Well BW1 does not meet its intended purpose for a background well. The well is cross gradient and has gone dry. Well MWL-BW1 needs to be replaced with two new monitoring wells that are at appropriate hydraulically upgradient locations to the MWL. One well should be installed in the fine-grained strata at a shallow depth to the water table. The second well should be installed in the productive Ancestral Rio Grande strata which represent the uppermost aquifer under RCRA.

Well MWL-MW1. Well MW1 was installed in 1988 for the intended purpose of providing a hydraulically downgradient monitoring well for the MWL. Well MW1 was then discovered by 1990 to be cross gradient to the flow of groundwater from beneath the MWL. The well MW1 fails to meet its intended purpose because it is at the wrong location. Data for well MW1 shows that turbidity on sampling on 4/5/06 was highly variable and significantly above the permissible limit of 5 NTUs under the RCRA Draft Technical Enforcement Guidance Document cited for performance in the April 29, 2004 Consent Order between SNL and NMED. Turbidity ranged from 72.4 NTUs to 14 NTUs before the water sample was collected.

The data from well MWL-MW1 is still being presented in the 2006 Sandia Groundwater Monitoring Report (SAND2006-0391) as being hydraulically downgradient of the MWL

and as if it is reporting data for a hydraulically downgradient monitoring well. This is fraudulent reporting under RCRA and there should be criminal penalties assessed under RCRA. Wells that do not meet their intended purpose are to be replaced according to the April 29, 2004 Consent Order between SNL and NMED. NMED should require replacement of well MWL-MW1.

The well installation record for well MWL-MW1 shows that the well produced water with a high turbidity of 21 NTUs when the well development was terminated. The claim of DOE/SNL that the purge to dry sampling method was required for well MW1 because of the very low permeability of the geologic strata is incorrect. Instead, the record shows that the low production of water from well MW1 is because of the failure of DOE/SNL to develop the well with the procedures required under RCRA. Apart from RCRA, the well development procedures fail to meet the standard industry practice.

Well MWL-MW5. Mistakes made during the construction of well MW5 allowed a large amount of annular sealant material of bentonite grout to enter the well. The large amount of this grout contaminant entering the well can be seen in the Mixed Waste Landfill Well MWL-MW5 Final Well Summary, p.9-11 (See Attachment E). Bailers put into the bottom of the screen came out filled with grout. Subsequent bailers put into the bottom of the screen also came out filled with grout and/or muddy water. The well development log for MWL-MW5 shows the final turbidity level at 48.9 NTUs when the well development was terminated. This level is more than 40 NTUs above the permissible limit of 5 NTUs under the RCRA Draft Technical Enforcement Guidance Document cited for performance in the April 29, 2004 Consent Order between SNL and NMED. The RCRA requirement and the standard industry practice are that monitoring wells are to be originally developed that meet the appropriate turbidity for representative water samples of not greater than 5 NTUs. The original development of MW5 was stopped before the grout contamination was removed.

The intended purposes for well MW5 was to provide hydraulic conductivity of the uppermost aquifer, and to serve as a downgradient monitoring well for the MWL. Neither purpose has not been met because the screen is mistakenly installed across both the fine-grained sediments and in the Ancestral Rio Grande strata, and the screen is contaminated with the bentonite grout. The well should be replaced. Indeed, the Consent Order requires that wells that have failed for their purpose be replaced.

The effect of the grout contamination to plug the aquifer strata and lower the measured value of hydraulic conductivity is evidenced by the data in Table 3-3, Summary of Hydraulic Conductivity Data for MWL Wells in Sandia Report SAND2002-4098. The hydraulic conductivity for well MW5 is shown as 0.682 ft/day compared to the markedly higher values of 1.73 ft/day measured in the lower screen of well MW4, and of 5.05 ft/day measured in well MW6. Well MW6 is the only well at the MWL with a screen installed only in the Ancestral Rio Grande strata.

Table 3-3 in the Sandia report identifies the permeability values for the lower screen in well MW4 and the screen in MW5 as being a composite value for both the fine-grained

strata and the Ancestral Rio Grande strata because the screens are installed in both strata type. Thus neither MW4 nor MW5 are capable of producing an accurate hydraulic conductivity value for either the fine-grained strata or the Ancestral Rio Grande strata.

However, Table 3-4 in the same Sandia report and the text of the report misrepresent the hydraulic conductivity values measured in the MWL wells MWL-MW4 Lower and MWL-MW5 as being representative of the Ancestral Rio Grande strata. This information is false because the two screens are also installed in the fine-grained sediments and the measured hydraulic conductivity is accordingly a composite value that is much lower than the hydraulic conductivity of the Ancestral Rio Grande strata. Only the bottom 10% of the screens in wells MW4 and MW5 are in the Ancestral Rio Grande strata. In addition, the bottom of the screen in well MW5 is the very part of the screened interval that was plugged by the grout!

