LMS/GNO/S12309

2014 Groundwater Monitoring and Inspection Report Gnome-Coach, New Mexico, Site

January 2015

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Abbreviations

bgs	below ground surface
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	feet
LM	Office of Legacy Management
LTHMP	Long-Term Hydrologic Monitoring Program
NGVD	National Geodetic Vertical Datum

Executive Summary

The Gnome-Coach, New Mexico, Site was the location of a 3-kiloton underground nuclear test in 1961. The U.S. Geological Survey conducted a groundwater tracer test in 1963 using four dissolved radionuclides—tritium, iodine-131, strontium-90, and cesium-137—as tracers. Surface reclamation and remediation began after the underground testing. Five wells (USGS-1, USGS-4, USGS-8, LRL-7, and DD-1) at the site are used to monitor groundwater for the presence of radionuclides. A Completion Report was prepared for the surface, and it was accepted by the State of New Mexico in January 2006. Annual sampling and monitoring of wells near the site began in 1972. In 2008, the annual site inspections were refined to include hydraulic head monitoring and the collection of samples from groundwater monitoring wells onsite using the low-flow sampling method. The annual site inspection and sampling event were conducted on February 18–19, 2014.

Analytical results obtained from this sampling event indicate that concentrations of tritium, strontium-90, and cesium-137 were consistent with historical results. This includes no detections in the sample from well USGS-1, which is used by the U.S. Department of the Interior Bureau of Land Management as a point of diversion to provide water for livestock belonging to area ranchers under water right C02095. The exception is the result for strontium-90 in the sample from well USGS-4. The concentration of strontium-90 in this sample increased by a factor of 2 times last year's result, but it is still consistent with the recent historical results. Well LRL-7 has not been sampled since January 2011, and water levels were still increasing in the well when the transducer data were downloaded in September. The frequency and rate of pumping increased in well USGS-1 in late November 2013. This is evident from the hydraulic head data from well USGS-1 that indicate an increase in drawdown and recovery in the water levels of approximately 5 feet when the pump cycles off. Historically, water levels in this well have recovered approximately 2 feet when the pump cycled off. The hydraulic head data continue to show that pumping in well USGS-1 provides a response in wells USGS-4 and USGS-8, which also increased in late November 2013. The increased magnitude of drawdown and corresponding recovery of water levels during pump cycles are the result of a new dedicated pump installed in well USGS-1 by the area ranchers and an increase in the frequency of pumping.

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1.0 Introduction

This report presents the 2014 groundwater monitoring results collected by the U.S. Department of Energy (DOE) Office of Legacy Management (LM) at the Gnome-Coach, New Mexico, Site (Figure 1). Groundwater monitoring consisted of collecting hydraulic head data and groundwater samples from the onsite wells. This report summarizes groundwater monitoring and site investigation activities that were conducted during fiscal year 2014.

2.0 Site Location and Background

The Gnome-Coach site consists of 640 acres of federally withdrawn lands approximately 25 miles east of Carlsbad in Eddy County, New Mexico (Figure 1). The site was the location of the first underground nuclear test performed under the Plowshare Program by the U.S. Atomic Energy Commission, a predecessor to DOE. The Plowshare Program was a research and development initiative started in 1958 to determine the technical and economic feasibility of peaceful applications of nuclear energy. The underground nuclear test conducted at the site was identified as Project Gnome and was performed on December 10, 1961. In preparation for the test, a 10-foot-diameter vertical emplacement shaft was advanced to a depth of 1,216 feet (ft) below ground surface (bgs). A horizontal tunnel/drift was mined 1,116 ft northeast from the shaft, ending in a hook shape designed to be self-sealing. The test consisted of detonating a nuclear device with an estimated yield of 3 kilotons at a depth of 1,184 ft bgs in a bedded salt deposit known as the Salado Formation (Figure 2). Post-test drilling operations and preparations for another underground nuclear test, identified as Coach, began shortly after the Project Gnome test. The Coach experiment was initially scheduled for 1963 but was canceled and never executed. Five wells (USGS-1, USGS-4, USGS-8, LRL-7, and DD-1) at the site are used to monitor groundwater for the presence of radionuclides.

No additional underground nuclear detonations occurred at the site; however, in 1963 the U.S. Geological Survey conducted a groundwater tracer test using four dissolved radionuclides—tritium, iodine-131, strontium-90, and cesium-137—as tracers (Beetem and Angelo 1964). The tracer test was conducted between wells USGS-4 and USGS-8, which are about 3,100 ft west of the Project Gnome monument that is directly above the underground nuclear detonation point (Figure 2). Wells USGS-4 and USGS-8 are completed in the Culebra Dolomite Member of the Rustler Formation that lies above the Salado Formation. The Culebra Dolomite is a fractured carbonate aquifer of Permian age and is the most prolific aquifer near the site. Well USGS-1 is also completed in the Culebra Dolomite and has been used by the U.S. Department of the Interior Bureau of Land Management since the 1980s as a point of diversion to provide water for livestock belonging to area ranchers under water right C02095.

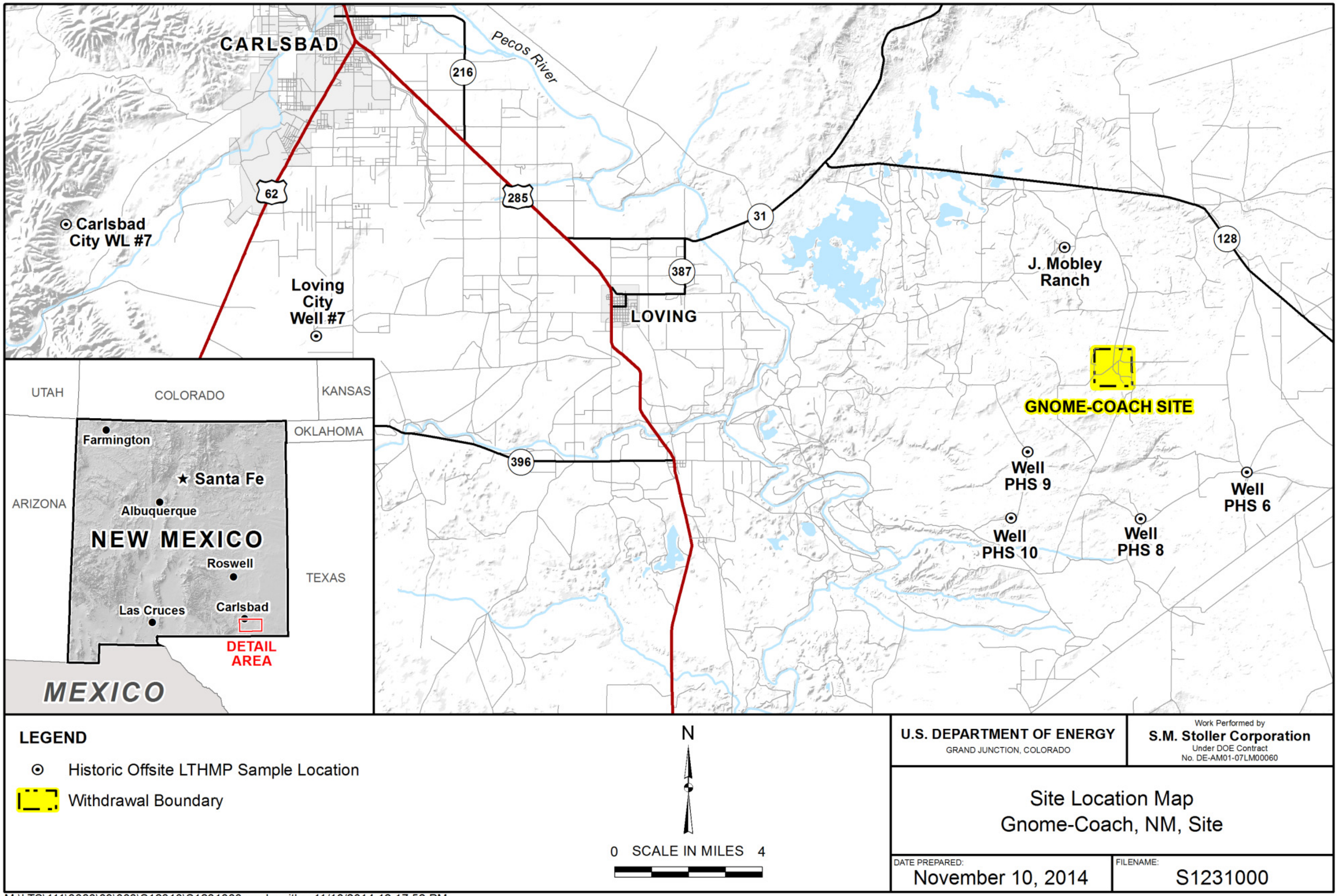

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Figure 1. Site Location Map for the Gnome-Coach, New Mexico, Site

