

# Gasbuggy, New Mexico Natural Gas, Produced Water, and Hydrologic Sampling and Analysis Results for 2014

December 2014

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## 1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management conducted natural gas and hydrologic sampling at the Gasbuggy, New Mexico, Site on June 17 and 18, 2014. The sampling of natural gas also included the collection of associated produced water. The hydrologic monitoring included sampling of several groundwater wells and surface water locations. Natural gas samples were analyzed for tritium and carbon-14. Water samples from gas production wells were analyzed for gamma-emitting radionuclides, gross alpha, gross beta, and tritium. Samples from the hydrologic monitoring were analyzed for gamma-emitting radionuclides and tritium. ALS Laboratory Group in Fort Collins, Colorado, analyzed all water samples; Isotech Laboratories in Champaign, Illinois, analyzed the natural gas samples.

## 2.0 Site Location and Background

The Gasbuggy site comprises 640 acres in Rio Arriba County, New Mexico, approximately 55 miles east of the city of Farmington and approximately 21 miles southwest of the town of Dulce, in the Carson National Forest (see Figure 1). As part of the Plowshare Program, one underground nuclear detonation was conducted at the Gasbuggy site on December 10, 1967, in an effort to stimulate natural gas production in the gas-bearing Pictured Cliffs Formation. The detonation took place at a depth of 4,240 feet below ground surface, approximately 40 feet below the Pictured Cliffs Sandstone/Lewis Shale contact. The detonation had an estimated yield of 29 kilotons.

There are no wells, springs, surface water, or gas wells onsite; all sampling locations are off of the Gasbuggy site. Seven offsite natural gas production wells were sampled during this event. Gas sample locations (Figure 2) range from 1 mile to 1.7 miles from the emplacement location. All seven of the gas wells sampled are perforated for gas production from the Pictured Cliffs Formation, the same formation targeted by the Project Gasbuggy test. Two of the seven gas wells are horizontal completions within the Pictured Cliffs Formation and are indicated on Figure 2 as having different bottom hole locations than the well head location at the surface.

The U.S. Environmental Protection Agency performed water sampling at water wells, springs, and ponds in the Gasbuggy vicinity from the inception of the Hydrologic Monitoring Program in 1972 through 2007. DOE's Office of Legacy Management performed the hydrologic sampling at these locations in 2007, 2008, 2009, and in 2014 (Figure 2).

Results of the hydrologic monitoring at Gasbuggy have consistently shown that groundwater and surface water at the sample locations have not been impacted by radionuclides from the nuclear test. DOE evaluated the Hydrologic Monitoring Program and concluded that these water sample locations are shallow and are hydro-logically up-gradient from the detonation zone (DOE 2009a). Therefore, the frequency of hydrologic monitoring was reduced to once every 5 years; the next hydrologic monitoring event is scheduled for 2019.