Thus neither well MW4 nor MW5 are capable of producing an accurate hydraulic conductivity value for the Ancestral Rio Grande strata. This practice is violative of 40 CFR 264.98 (e) which requires that the owner or operator must determine the ground-water flow rate and direction in the uppermost aquifer at least annually. Table 3-4 misrepresents the permeability values of wells MW4 and MW5 as being representative of the Ancestral Rio Grande strata.

The average hydraulic conductivity value determined from the three wells MW4, MW5, and MW6 was then used in Sandia report SAND2002-4098 to calculate a flow velocity for groundwater in the Ancestral Rio Grande strata which underestimates the flow velocity for the uppermost aquifer to be 18.5 ft/year. The flow velocity for the uppermost aquifer at the MWL is unknown and misrepresented. The Sandia report thus makes false material representations for calculation and reporting of a slow groundwater flow rate at the MWL.

Given the planned development of the Mesa del Sol Subdivision with a set of large capacity supply wells, it is imperative that there be accurate knowledge for the speed of travel of groundwater from below the Sandia Mixed Waste Landfill to the hydraulically downgradient supply wells of Mesa del Sol. Accurate knowledge of the aquifer properties, and the speed of travel of contaminated groundwater, requires drilling a borehole to characterize the Ancestral Rio Grande strata through the entire thickness of the strata and the installation of a pumping well in the most productive strata for a multiple-well pumping test. An appropriate location for the pumping test is midway between the MWL and the downgradient monitoring well MWL-MW6.

CA questions why the SNL Mixed Waste Landfill has been allowed to have a defective monitoring system which does not meet RCRA requirements. The answer is that the New Mexico Environment Department failed to require SNL to comply with RCRA requirements, specifically, 40 CFR 270.1. 40 C.F.R. § 270.1(c) provides, "Owners and operators of hazardous waste management units must have permits during the active life (including the closure period) of the unit. Owners and operators of . . . landfills . . . that received waste after July 26, 1982, or that certified closure (according to Section 265.115

of this chapter) after January 26, 1983, must have post-closure permits, unless they demonstrate closure by removal or decontamination as provided under Section 270.1(c)(5) and (6), or obtain an enforceable document in lieu of a post-closure permit, as provided under paragraph (c)(7) of this section. If a post-closure permit is required, the permit must address applicable 40 C.F.R. part 264 groundwater monitoring, unsaturated zone monitoring, corrective action, and post-closure care requirements of this chapter."

Part 270.1 did not allow the NMED to waive DOE/SNL from obtaining a RCRA permit at the MWL. Part 270.1 does not provide for the NMED to allow the MWL to be treated as a SWMU since the MWL received hazardous waste after January 26, 1983. Nor does Part 264.90 allow the MWL to be treated as a SWMU because landfills that received hazardous wastes after July 26, 1982 are to be treated as "**regulated units**" and have to meet the requirements of Part 264.90-100 "**in lieu of**" part 264.101. The MWL should have been put under the closure and post closure requirements of a regulated unit that require an adequate well monitoring program under 40 CFR 264.90-100. Instead, the NMED, U.S. EPA and SNL ignored the requirements to have a RCRA permit in the first place and then ignored the requirements for a Part 264 groundwater monitoring program. NMED went to Part 264.101 that talks about setting up a corrective action management unit under Part 264 Subpart S. Subpart S is not applicable at all to the MWL by definition under RCRA because there is no remediation of the wastes at the MWL.

NMED is also not enforcing the requirements of RCRA through the Consent Order. The April 29, 2004 Consent Order requires "In the event of a well or piezometer failure, or if a well or piezometer is any way no longer usable for its intended purpose, it must be replaced with an equivalent well or piezometer." (CO, p.63). To demonstrate its arrogance, DOE/SNL further informs us in its Inspector General Response that "...the requirements for drilling, design and construction of groundwater monitoring wells listed in the [Consent Order] are also not applicable." (SNL Response, p. 10). DOE/SNL apparently does not intend to abide by RCRA, DOE Orders or the Consent Order with respect to providing a high quality monitoring system to protect the Albuquerque aquifer. DOE/SNL apparently believes, and the NMED has not contradicted the position, that any type of shoddy well monitoring system can satisfy the requirements that DOE/SNL make for itself. DOE/SNL hold themselves outside the law. DOE/SNL asserts in its Response that the Consent Order does not apply to the wells that were constructed previously to the date of the Consent Order. DOE/SNL ignore the fact that DOE Orders 5820.2a, 435.1, and 450.1 require the use of RCRA 264 Subpart F.