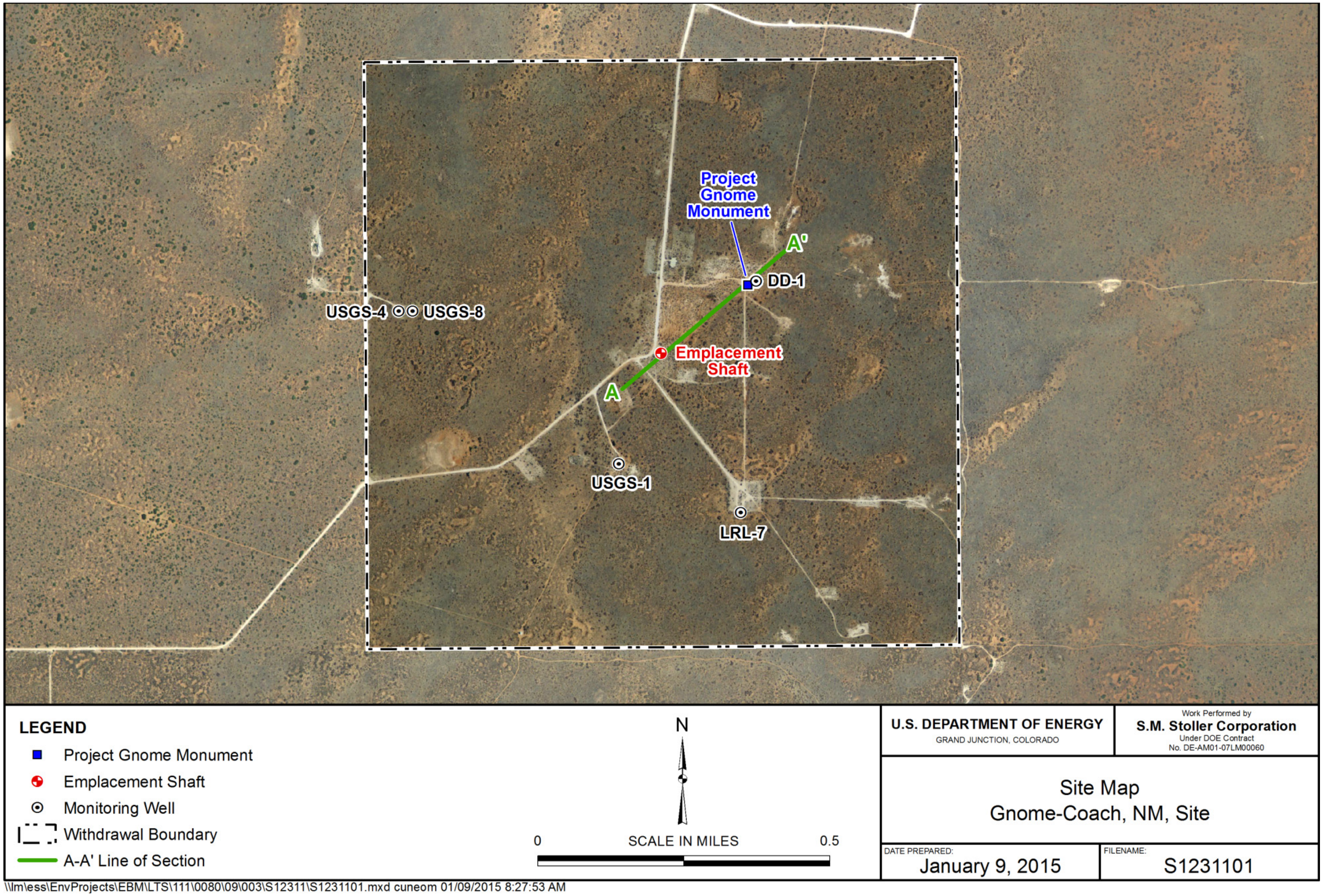

Figure 2. Site Features at the Gnome-Coach, New Mexico, Site

2.1 Summary of Reclamation and Remediation Activities

Cleanup of the surface and subsurface contamination resulting from the underground nuclear testing, post-test drilling, and groundwater tracer test was conducted in 1968 and 1969. A second major cleanup was conducted from 1977 to 1979 (REECO 1981). In 1994, radiological contamination was identified on the surface and in the shallow subsurface (to a depth of 20 ft bgs) during a survey and sampling event conducted by the U.S. Environmental Protection Agency (EPA). The DOE National Nuclear Security Administration Nevada Site Office conducted a corrective action investigation to assess the extent of contamination at the site. The field investigations were performed from February through June 2002 and in May 2003. The Corrective Action Investigation Report (DOE/NNSA 2004) summarizes the results of the investigation. After discussions with the State of New Mexico, it was decided that the site would be administered under the Voluntary Remediation Program. A Completion Report was prepared in accordance with the Voluntary Remediation Program (DOE/NNSA 2005), and a Conditional Certificate of Completion documents that surface remediation activities have been successfully completed in accordance with the Voluntary Remediation Program. The Conditional Certificate of Completion also specifies ongoing requirements that must be maintained.

Subsurface activities have consisted of annual sampling and monitoring of groundwater as part of the Long-Term Hydrologic Monitoring Program (LTHMP). EPA began the LTHMP in 1972 (EPA 1972) and conducted the sampling until 2008, when LM assumed responsibility for sampling. Since 1972, locations used for long-term sampling have changed: some locations were abandoned or replaced, and new locations have been added. Samples collected from these locations have generally been analyzed for gamma-emitting radionuclides (using high-resolution gamma spectrometry), strontium-90, and tritium (using conventional and electrolytic enrichment methods). LM evaluated the LTHMP and the associated monitoring network after assuming responsibility for the sampling in 2008. The purpose of the evaluation was to determine the effectiveness of the current monitoring network and determine future monitoring at the site. The evaluation considered potential transport pathways for contaminant migration from the detonation zone and tracer test to surrounding receptors. Analytical results from more than 30 years of monitoring indicate that groundwater at sample locations outside the land-withdrawal boundary (Figure 1) were not impacted by nuclear-test-related contamination. For this reason, in 2010 locations outside the land-withdrawal were excluded from future sampling, but wells within and near the boundary continue to be monitored.

To enhance monitoring at the site, low-flow bladder pumps were installed in wells USGS-4, USGS-8, and LRL-7 in June 2008. The dedicated bladder pumps were installed to replace the previous sampling method that used a depth-specific bailer and to allow the collection of more representative samples using the low-flow sampling method. Pressure transducers were also installed in the onsite monitoring wells in 2008, 2009, and 2010 to collect hydraulic head data for evaluating groundwater flow directions. Geophysical well logging was conducted in onsite wells USGS-1, USGS-4, and USGS-8 in April 2010. The well logging was conducted to obtain borehole deviation data from wells USGS-1 and USGS-4, natural gamma data from wells USGS-4 and USGS-8, and down-hole video logs from wells USGS-4 and USGS-8. The borehole deviation data allow measured depths to be corrected to true vertical depths to support the calculation of hydraulic head at site wells that deviate from vertical. The gamma ray logs provide geologic information that can be used to correlate with other wells in the area. The video log images suggest that the well casings are generally in good condition. The 2010 Groundwater Monitoring and Inspection Report (DOE 2011) summarizes the well logging results.

A seismic survey was conducted at the site in February and March 2011. Seven seismic reflection profiles totaling approximately 13.9 miles were acquired to assist in the interpretation of subsurface hydrogeology and development of a conceptual site model. The survey was designed to image the upper few thousand feet of the section, which includes the tracer test (at a depth of about 450 ft bgs at wells USGS-4 and USGS-8) and the detonation (at a depth 1,184 ft bgs). A check shot survey was acquired in well USGS-4 to calibrate the seismic profiles to the subsurface lithology. Significant features identified that would influence groundwater flow were areas of collapse in the evaporites overlying the Salado Formation and possible faults that cross the site. The 2012 Groundwater Monitoring and Inspection Report (DOE 2013) summarizes the seismic survey results.

3.0 Geology and Hydrology

The site is in the northwestern part of the Delaware Basin, a deep, oval, sedimentary basin 75 miles wide and 135 miles long in southeastern New Mexico. The geology and hydrology of this basin are well studied because of oil and gas exploration, mining, and operation of the Waste Isolation Pilot Plant approximately 8 miles north-northeast of the site. The basin deposits generally dip gently to the east and southeast, although in places the bedding is almost flat. During the late Permian Period, a warm shallow sea in the region provided an ideal environment for reef development, which blocked seawater circulation. As the seawater began to evaporate, brines were formed, and crystalline salts precipitated and accumulated on the basin floor. As a result, the site area is underlain by several thousand feet of limestone, dolomite, gypsum, halite, anhydrite, and potassium salts (potash). The Salado Formation, in which the Gnome detonation took place, is a 2,500-ft-thick bed of halite that formed during the Permian Period. The Salado Formation is virtually impermeable due to the plastic nature of the salt under pressure.

Figure 3 is a cross-section showing the stratigraphy at the site, the emplacement shaft and drift, and the detonation cavity that resulted from the underground test. Overlying the Salado Formation are five thin-bedded members of the Rustler Formation. This formation includes the Culebra Dolomite Member, which is the subject of extensive study as part of the operation of the Waste Isolation Pilot Plant. Below the Culebra Dolomite and above the Leached Member of the Salado Formation is the Lower Member that is now referred to as the Los Medanos Member. Above the Culebra Dolomite is the Tamarisk Member, which is overlain by the Magenta Member. The uppermost member of the Rustler Formation is the Forty-Niner Member, a mixture of gypsum and anhydrite. The youngest Permian sequences in the site area are the thin, red, sedimentary rocks of the Dewey Lake Redbeds Formation. The Gatuna Formation and alluvial sand deposits overlie the Dewey Lake Redbeds Formation.