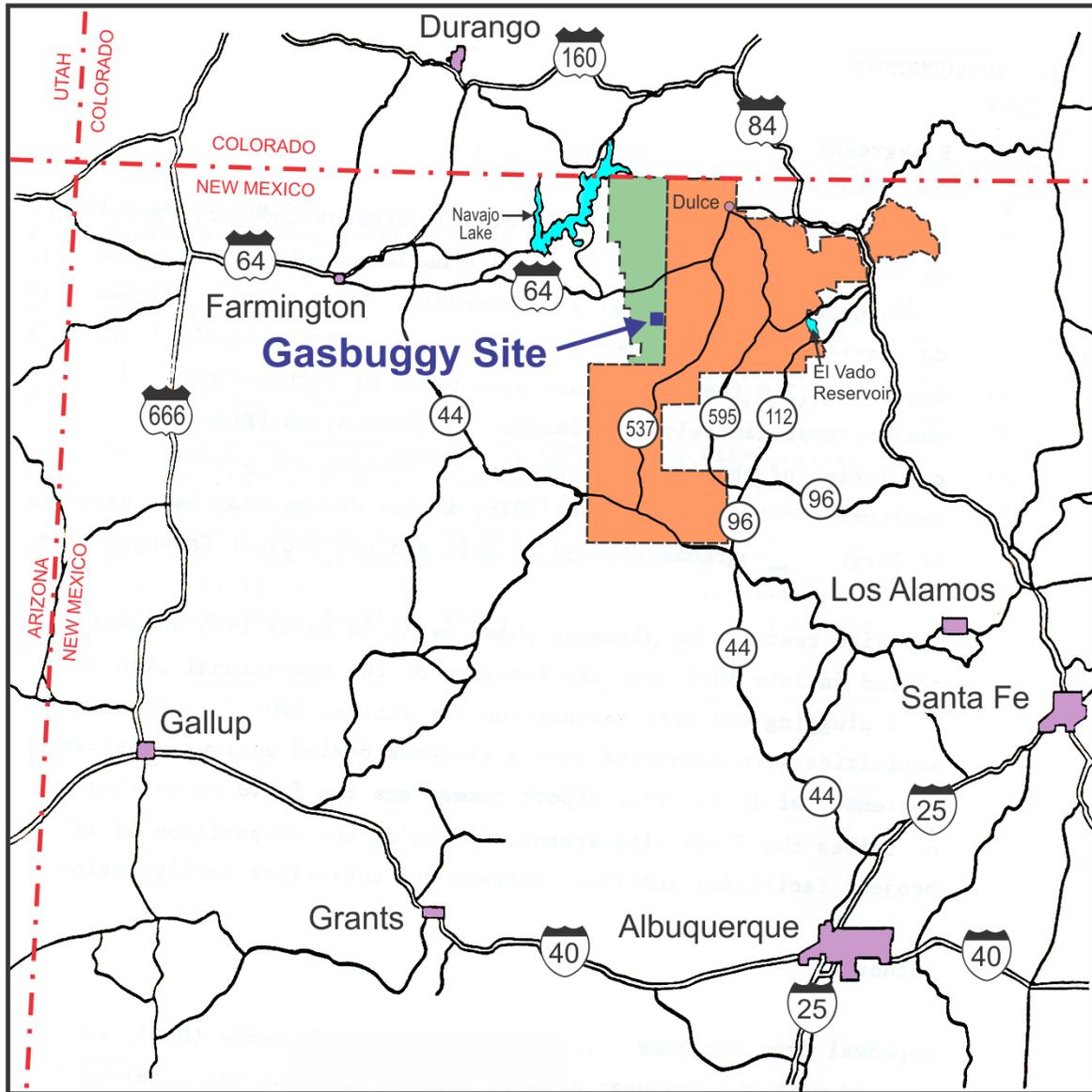
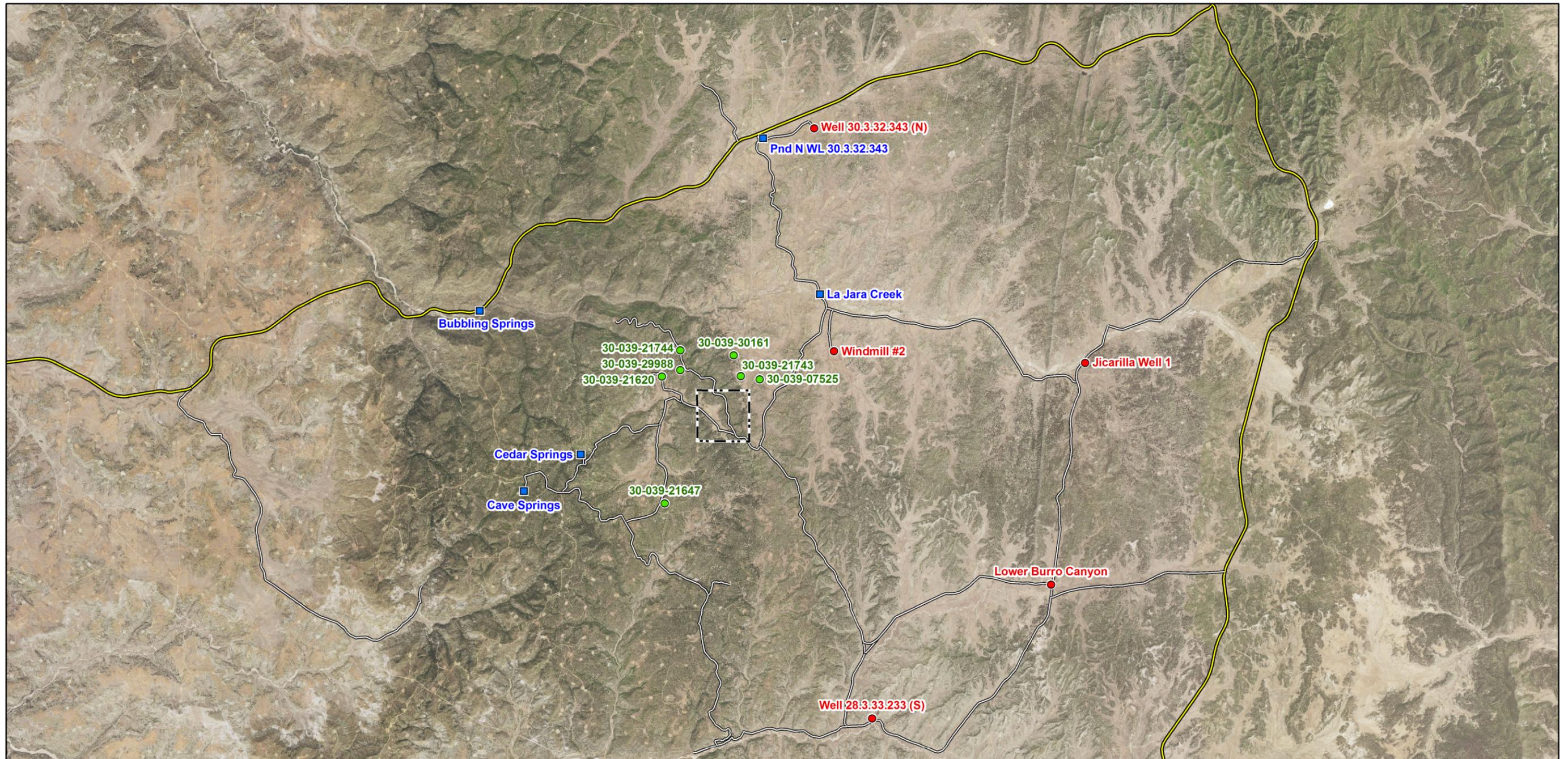
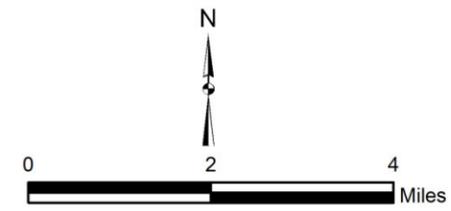