Citizen Action notes that in its Response to the Inspector General, DOE/SNL makes admissions that reveal an inadequate monitoring system at the MWL. DOE/SNL admits that it is not performing vadose monitoring at the MWL. Vadose zone monitoring is required by the Resource Conservation and Recovery Act (RCRA) and DOE Orders for early detection of contamination. Vadose zone monitoring information for the Long Term Monitoring and Maintenance Plan should be furnished before the approval of the Corrective Measures Implementation Report.

An additional admission by the DOE/SNL Response is that the background well MWL-BW1 is cross-gradient, rather than upgradient to the MWL as required by RCRA.

The DOE/SNL Response is incorrect to claim that all of the monitoring wells at the SNL Mixed Waste Landfill are installed in the uppermost aquifer as required by RCRA. The DOE/SNL Response makes the following error of fact concerning the number of monitoring wells at the SNL MWL that are installed in the uppermost aquifer. From Section 4.5, page 18 of the DOE/SNL Response:

> "The EPA and the NMED require that the groundwater monitoring wells be completed in the uppermost aquifer. All of the MWL monitoring wells are completed in the uppermost aquifer."

In fact, of the seven (7) monitoring wells installed at the MWL, the only monitoring well installed in the uppermost aquifer under RCRA is monitoring well MWL-MW6 at a location 500 feet west of the western boundary of the MWL.

At the GPAB meeting, you incorrectly asserted that monitoring the uppermost aquifer was not a requirement under RCRA Part 264.101, which section does not refer to the uppermost aquifer. Apparently, the DOE/SNL Response also does not apply the appropriate definition under RCRA of the "uppermost aquifer." DOE/SNL has failed to apply the RCRA definition of "uppermost aquifer" to its analysis and includes wells which are in the fine-grained sediments. Under RCRA the coarse-grained sediments in the Ancestral Rio Grande strata are identified as the "aquifer" and the "uppermost aquifer" as follows in RCRA 40 CFR §260.10 – Definitions:

"When used in parts 260 through 273 of this chapter, the following terms have the meanings given below:"

- "Aquifer means a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs."
- "Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary" [Here "facility" refers not to the boundary of the MWL but to the property boundary of the Sandia National Laboratories].

The RCRA definitions are mandatory for describing the terms "uppermost aquifer" and "aquifer." 40 CFR 260.1 (a) states that "This part provides definitions of terms, general standards, and overview information applicable to parts 260 through 265 and 268 of this chapter."

Furthermore, in addition to the installation of a new network of monitoring wells for the proper monitoring of the uppermost aquifer at the MWL, the RCRA, NMED, DOE Orders, and the standard industry practice, require the installation of an appropriate network of monitoring wells in the fine-grained sediments below the MWL for the early detection of the arrival of contamination from the MWL to the water table.

An omission by the DOE/SNL Response is the Summary and Conclusions Statement in Section 5.0 as follows:

> "The DOE and Sandia assert that the allegations provided in the OIG attached report are technically incorrect and without basis. The MWL monitoring well network complies with applicable regulations and is performing as designed. The network of seven wells sufficiently monitors the potential releases from the MWL and includes downgradient wells screened in appropriate hydrogeologic units, one well within the footprint of the MWL, and one background well."

Quite the opposite of the DOE/SNL assertion, the record shows that all of the allegations provided to the OIG concerning the MWL monitoring program are technically correct and with basis. Indeed, the careless regard of DOE/SNL to protect the Albuquerque groundwater resource continues to be demonstrated in the DOE/SNL Response. The errors of fact in the DOE/SNL Response are summarized below.

- The MWL monitoring well network does not comply with applicable regulations and is not performing as designed.

– The groundwater monitoring program at the Sandia Mixed Waste Landfill has not produced the required knowledge for any decision on closure of the "mixed waste dump" other than to excavate the buried wastes. The groundwater monitoring data prove that the buried wastes at the MWL are contaminating the groundwater. The nature and extent of the groundwater contamination is not known because of the deficiencies with the groundwater monitoring program.

– The vadose zone monitoring required by RCRA and DOE Orders for early detection of contamination released from the MWL does not exist.

– Only one of the monitoring wells is screened appropriately in the productive aquifer strata – the "uppermost aquifer" under RCRA – and this well is located 500 feet distant from the western side of the MWL; a distance too great for the early detection of groundwater contamination from the MWL.

– Three of the seven monitoring wells are located cross gradient to the direction of groundwater flow beneath the MWL, and are not reliable for the detection of groundwater contamination from the MWL.

– The well located in the footprint of the MWL is allowing water to leak between the upper and lower screen and is a fast pathway for cross-contaminating the Ancestral Rio Grande strata, the groundwater resource for Albuquerque and the surrounding region.

– Because of the declining water levels, two of the MWL monitoring wells are now incapable of producing water samples because they are going dry. DOE/SNL were aware for the past ten years of the eventual need to replace wells that have gone dry. NMED fails to require replacement of the wells that no longer meet their intended purpose because of low water levels.