The Culebra Dolomite is a widespread, laterally continuous, fractured carbonate aquifer that is approximately 30 ft thick and is encountered at depths ranging from approximately 460 to 515 ft bgs at the site. The groundwater within the Culebra generally moves through fractures and is of poor quality because of high concentrations of dissolved solids (Mercer 1983). The Culebra is the most prolific aquifer at the site. Despite the poor water quality, it is a source of water for ranchers who maintain livestock throughout the area.

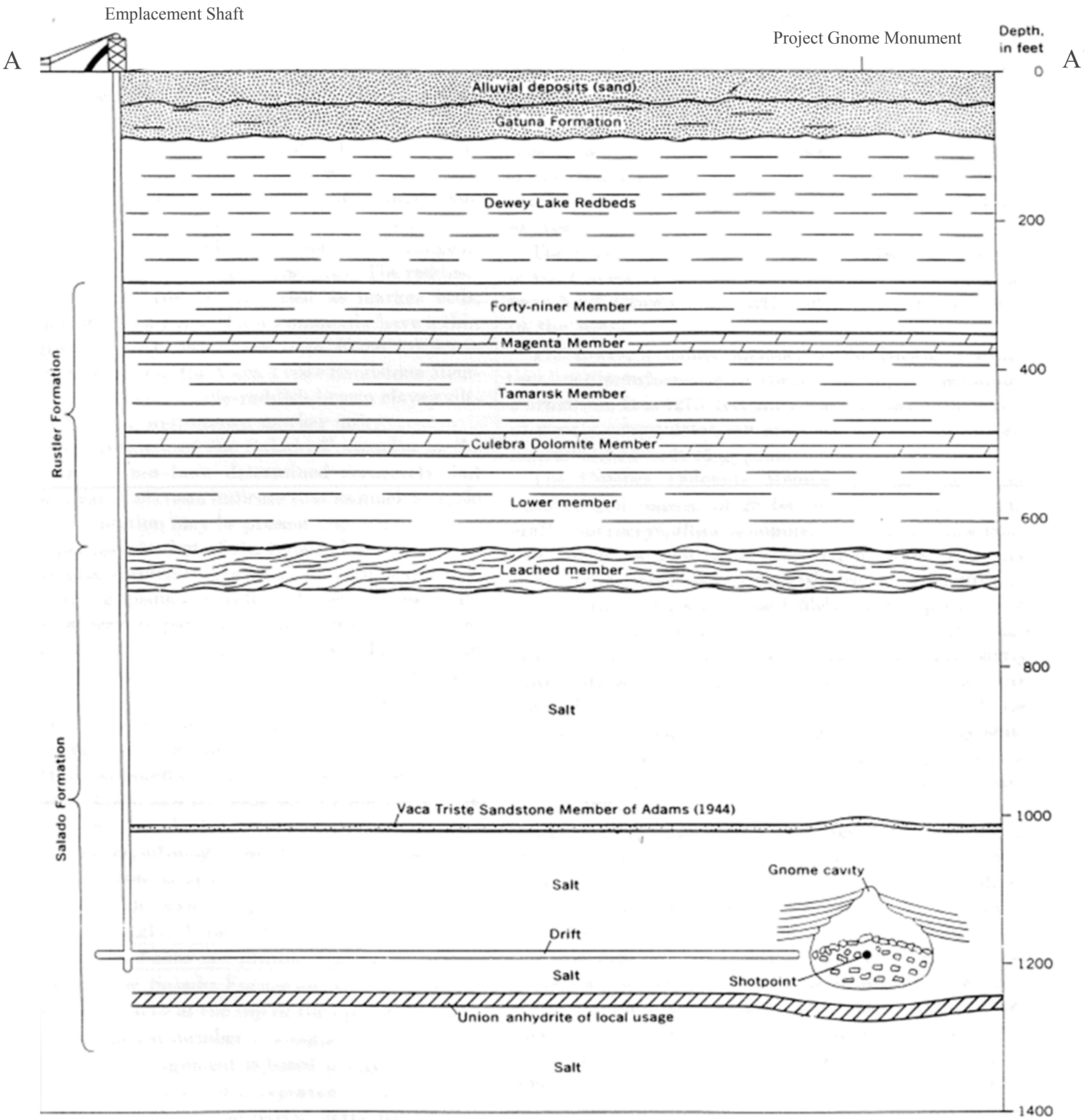

Figure 3. Stratigraphical Cross-Section at the Gnome-Coach Site

4.0 Groundwater Monitoring and Inspection Results

Groundwater monitoring and site inspection activities conducted on February 18–19, 2014, consisted of a site inspection, hydraulic head monitoring, and groundwater sampling. In addition to the annual groundwater monitoring and site inspection, data from pressure transducers were downloaded in September 2014. The *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PRO/S04351) is used to guide the quality assurance/quality control of the annual sampling and monitoring program. The analytical results obtained from the annual sampling were validated in accordance with the "Standard Practice for Validation of Environmental Data" section in the *Environmental Procedures Catalog* (LMS/POL/S04325). Samples were analyzed using accepted procedures that were based on the specified methods. The laboratory radiochemical minimum detectable concentration reported with these data is an estimate of the predicted detection capability of a given analytical procedure, not an absolute concentration that can or cannot be detected. A copy of the data validation package is maintained in LM records and is available upon request. It can also be accessed on the LM Public Website at http://www.lm.doe.gov/gnome/Sites.aspx.

4.1 Site Inspection Results

The site inspection was conducted on February 18–19, 2014. The inspection included evaluating roads and monitoring well heads, installing a new well box at well DD-1, surveying the well heads, and inspecting the Project Gnome monument for signs of damage, natural deterioration from weather, or vandalism. The new well box at DD-1 was installed to reduce the deterioration of the well head and secure the well. The monitoring wells were surveyed by a registered land surveyor to provide northings and eastings with new top-of-casing elevations for the recently modified well heads. The survey data were documented in New Mexico East Zone State Plane Coordinate System with horizontal data based on the North American Datum of 1927 and the vertical data based on the National Geodetic Vertical Datum (NGVD) of 1929. Roads, well heads, and the monument were in good condition at the time of the inspection. The well head survey data are provided in Table A-1 of Appendix A.

On July 21, 2014, LM was informed that the new well box at DD-1 had been damaged and removed by vandals. Federal law enforcement was notified and a report was filed to document the incident. Field personnel traveled to the site to evaluate the damage and a new well head cover was installed to secure the well on July 24, 2014.

4.2 Hydraulic Head Monitoring and Results

Heads were recorded every 2 hours by pressure transducers in the site monitoring wells (USGS-1, USGS-4, USGS-8, LRL-7, and DD-1). The transducer data were downloaded and water levels were measured manually in the site wells as part of the annual monitoring event on February 18–19, 2014. The transducer data in wells USGS-1, USGS-4, USGS-8, and LRL-7 were downloaded again on September 30, 2014. The transducer in well DD-1 was not downloaded in September because the well is completed in the detonation cavity and access is restricted. Manual water level measurements were used to convert the transducer data to groundwater elevations. Transducer data were corrected for the different specific gravity of water for each screened unit. The specific gravity of water in Culebra screened wells is approximately 1.0035. The specific gravity of water from Salado screened wells is approximately 1.15. Water elevations were not converted to a freshwater-equivalent groundwater elevation. Table 1 presents the water level data and measured groundwater elevations obtained from the new well head survey in 2014, along with the zone of completion and the hydrostratigraphic unit monitored for the wells.

Table 1. Gnome-Coach Site Water Levels

Well	Date	DTW (ft)[a]	TOC Elevation (ft amsl)	TSZ Elevation (ft amsl)	BSZ Elevation (ft amsl)	Formation/Unit Monitored	Groundwater Elevation (ft amsl)
USGS-1	2/19/2014	439.90[c]	3,426.60	2,907[b]	2,875[b]	Culebra Dolomite	2,986.79[b]
USGS-4	2/19/2014	427.12	3,413.72	2,940[b]	2,907[b]	Culebra Dolomite	2,991.41[b]
USGS-8	2/19/2014	420.02	3,411.25	2,947[b]	2,915[b]	Culebra Dolomite	2,991.21[b]
LRL-7	2/19/2014	463.04	3,442.52	2,653[d]	2,127[d]	Salado Formation	2,979.38[d]
DD-1	2/19/2014	NM	3,397.49	2,259[d]	NM	Salado Formation	NM

Notes:

[a] Depth to water has not been corrected for true vertical depth.

[b] Elevation has been corrected for true vertical depth. (At the water level depth, the deviation correction for USGS-1 is 0.09 ft; the deviation correction for USGS-4 is 4.83 ft; and no correction is required for USGS-8 because it did not deviate from vertical).

[c] Well USGS-1 has a dedicated submersible pump that was operating at the time of the measurement.

[d] Elevations for LRL-7 and DD-1 have not been corrected for true vertical depth because borehole deviation corrections are not available for these wells.