Figure 1. Gasbuggy Site Location Map



LEGEND	
● Groundwater Well Location	— Dirt Road
● Gas Well Location	— Paved Road
■ Surface Water Location	- - - Site Boundary



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June 2014 Sampling Locations Gasbuggy, NM, Site	
DATE PREPARED: January 9, 2015	FILENAME: S1256000

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Figure 2. June 2014 Sampling Locations

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Sampling of natural gas and produced water from nearby producing gas wells was conducted for the first time during the 2009 sampling event. Nearby gas wells that are producing gas from the same formation affected by the Gasbuggy test represent a more plausible contaminant migration pathway. Therefore, DOE has been sampling natural gas production wells annually since 2009.

DOE has established notification agreements with the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS), whereby DOE will be notified of new gas well permitting activity in the area. DOE plans to sample new natural gas wells that are drilled in the vicinity of Gasbuggy. Initial sampling of new natural gas wells would be based on well specific considerations.

### **3.0 Sample Analytical Results**

Analytical results from the June 17 and 18, 2014, sampling event are shown in Tables 1, 2, and 3. Because of insufficient water, produced water was collected only at three of the seven sampled gas wells. Tritium, the most mobile detonation-related contaminant and consequently the contaminant of interest to DOE, was not detected in any of the water or natural gas samples.

Low levels of gross beta, which are estimated values<sup>1</sup>, were detected in all samples of produced water (Table 1). Similar results were obtained from these wells during the 2011 sampling event (DOE 2011). Potassium-40 decays by beta emission along with a gamma ray and is likely the source of the gross beta activity detected in the well. Potassium-40 is a naturally occurring radioisotope that is not a byproduct of a nuclear detonation and, therefore, is not attributable to the Gasbuggy test. All other analytes were below detection (Table 1).