– Three of the MWL monitoring wells were installed with the mud-rotary drilling method, a drilling method that does not meet the standard industry practice for the installation of monitoring wells to produce reliable contaminant data and reliable measurement of hydraulic properties. The mud-rotary method was used after the

correct air rotary casing hammer method was used for the installation of well MWL-MW1.

- The scheme by DOE/SNL to use major ion chemistry data to prove the mud-rotary wells are not affected by the bentonite clay is technically incorrect and without basis.
- Water samples are collected from five of the MWL monitoring wells using a purge-to-dry water sampling methodology that strips volatile contaminants from the water samples and causes other chemical changes to the water samples that may mask detection of contaminants because of the addition of oxygen.
- The methods used by DOE/SNL to calculate the speed of groundwater travel from beneath the MWL to the downgradient supply wells are technically unsound and create an imminent danger for the widespread contamination of the Ancestral Rio Grande strata, the productive groundwater resource for the region of Albuquerque and for the supply wells in the new Mesa del Sol Subdivision.

Respectfully submitted,

David B. McCoy

David B. McCoy, Director
Citizen Action New Mexico
PO BOX 4276
Albuquerque, NM 87196-4276
505 262-1862

Cc: service list
EPA Region 6
Richard Greene
Regional Administrator
1445 Ross Avenue
Suite 1200
Dallas, Texas 75202
(214) 665-6444

New Mexico Environment Department
Secretary Ron Curry
1190 St. Francis Drive, Suite #N4050
Santa Fe, NM 87502

U.S. Department of Energy
Samuel W. Bodman, Secretary
1000 Independence Ave., S.W.
Washington, D.C. 20585

Department of Defense
Secretary of Defense
Donald H. Rumsfeld
1000 Defense Pentagon, # 3E880
Washington, D.C. 20301

Sandia National Laboratories, New Mexico
Thomas O. Hunter, President and Director
PO Box 5800
Albuquerque, NM 87185

Lockheed Martin Corporation
Registered Agent
Corporation Service Company
125 Lincoln Ave., Suite 223
Santa Fe, NM 87501

United States Attorney's Office
District of New Mexico
David C. Iglesias
United States Attorney
201 3rd Street NW
Albuquerque, NM 87102
(505) 346-7274

Attachment A

Table 3-1
Depth to Water in MWL Monitoring Wells
1998 through 2001

Measurement Date	Depth to Water (fbtoc)						
	MWL-MW1	MWL-MW2	MWL-MW3	MWL-MW4	MWL-MW5	MWL-MW6	MWL-BW1
01-07-98	463.25	460.00	464.72	NA	NA	NA	466.70
02-02-98	463.36	460.01	464.46	NA	NA	NA	466.84
03-03-98	463.45	460.18	464.91	NA	NA	NA	466.94
04-10-98	463.82	461.21	465.63	NA	NA	NA	467.35
05-07-98	463.63	460.27	465.12	NA	NA	NA	467.14
06-02-98	463.78	460.45	465.32	NA	NA	NA	467.27
07-02-98	463.93	460.47	465.41	NA	NA	NA	467.45
08-04-98	464.51	460.62	465.58	NA	NA	NA	467.51
09-01-98	464.03	460.55	465.53	492.92	NA	NA	467.35
10-02-98	463.85	460.45	465.41	492.89	NA	NA	467.28
11-02-98	463.63	460.4	465.4	NA	NA	NA	467.23
12-01-98	464.18	460.7	465.71	NA	NA	NA	467.65
01-04-99	NA	460.63	465.63	NA	NA	NA	NA
02-01-99	464.14	460.79	465.76	NA	NA	NA	467.61
03-04-99	464.07	460.58	465.53	NA	NA	NA	467.51
04-01-99	464.1	NA	465.87	NA	NA	NA	467.51
01-28-00	464.17	460.7	465.54	NA	NA	NA	467.63
03-20-00	464.22	460.88	465.71	NA	NA	NA	467.39
03-28-00	464.36	460.56	NA	NA	NA	NA	467.68
06-20-00	464.68	461.18	465.87	NA	NA	NA	468.28
07-03-00	464.7	461.26	466.03	NA	NA	NA	468.18
08-01-00	464.72	461.29	466.04	NA	NA	NA	468.20
10-05-00	465.27	461.76	466.52	NA	NA	NA	468.77
10-06-00	464.84	461.3	466.06	NA	NA	NA	468.34
11-06-00	464.53	461.2	465.97	NA	NA	NA	468.32
12-01-00	465.12	461.58	466.37	NA	488.75	483.35	468.66
01-08-01	464.98	463.55	466.26	NA	488.53	483.06	468.42
01-31-01	465.01	463.57	466.28	NA	488.55	483.09	468.44
03-02-01	465.07	463.62	466.24	NA	488.63	483.08	468.49
04-02-01	464.93	461.46	466.27	NA	488.6	483.03	468.4
05-01-01	464.98	462.66	466.45	NA	488.94	483.13	468.5
06-04-01	465.04	462.68	466.48	494.66	488.96	483.16	468.52
08-01-01	465.35	461.62	466.48	495.24	490.75	483.16	468.83
09-04-01	465.37	461.62	466.51	495.86	490.77	483.17	468.85
10-01-01	465.94	462.25	467.1	495.92	491.01	483.95	468.89
11-01-01	465.96	462.26	467.14	495.94	488.99	483.2	468.93
12-04-01	465.65	462.08	466.97	495.78	489.55	483.66	469.04