Abbreviations:

amsl = above mean sea level
BSZ = bottom of screen zone, uncased/open interval, or perforated interval in feet above mean sea level
DTW = depth to water (all measurements obtained from north top of casing)
NM = not measured or unknown
TOC = top of casing elevation in feet above mean sea level (Vertical Datum NGVD 29)
TSZ = top of screen zone, uncased/open interval, or perforated interval in feet above mean sea level

The hydraulic head data are shown in Figure 4 and Figure 5. The hydrographs are grouped according to each well's open interval and formation monitored. Head data collected using a water-level tape appear as individual symbols, and data collected with transducers appear as lines. Head data collected during this monitoring period were converted to groundwater elevations using referenced top of casing elevations that were obtained from the well head survey. Hydraulic head data from wells USGS-1 and USGS-4 have been corrected to true vertical depth. For reference, the borehole deviation data obtained from wells USGS-4 and USGS-1 require corrections of 4.83 ft and 0.09 ft to obtain true vertical depths, respectively (DOE 2011). No correction is required for well USGS-8. Borehole deviation data are currently not available for wells DD-1 and LRL-7, so groundwater elevations depicted in Figure 5 are approximate.

Figure 4 shows the hydrographs for the three wells (USGS-1, USGS-4, and USGS-8) completed in the Culebra Dolomite. Well USGS-1 provides water for livestock belonging to area ranchers, and a dedicated submersible pump that cycles on and off to maintain a constant volume in a nearby water tank. The frequency and rate of pumping increased in well USGS-1 in late November 2013. This is evident from the hydraulic head data from well USGS-1 that indicate an increase in drawdown and recovery in the water levels of approximately 5 ft when the pump cycles off. Historically, water levels in this well only recovered approximately 2 ft when the pump cycled off (Figure 4). The hydraulic head data continue to show that pumping in well USGS-1 provides a response in wells USGS-4 and USGS-8, which also increased in late November 2013. The increased magnitude of drawdown and corresponding recovery of water levels during pump cycles are the result of a new dedicated pump installed in well USGS-1 by the area ranchers and an increase in the frequency of pumping.

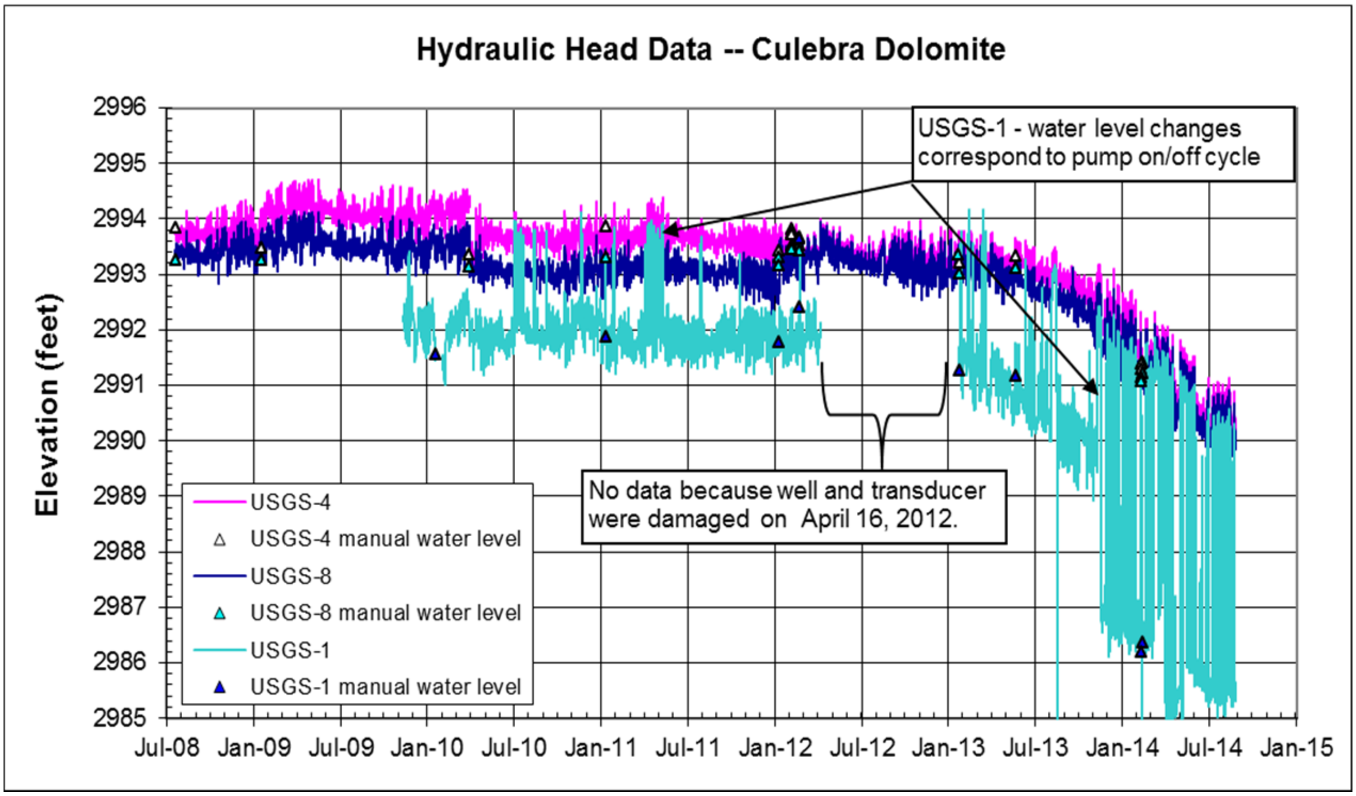

Figure 4. Hydrograph Showing Water Elevations in Wells USGS-1, USGS-4, and USGS-8

Figure 5 shows the hydrographs for the two wells (LRL-7 and DD-1) completed in the Salado Formation. Hydraulic head data indicate that the water level in well LRL-7 does not fully recover from annual sampling events and that the water level is still recovering from the last annual sampling event in January 2011. Hydraulic head data indicate that the water level in well DD-1 abruptly stopped rising in June 2011, and it is uncertain whether the data are correct or it is the result of a transducer malfunction. Attempts were made in January and March 2012 to verify these data by raising the transducer in measured increments to evaluate if recorded pressure responses were consistent with the incremental raising of the transducer. Results from this evaluation indicate the transducer was operating correctly. A water level was measured manually in this well during the January 2013 monitoring event (Figure 5). Additional water level measurements will need to be collected from this well to verify that the data are correct. Manual water levels are not typically measured in DD-1 because of the contamination.

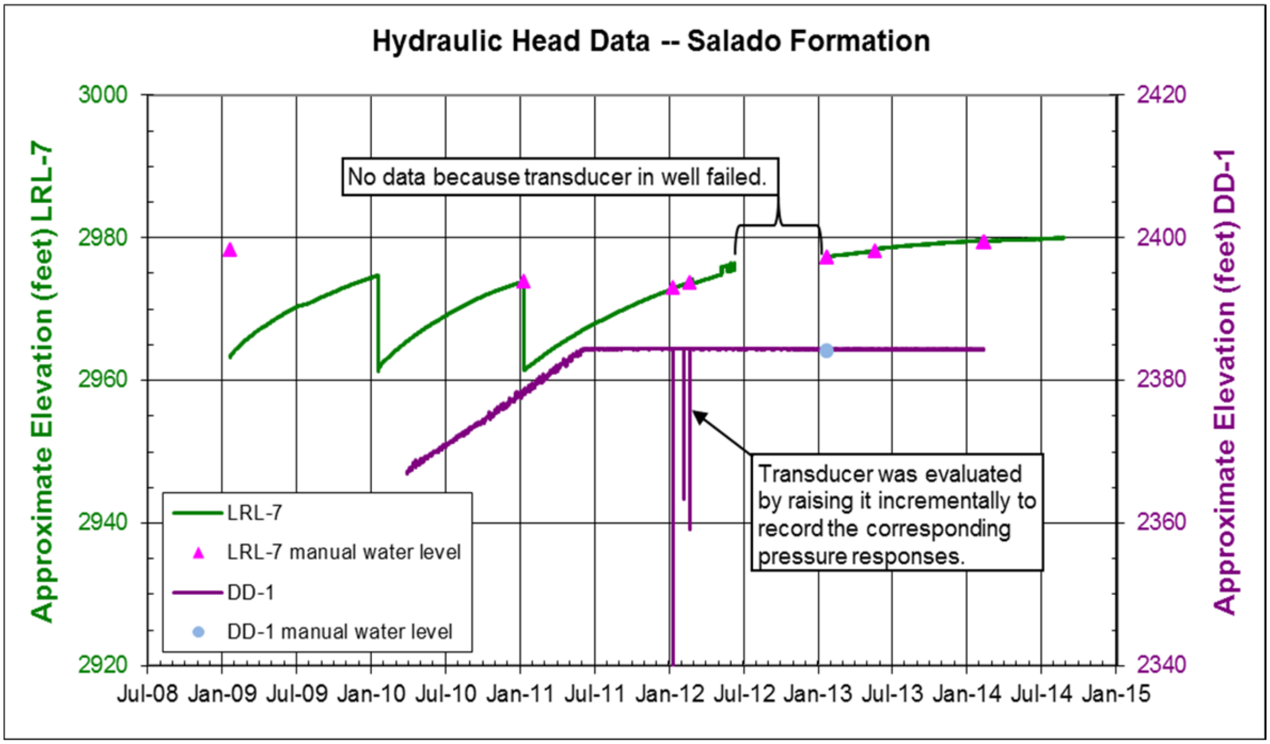

Figure 5. Hydrograph Showing Water Elevations in Wells DD-1 and LRL-7

4.3 Groundwater Sampling and Results

Groundwater samples were collected from wells USGS-1, USGS-4, and USGS-8 on February 19, 2014. A sample was not collected from well LRL-7 during this monitoring event to allow water levels at this location to continue to recover from the last sampling event in January 2011. A sample was also not collected from well DD-1 because the detonation-related contamination is well documented. Monitoring wells USGS-4 and USGS-8 were sampled using dedicated low-flow submersible bladder pumps. The tubing inlets of the bladder pumps are located in the screened or open interval to allow water to be collected directly from the adjacent geologic formation. The sample from well USGS-1 was collected as a grab sample because the dedicated pump was operating to replace water in the nearby stock tank at the time of the sampling. Samples were analyzed for gamma-emitting radionuclides (using high-resolution gamma spectrometry), strontium-90, and tritium (using conventional methods). An additional sample was collected from well USGS-1 for tritium analysis using the electrolytic enrichment method.