No tritium or carbon-14 was detected in the natural gas samples (Table 2). Although tritium has never been detected, carbon-14 has been detected in low concentrations during past sampling events (DOE 2009b and DOE 2010).

All groundwater and surface water samples analyzed for tritium and gamma spectrometry were below detection limits.

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<sup>1</sup> When a reported radionuclide concentration is less than three times the method detection limit, the result is considered an estimated value because of the high degree of uncertainty associated with very low measured concentrations.

Table 1. Gasbuggy Natural Gas Production Well Produced Water Sample Analysis Results

Sample Location (API No.)	Collection Date	Tritium (pCi/L) (Detection Limit 330)	Gamma Spectrometry (pCi/L) (Detection Limit 5.0 {Cesium-137})	Gross Alpha (pCi/L) (Detection Limit 20)	Gross Beta (pCi/L) (Detection Limit 20)
Indian A No. 002 (30-039-07525)	06/18/2014	ND	ND	ND	20.6 <sup>a</sup>
Schalk 29-4 No. 017 (30-039-21743)	06/18/2014	ND	ND	ND	32.7 <sup>a</sup>
Valencia Canyon Unit No. 037 (30-039-21647)	06/18/2014	ND	ND	ND	33.7 <sup>a</sup>

<sup>a</sup> Estimated value

API = American Petroleum Institute

ND = not detected

pCi/L = picocuries per liter

Table 2. Gasbuggy Natural Gas Production Well Gas Sample Analysis Results

Sample Location (API No.)	Collection Date	Tritium (pCi/L) <sup>a</sup> (Detection Limit N/A)	Carbon-14 (pCi/L) (Detection Limit N/A)
Indian A No. 002 (30-039-07525)	06/18/2014	ND	ND
Many Canyons 29-04-26 No. 133 (30-039-29988)	06/18/2014	ND	ND
Many Canyons 29-04-25 No. 123 (30-039-30161)	06/18/2014	ND	ND
Schalk 29-4 No. 007 (30-039-21620)	06/18/2014	ND	ND
Schalk 29-4 No. 014 (30-039-21744)	06/18/2014	ND	ND
Schalk 29-4 No. 017 (30-039-21743)	06/18/2014	ND	ND
Valencia Canyon Unit No. 037 (30-039-21647)	06/18/2014	ND	ND

<sup>a</sup> All concentrations in this table are in picocuries per liter of methane

API = American Petroleum Institute

ND = not detected

pCi/L = picocuries per liter

NA = not applicable

Table 3. Gasbuggy Groundwater and Surface Water Gas Sample Analysis Results

Sample Location	Collection Date	Tritium(pCi/L) <sup>a</sup> (Detection Limit 330)	Gamma Spectrometry(pCi/L) (Detection Limit 5.0 {Cesium-137})
Bubbling Springs	Dry—No Sample	No Sample	No Sample
Cave Springs	06/17/2014	ND	Not Analyzed
La Jara Creek	06/17/2014	ND	Not Analyzed
Pond N	06/17/2014	ND	Not Analyzed
Jicarilla Well No.1	06/17/2014	ND	ND
Lower Burro Canyon Well	06/17/2014	ND	ND
Jicarilla Well S	06/17/2014	ND	ND
Windmill #2	06/17/2014	ND	ND
Jicarilla Well N	Windmill Inoperable— No Sample	No Sample	No Sample

<sup>a</sup> All concentrations in this table are in picocuries per liter of methane

ND = not detected

pCi/L = picocuries per liter

## 4.0 Conclusions

Results from the sampling of natural gas, associated produced water, and hydrological sampling indicate that these locations have not been impacted by detonation-related contaminants. The next hydrological monitoring event is scheduled for 2019. DOE, in coordination with the BLM and the USFS, plans to sample new natural gas wells that are drilled in the vicinity of the Gasbuggy site.

## 5.0 References

DOE (U.S. Department of Energy), 2009a. *Gasbuggy, New Mexico Long-Term Hydrologic Monitoring Program Evaluation Report*, LMS/GSB/S04019, Office of Legacy Management, Grand Junction, Colorado, June.

DOE (U.S. Department of Energy), 2009b. *Gasbuggy, New Mexico, Hydrologic and Natural Gas Sampling and Analysis Results for 2009*, LMS/GSB/S05869, Office of Legacy Management, Grand Junction, Colorado, November.

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