Note: MWL-MW4 could not be measured from November 1998 through November 2000 due to the presence of a packer in the well. MWL-MW5 and MWL-MW6 were installed in 2000.
fbtoc feet below top of casing
MWL Mixed Waste Landfill
NA not applicable or not recorded

Attachment B

Table 4-11
Summary of SVOCs Detected in Groundwater Beneath the MWL
1990 through 2001

Well	Analyte EPA Method 8270[a]	Sample Date	Result (g/L)	Lab
MWL-BW1	bis(2-Ethylhexyl)phthalate	09-27-90	13	QSTL
MWL-MW1	bis(2-Ethylhexyl)phthalate	05-04-94	160	QSTL
MWL-MW2	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
	bis(2-Ethylhexyl)phthalate	04-17-95	89	QARV
MWL-MW4	bis(2-Ethylhexyl)phthalate	04-19-95	6.9 J (10)	QARV
MWL-MW5	bis(2-Ethylhexyl)phthalate	07-24-01	0.368 J (0.98)	GEL
	bis(2-Ethylhexyl)phthalate	07-24-01	0.258 J (0.98)	GEL
MWL-MW6	2-Methylnaphthalene	07-23-01	0.244 J (1)	GEL
	Acenaphthylene	07-23-01	0.241 J (1)	GEL
	Anthracene	07-23-01	0.252 J (1)	GEL
	Benzo(a)anthracene	07-23-01	0.444 J (1)	GEL
	Benzo(a)pyrene	07-23-01	0.357 J (1)	GEL
	Benzo(b)fluoranthene	07-23-01	0.396 J (1)	GEL
	Benzo(k)fluoranthene	07-23-01	0.354 J (1)	GEL
	Chrysene	07-23-01	0.33 J (1)	GEL
	Dibenz[a,h]anthracene	07-23-01	4.29	GEL
	Fluoranthene	07-23-01	0.235 J (1)	GEL
	Fluorene	07-23-01	0.253 J (1)	GEL
	Phenanthrene	07-23-01	0.297 J (1)	GEL
	bis(2-Ethylhexyl)phthalate	07-23-01	0.529 J (1)	GEL

Note: No EPA MCLs are established for the SVOCs listed on this table.

[a]EPA November 1986.

EPA U.S. Environmental Protection Agency
GEL General Engineering Laboratory (off-site laboratory)
J ( ) estimated value by the laboratory, above the method detection limit but below the reporting limit, shown in parentheses
Lab laboratory
g/L microgram(s) per liter
MCL Maximum contaminant level
MWL Mixed Waste Landfill
QARV Quanterra, Inc., Arvada, Colorado (off-site laboratory)
QSTL Quanterra Laboratory, St. Louis, Missouri (off-site laboratory)
SVOC semivolatile organic compound

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MW-1	Project No.: 98026 01041
Well I.D.: MW-3	Date: 4-7-06
Weather clear, cool 39°F	
Method: X Portable pump ____ Dedicated pump	Pump depth: 474'

80% recovery = 471.65

PURGE MEASUREMENTS

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	Color and appearance
469.28	0821									
471.46	0834	4	16.23	0005	241.2	5.21		.42	92.8	9.11
472.58	0840	6	16.55	495	133.2	7.86		41.4	61.6	6.00
473.68	0845	8	16.96	496	131.8	7.90		62.6	59.5	5.74
471.15	0828	~~10~~ DRY								
474.22	0855	5	16.91	485	83.6	7.56		76.2	91.3	8.89
	0856	Sample								

COC number(s): 609592

Sample number(s): 67631

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X_ (length of tubing) = _____ milliliters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.: 98026 01 01 01
Well I.D.: BW-1	Date: 4-4-06
Weather: clear, cool 42°F	
Method: X Portable pump ____ Dedicated pump	Pump depth: 474'

PURGE MEASUREMENTS

Depth to Water (FT)	Time 24 hr	Vol L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	Color and appearance
472.31	0830		Begin	Purge						
1 473.85	0905	6	15.87	469	185.3	7.57		2.35	89.4	6.90
*		6	Dry							
		7								
6 473.99	0841		14.28	490	42.8	7.24		3.94	84.3	8.36
	0905	DRY								
	0910	BEGIN SAMPLING								
6/06	PURGED 7 GALLONS DI WATER THRU PUMP TUBING									
	RELEASING GROUND WATER FOR SAMPLING									

COC number(s): 609587

Sample number(s): 076300

* Well went dry after 2 gal. purged. Pulled up pump & added 5gal DI water to bucket & pumped thru line to get readings.