Table 2 presents a summary of radiochemical analytical results from the sampling event in 2014 along with the results from 2008 through 2013 for comparison. LM has performed the sampling at the site since 2008. Prior to 2008, EPA had conducted the sampling and, until the 2012 sampling event, had also analyzed the samples. All samples collected since the 2011 sampling event have been analyzed by GEL Laboratories in Charleston, South Carolina. Radiochemical analytical results obtained from the 2014 monitoring event were generally consistent with previous analytical results. The exception is the result for strontium-90 in the sample from well USGS-4. The concentration of strontium-90 in this sample increased by a factor of 2 times last year's result but is still consistent with other recent historical results (Table 2). The radionuclide concentrations in wells USGS-4 and USGS-8 are the result of radionuclides injected during the tracer test in 1963. Radionuclides were not detected above the laboratory minimum detectable concentration in samples collected from well USGS-1 (Table 2).

Table 2. Radiochemical Analytical Results 2008 through 2014

Sample Location	Collection Date	Tritium (pCi/L)	Tritium Enriched Method (pCi/L)	Cesium-137 (pCi/L)	Strontium-90 (pCi/L)	Formation/Unit Monitored
USGS-1	7/30/2008	<169	NA	<5.0	NA	Culebra Dolomite
	1/27/2009	<154	NA	<4.94	<1.8	
	1/26/2010	<146	7.6	<2.1	<0.89	
	1/26/2010[a]	<146	<3.4	<1.4	<1.9	
	1/19/2011	<150	NA	<2.2	<3.6	
	1/19/2011[a]	<150	NA	<2.4	<1.1	
	1/18/2012	<240	<2.33	<5.69	<0.728	
	1/18/2012[a]	<243	NA	<6.82	<0.794	
	1/29/2013	<371	<2.18	<4.68	<0.909	
	1/29/2013[a]	<371	NA	<5.97	<0.716	
	2/19/2014	NA	<2.4	<5.68	<0.987	
	2/19/2014	<298	NA	<4.81	<1.08	
USGS-4	7/30/2008	22,300	NA	<4.59	NA	Culebra Dolomite
	1/27/2009	16,800	NA	<4.99	2,980	
	1/26/2010	13,200	NA	<1.4	2,540	
	1/19/2011	11,300	NA	<2.4	2,650	
	1/18/2012	9,110	NA	<5.62	884	
	1/30/2013	10,200	NA	<5.33	987	
	2/19/2014	7,680	NA	<5.85	1,780	
USGS-8	7/30/2008	30,000	NA	154	NA	Culebra Dolomite
	1/27/2009	28,800	NA	163	3,440	
	1/27/2010	25,500	NA	181	3,320	
	1/19/2011	21,200	NA	150	3,650	
	1/18/2012	21,700	NA	154	1,400	
	1/29/2013	20,900	NA	174	1,580	
	2/19/2014	18,400	NA	176	1,640	
LRL-7	7/30/2008	4,070	NA	126	NA	Salado Formation
	1/28/2009	4,870	NA	139	<24	
	1/26/2010	4,350	NA	129	<33	
	1/19/2011	3,910	NA	134	<29	
	1/18/2012	NA	NA	NA	NA	
	1/30/2013	NA	NA	NA	NA	
	2/19/2014	NA	NA	NA	NA	

Notes:
[a] = Indicates a field duplicate sample

Abbreviations:
NA = not analyzed
pCi/L = picocuries per liter

Charts 1 through 7 in Appendix B show temporal plots of radionuclide concentrations (1972 through 2014) in samples collected at wells LRL-7, USGS-4, and USGS-8. Concentrations are plotted on a semilogarithmic scale. All sample results, including nondetects, are plotted. As indicated in the charts, many results from sampling events before the late 1980s had no reported detection limit. For interpretation purposes, relatively high concentrations (i.e., concentrations significantly higher than detection limits associated with subsequent sampling) should be considered detections. The increases in tritium concentrations in samples collected from well LRL-7 (Chart 1) and cesium-137 concentrations in samples collected from wells USGS-8 and LRL-7 (Chart 4 and Chart 6) after the 2007 sampling event are attributed to changes in the sampling method. Prior to 2008, EPA collected samples using a depth-specific bailer, and after 2007, LM collected samples from dedicated bladder pumps using the low-flow sampling method. Tritium concentrations in samples collected from well USGS-4 (Chart 1) also appear to be decreasing at a rate that is greater than the natural decay rate for tritium.

5.0 Conclusions

The annual site inspection and sampling event were conducted on February 18–19, 2014. The monitoring wells were surveyed to provide new top-of-casing elevations for the recently modified well heads. Roads, well heads, and the monument were in good condition at the time of the inspection; however, LM was later notified that the well box at DD-1 had been removed by vandals. A new well head cover was installed to secure the well on July 24, 2014, shortly after the incident.

Analytical results obtained from this sampling event indicate that concentrations of tritium, strontium-90, and cesium-137 were consistent with historical results. This includes no detections in the sample from well USGS-1 that is used to provide water for livestock belonging to area ranchers. The exception is the result for strontium-90 in the sample from well USGS-4. The concentration of strontium-90 in this sample increased by a factor of 2 times last year's result, but it is still consistent with the other recent historical results. Well LRL-7 has not been sampled since January 2011, and water levels were still increasing in the well when the transducer data were downloaded in September. The frequency and rate of pumping increased in well USGS-1 in late November 2013. This is evident from the hydraulic head data from well USGS-1 that indicate an increase in drawdown and recovery in the water levels of approximately 5 ft when the pump cycles off. Historically, water levels in this well only recovered approximately 2 ft when the pump cycled off. The hydraulic head data continue to show that pumping in well USGS-1 provides a response in wells USGS-4 and USGS-8, which also increased in late November 2013. The increased magnitude of drawdown and corresponding recovery of water levels during pump cycles are the result of a new dedicated pump installed in well USGS-1 by the area ranchers and an increase in the frequency of pumping.

6.0 References

Beetem, W.A., and C.G. Angelo, 1964. Tracer study at Project Gnome site, near Carlsbad, New Mexico: Background information. Technical Letter: Carlsbad Hydrology-2, U.S. Geological Survey.

DOE (U.S. Department of Energy), 2011. *2010 Groundwater Monitoring and Inspection Report, Gnome-Coach Site, New Mexico*, LMS/GNO/S07114, Office of Legacy Management, Grand Junction, Colorado, February.

DOE (U.S. Department of Energy), 2013. *2012 Groundwater Monitoring and Inspection Report, Gnome-Coach Site, New Mexico*, LMS/GNO/S09337, Office of Legacy Management, Grand Junction, Colorado, March.

DOE/NNSA (U.S. Department of Energy National Nuclear Security Administration), 2004. *Surface Corrective Action Investigation Report for the Gnome-Coach Site, New Mexico*, DOE/NV–926, May.

DOE/NNSA (U.S. Department of Energy National Nuclear Security Administration), 2005. *Voluntary Remediation Program Completion Report, Gnome-Coach Site, New Mexico*, Rev. 1, DOE/NV–1077, Las Vegas, Nevada, December.

EPA (U.S. Environmental Protection Agency), 1972. *Environmental Monitoring Report for the Nevada Test Site and Other Test Areas used for Underground Nuclear Detonations*, NERC-LV-539-23, May.

Environmental Procedures Catalog, LMS/POL/S04325, continually updated, prepared by Stoller Newport News Nuclear, Inc., a wholly owned subsidiary of Huntington Ingalls Industries, Inc., for the U.S. Department of Energy Office of Legacy Management.

Mercer, J.W., 1983. *Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medaños Area, Southeastern New Mexico*, U.S. Geological Survey Water-Resources Investigations Report 83-4016.

REECO (Reynolds Electrical & Engineering Company, Inc.), 1981. *Gnome Site Decontamination and Decommissioning Project—Radiation Contamination Clearance Report*, DOE/NV/004410-59, Las Vegas, Nevada, August.

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PRO/S04351, continually updated, prepared by Stoller Newport News Nuclear, Inc., a wholly owned subsidiary of Huntington Ingalls Industries, Inc., for the U.S. Department of Energy Office of Legacy Management.