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons

4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons

6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters

3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters

1/2" OD: 21.6 ml/ft X____ (length of tubing) = _____ milliliters

Attachment E-1

Daily Activity Log (cont.)

Day #	Date	Activity
10	Nov. 3, 2000	Weather cloudy, slightly drizzly, and in the mid-40s. All the 11 ¾" was out @ 10:30 AM. DTW approx. 497.4 ft bgs. Southwest Geophysical arrived @ 2:30 PM and finished logging the hole @ 3:45 PM. Logger's TD was 546 ft and DTW on the log was 496 ft. Began running the Tremie pipe.
11	Nov. 4, 2000	Weather cloudy, windy and rainy. All the Tremie pipe was in the hole by 7:45 AM. Ran 5-ft sump with bottom cap, one 20-ft joint of 5" screen, and 25 20-ft joints of 5" PVC casing. Length of casing string = 498.71 ft. In order to place the top of the screen at 496 ft the top of the casing was set at 2.7 ft ags. Rigged up pump and water truck. For the backfill, pumped down 10 sacks of #10-20 sand and tagged at 527 ft. Pumped in two buckets of bentonite pellets followed by a sack of #10-20 sand. Tagged the backfill at 521 ft. Plugged-back TD (PBTD) = 521 ft bgs.
12	Nov. 5, 2000	For the sandpack, pumped 10 sacks of #10-20 sand and tagged at 510 ft. Pumped 14 more sacks and tagged at 495 ft. Pumped in three more sacks of #10-20 and tagged at 489 ft. The last three sacks filled 6 ft of hole. Pumped 6 sacks of #30-70 (fine) sand and tagged at 487 ft. The 6 sacks of #30-70 filled 2 ft of hole. There must be a hole collapse between 487 and 489 ft which took the extra sand, and the collapsed material probably fell into the interval 489-95 ft and mixed with the final three sacks of #10-20. For the seal, pumped seven buckets of bentonite pellets and tagged at 465 ft. Pumped 10 sacks of grout for lift #1. Pulled the 9 5/8" up to 377 ft.
13	Nov. 6, 2000	Weather calm but cold, ~ 30° F. Tagged top of grout lift #1 at 379 ft. Pumped another 10 sacks of grout for lift #2. Pulled 9 5/8" to 297 ft. Pumped 10 more sacks of grout to complete lift #2. Pulled 9 5/8" up to 227 ft. At 1:30 PM a 5-ft bailer followed by a 10-ft bailer were run in the well to the bottom of the screen and each came out filled with grout. The tagger could not go deeper than 512 ft in the well. DTW = 421 ft bgs. Tagged the grout of lift #2 in the annulus at 212 ft. Pulled 9 5/8" up to 207 ft.
14	Nov. 7, 2000	Weather very windy, ~30° F with snow flurries. Tagged grout in annulus at 192 ft. DTW = 429.5 ft bgs. Tagged grout inside well at 514 ft. Ran 5-ft bailer and recovered 2.5 gal of "muddy" water with some grout on the very bottom lip of the bailer. Two more bailer runs had similar recoveries, and the next three runs had

Attachment E-2

Daily Activity Log (cont.)

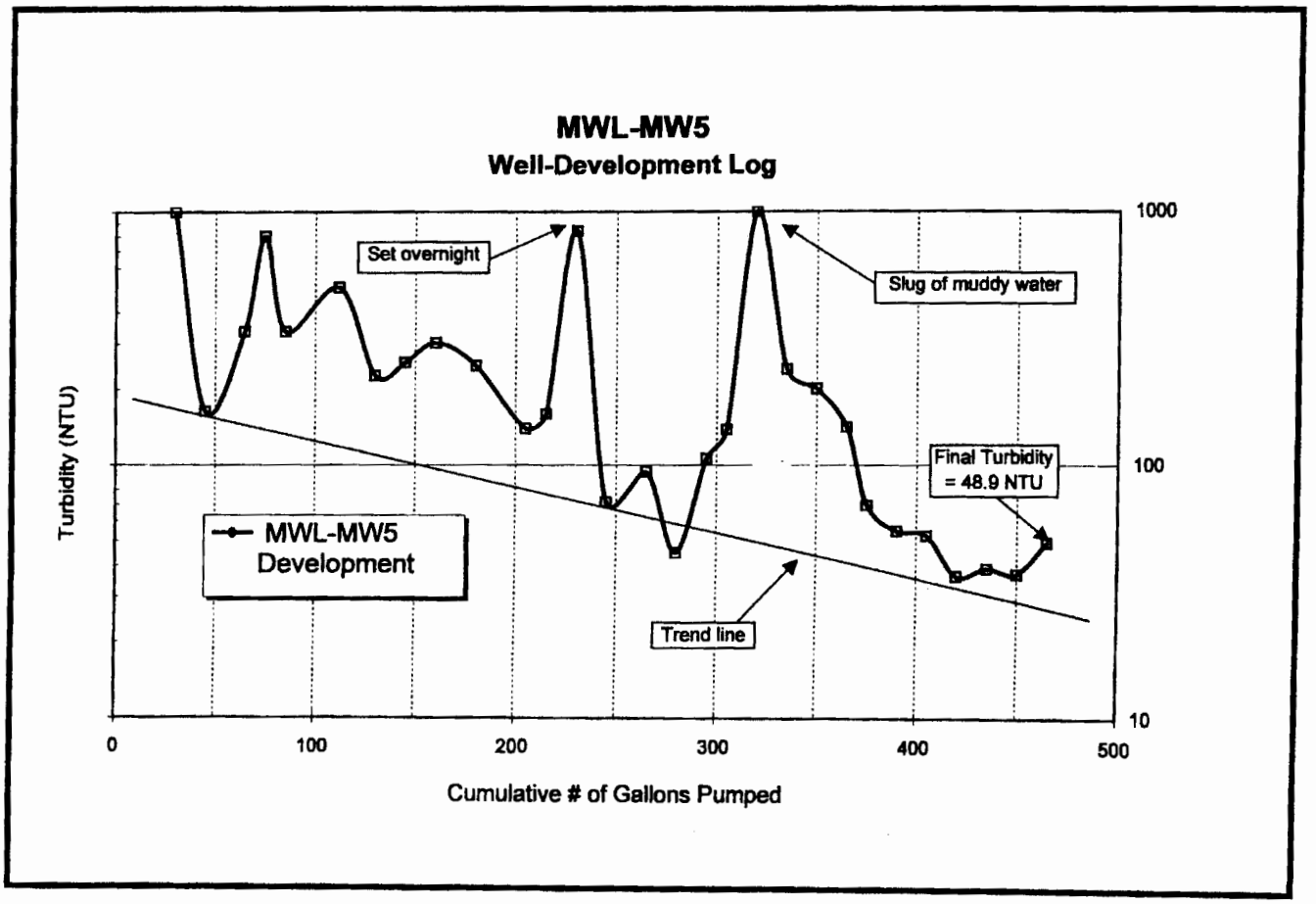
Day #	Date	Activity
		recoveries that were somewhat cleaner. Total bailer recovery = 15 gal. Ran tagger in the well and could not go beyond 512 ft bgs, i.e., 4 ft above the base of the screen. Ran bailer eight more times and recovered 20 gal of "less grouty" water as above. DTW = 475.6 ft. Pumped three buckets of bentonite pellets down the annulus and chased with ¾ sack of #10-20 sand. Tagged top at 171 ft. Pumped 15 sacks of grout for lift #3, pulled the 9 5/8" up to 107, and pumped another 15 sacks of grout for lift #3. Pulled the 9 5/8" up to 57 ft. Ran tagger inside the well and stopped at 514 ft. Tagged top of grout in annulus at 41 ft. Ran the 5-ft bailer three times and recovered grouty water.
15	Nov. 8, 2000	Weather calm, overcast, and cold, ~25° F. Tagged grout in the annulus at 40 ft, and bottom of well at 514 ft. Pulled all 9 5/8" drive casing out. For lift #4 pumped eight sacks of grout and tagged at 29 ft. Dry-packed with 29 sacks of grout to surface at 10:00 AM. Well construction finished. DTW = 463 ft.
16	Nov. 9, 2000	DTW = 465 ft. Stick up of casing is now 2.1 ft, vs. 2.7 ft earlier. Got clearance from Rad Protection to release a load of Stewart Bros. equipment. Crew left for end of their 10-day work cycle @ 11:00 AM.
17	Nov. 14, 2000	DTW = 470.9 ft bgs. Tagged bottom of well in PVC at 508 ft bgs. Made three runs with the 5-ft bailer and received 7.5 gal of grouty water. Made nine runs with the 10-ft bailer and recovered about 34 gal of grouty water. Ran pump to 509 ft. DTW = 498.5 ft. Water meter on pump hose not working, so volumes recovered had to be made by measuring drum fill with a "dip stick." Began pumping well @ 2:50 PM. In 3 minutes the well pumped dry. DTW = 510 ft. Pumped approx. 100 gallons of water down the hole. DTW = 425 ft and dropped to 495 ft by 3:30 PM and raised to 486 ft @ 4:00 PM. Suspect pump was not working so pulled it and stuck it in the water truck: worked fine. Began running back in hole with pump.
18	Nov. 15, 2000	Finished running pump in hole to 509 ft. DTW = 470 ft. Pumped well dry @ 8:20 AM. Pumped approx. 200 gal of water down the hole. DTW = 261 ft and fell slowly. Pumped dry @ 9:10 AM. Allowed to recover to 491 ft. Pumped dry four times and recovered from 509 to 491 ft (18 ft). Recovery time dropped from 57.5 to 39 minutes. Lowered the pump to 514 ft. DTW = 486 ft.