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Appendix A

Well Head Survey Data

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Table A-1. 2014 Survey Data

Location ID	Latitude	Longitude	Northing (feet)	Easting (feet)	Elevation (feet)	Description
LRL-7	N32° 15' 26.256"	W103° 51' 58.088"	457635.64	644423.65	3442.52	TOP CASING WELL LRL-7
	N32° 15' 26.281"	W103° 51' 58.047"	457638.15	644427.17	3441.58	CONCONCRETE PAD WELL LRL-7
	N32° 15' 26.283"	W103° 51' 58.044"	457638.33	644427.37	3441.16	GROUND SHOT LRL-7
USGS-1	N32° 15' 30.540"	W103° 52' 10.865"	458063.73	643324.60	3424.86	GROUND SHOT USGS-1
	N32° 15' 30.541"	W103° 52' 10.875"	458063.85	643323.80	3425.95	BRASS CAP CONCRETE PAD USGS-1
	N32° 15' 30.622"	W103° 52' 10.914"	458072.04	643320.38	3426.60	TOP CASING WELL USGS-1
USGS-4	N32° 15' 44.350"	W103° 52' 34.017"	459450.73	641330.62	3413.72	TOP CASING WELL USGS-4
	N32° 15' 44.356"	W103° 52' 34.037"	459451.28	641328.96	3412.81	BRASS CAP CONCRETE PAD USGS-4
	N32° 15' 44.363"	W103° 52' 34.057"	459451.98	641327.24	3412.20	GROUND SHOT USGS-4
USGS-8	N32° 15' 44.360"	W103° 52' 32.596"	459452.21	641452.62	3410.38	CONCRETE PAD USGS-8
	N32° 15' 44.361"	W103° 52' 32.602"	459452.31	641452.18	3409.67	GROUND SHOT USGS-8
	N32° 15' 44.361"	W103° 52' 32.560"	459452.32	641455.76	3411.25	TOP CASING WELL USGS-8
DD-1	N32° 15' 46.906"	W103° 51' 57.458"	459722.57	644468.67	3397.49	TOP CASING WELL DD-1
	N32° 15' 46.938"	W103° 51' 57.487"	459725.72	644466.13	3396.71	CONCRETE PAD WELL DD-1
	N32° 15' 46.939"	W103° 51' 57.488"	459725.89	644466.02	3395.83	GROUND SHOT DD-1
Gnome Monument	N32° 15' 46.950"	W103° 51' 57.567"	459726.95	644459.29	3400.34	TOP GNOME MONUMENT
Control Point	N32° 15' 30.789"	W103° 52' 28.274"	458082.50	641829.65	3439.78	CP "GNOME (COTTON PICKER)"
Control Point	N32° 20' 07.867"	W103° 50' 03.744"	486136.55	654109.93	3290.36	CP COTTON PICKER 9
Control Point	N32° 20' 15.261"	W103° 51' 58.090"	486839.51	644296.23	2999.33	CP NMDOT 3279-17

Coordinate System: New Mexico East Zone State Plane Coordinate System with horizontal data based on the North American Datum of 1927 and the vertical data based on the National Geodetic Vertical Datum of 1929.

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Appendix B

Well Concentration Plots

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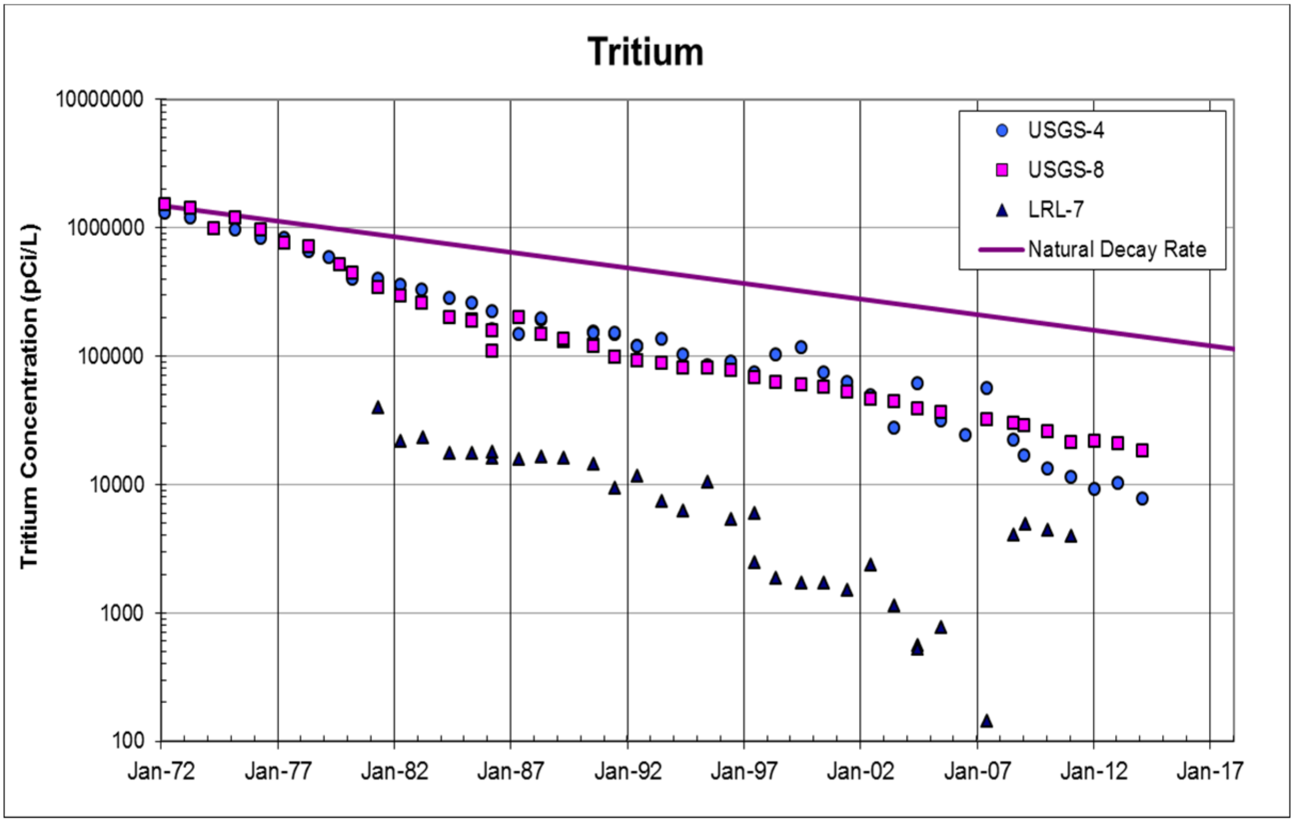