Attachment E-3

Daily Activity Log (cont.)

Day #	Date	Activity
		Pumped dry five more times and recovered from 514 to 491 ft (13 ft). Recovery time dropped from 39 to 34.5 minutes.
19	Nov. 16, 2000	Weather cold, ~23° F, but calm. DTW = 486.5 ft. Had to thaw out upper joint of Tremie with a torch. Pumped well dry twice and recovered from 514 to 491 ft. Recovery time was 27 minutes each time. Lowered pump to 515 ft. Pumped dry 17 times and recovered from 515 to 491 ft (24 ft). Recovery time dropped from 26.5 to 22.5 minutes.
20	Nov. 17, 2000	Weather cold, ~23° F, but calm and clear. DTW = 486.8 ft. Thawed out upper joint of Tremie with a torch. Pumped well dry 16 times and recovered from 515 to 491 ft (24 ft). Recovery time dropped from 22.5 to 16 minutes. Turbidity dropped to 48.9. Pulled the pump and Tremie pipe. Total net recovery was 545 gal (in addition to 300 gal of introduced water). Ran in hole with 10-ft bailer in attempt to clean out sump. The first four bailer runs recovered 4 gal consisting of muddy water and several pounds of sand. The fifth and final bailer run at @ 4:00 PM recovered about 2 gal muddy water and about 1 gal of sand. Sand was about 80% #10-20 sand-pack material. Total volume of the recovered #10-20 was 1 ½ gal. Recovery also included the ends of two security screws that had been put in the end cap before running the casing. Ran depth sounder @ 4:15 PM and tagged bottom at 522 ft. Bottom cap is at 521.5 ft. Bentonite plug on top of backfill = 521-527 ft. DTW @ 4:20 PM = 478.8 ft. Decided to leave well alone for night. Pulled rig off.
21	Nov. 18, 2000	Weather cold, ~23° F. DTW = 486.75 ft. Tagged bottom of well at 521 ft. Constructed pad and painted. Crew hauled several loads back to Grants.
22	Nov. 19, 2000	Weather clear and calm, ~27° F. DTW = 486.9 ft bgs. All decon complete by 10:40 AM. Stewart Bros. logged out of TA3 @ 11:00 AM. **Project completed**.

Attachment E-4



C:\DVH\BOREHOLES\MW6\DEV_LOG.XLS

Attachment E-5

MWL-MW5 Development Parameters					
Gallons Pumped (Cumulative #)	Temperature (Deg. C)	pH	Conductivity (mmho)	Turbidity (NTU)	Remarks
					Rec. 300 gal introduced wtr.
30	16.2	7.42	0.860	1000	
45	18.0	7.40	0.871	163	
65	11.6	7.53	0.481	337	
75	18.0	7.38	0.889	802	
85	11.1	7.40	0.900	336	
112	11.3	7.33	0.946	503	
130	14.3	7.38	0.905	225	
145	14.0	7.38	0.875	253	
160	12.2	7.36	0.867	303	
180	16.9	7.28	0.868	246	
205	10.5	7.39	0.865	139	
215	8.9	7.34	0.882	159	
230	9.7	7.91	1.027	841	Set overnight
245	8.1	7.58	0.885	71.5	
265	7.3	7.50	0.905	94.2	
280	9.4	7.48	0.903	44.7	
295	10.5	7.48	0.875	106	
305	13.8	7.43	0.907	138	
320	14.5	7.45	0.920	1000	Slug of muddy water
335	15.0	7.33	0.919	238	
350	14.2	7.36	0.931	200	
365	16.4	7.33	0.922	141	
375	16.0	7.32	0.904	69.1	
390	16.2	7.37	0.909	54.5	
405	18.7	7.31	0.890	52.3	
420	17.4	7.45	0.907	36.1	
435	18.3	7.29	0.886	38.7	
450	18.3	7.25	0.898	36.8	
465	17.7	7.30	0.884	48.9	Gritty residue still in sample
545					Total net recovery