Chart 1. Tritium Concentrations at Wells USGS-4, USGS-8, and LRL-7

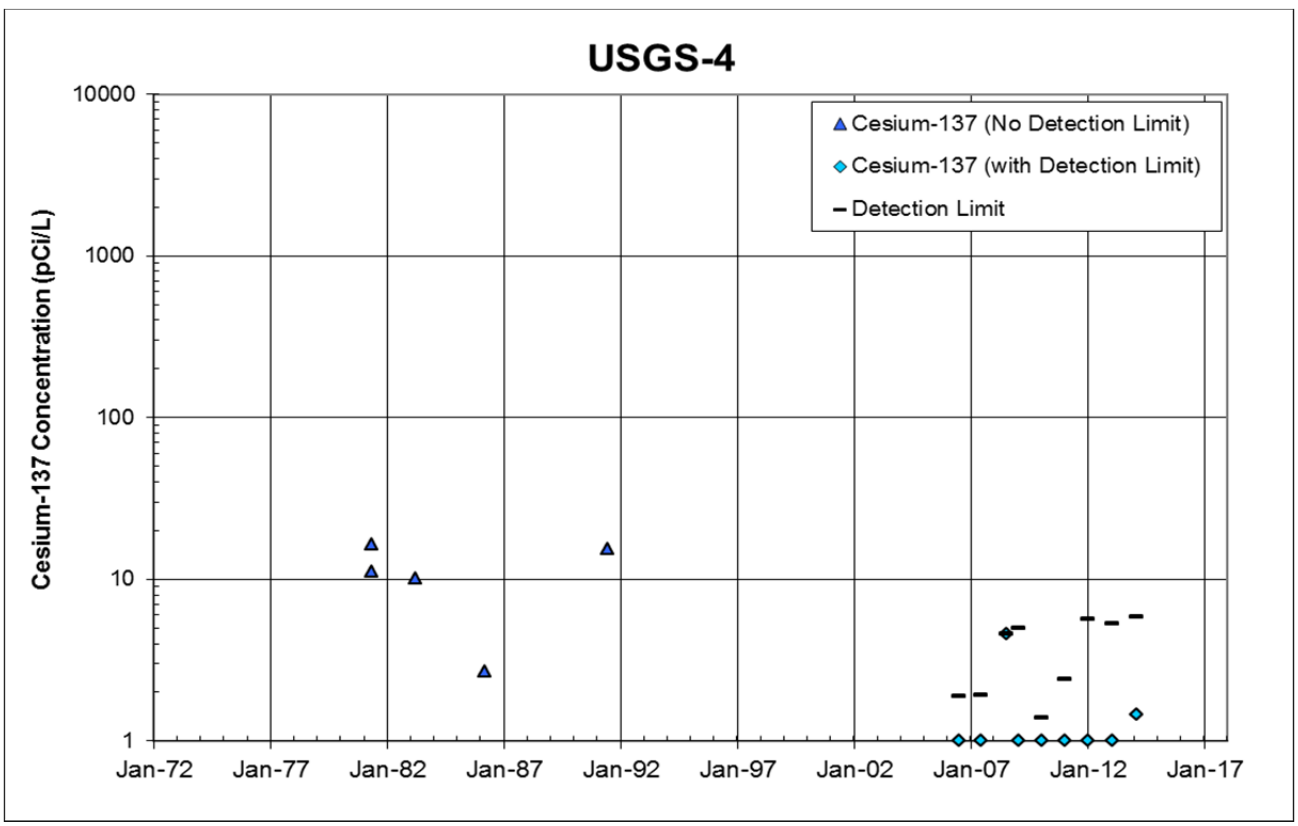

Chart 2. Cesium-137 Concentrations at Well USGS-4

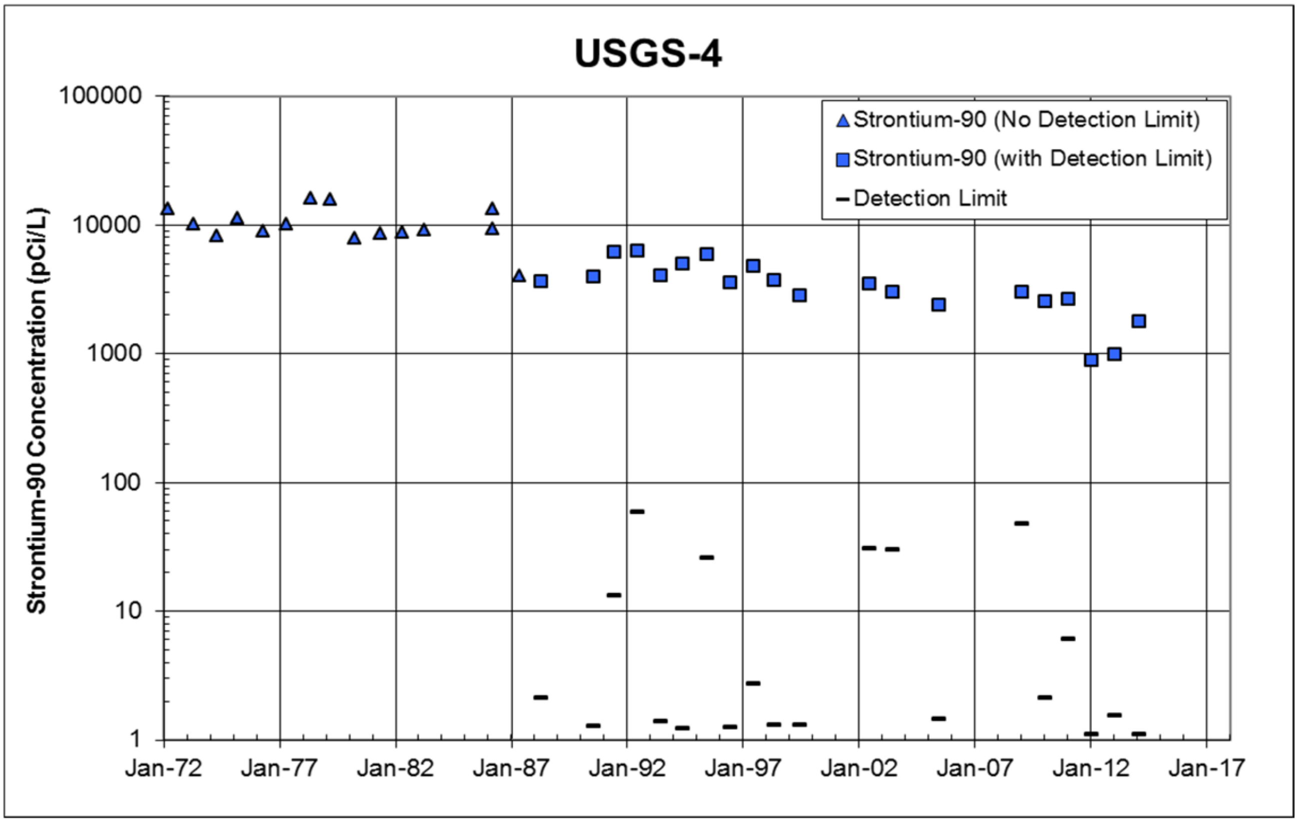

Chart 3. Strontium-90 Concentrations at Well USGS-4

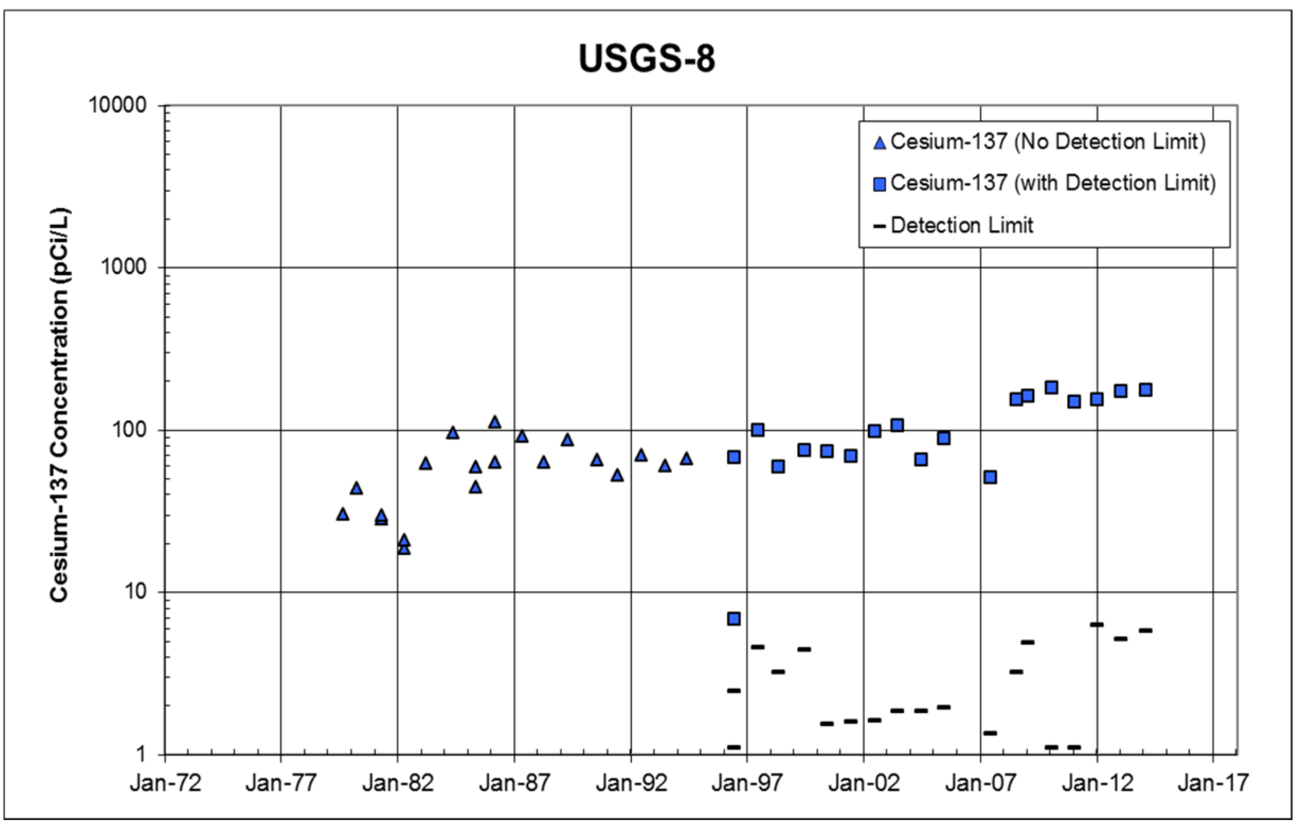

Chart 4. Cesium-137 Concentrations at Well USGS-8

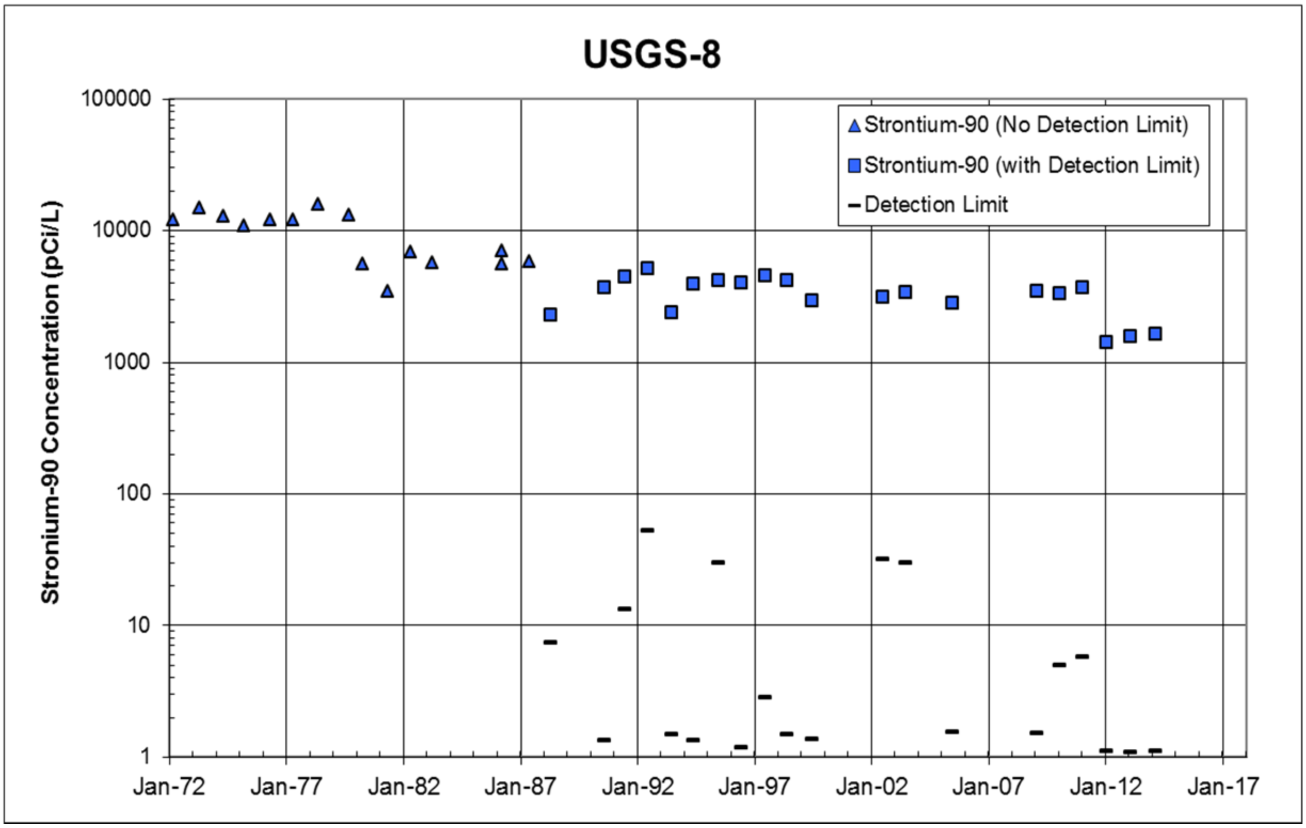

Chart 5. Strontium-90 Concentration at Well USGS-8

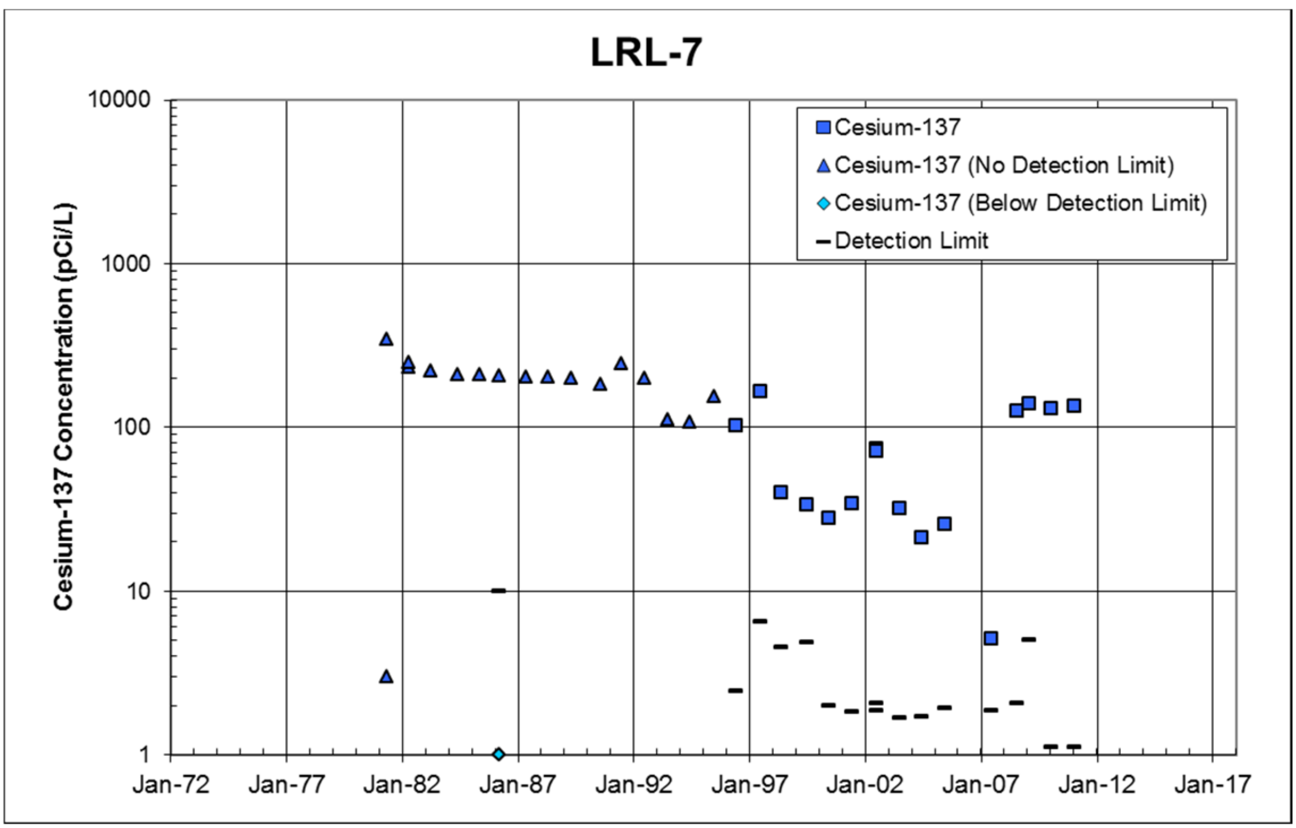

Chart 6. Cesium-137 Concentration at Well LRL-7

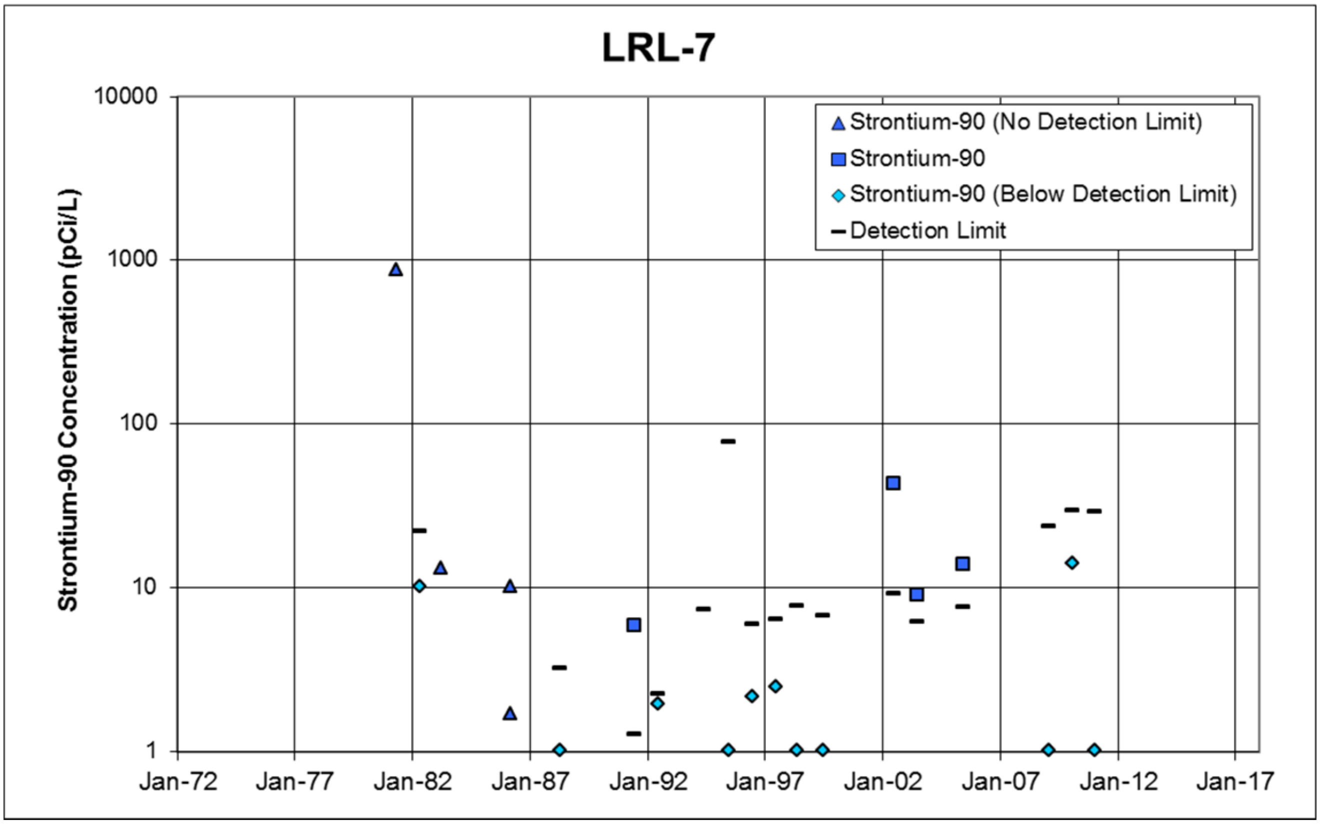

Chart 7. Strontium-90 Concentrations at Well LRL-7

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