

### 3.1.6 High-Resolution Uranium Isotopic Analyses

Previous reports have presented data summaries and discussions of specialized uranium analyses performed on selected samples. These high-resolution isotopic analyses generate data used by experts to estimate the relative fraction of the uranium present in a sample that represents naturally-occurring uranium vs. anthropogenic uranium. This distinction is important because the former Rocky Flats Plant worked with anthropogenic (depleted and enriched) uranium only, not natural uranium. Therefore, if uranium in a given sample is natural, it does not represent Site-related uranium contamination.

This analytical service, and the associated data interpretation, was provided by workers at LANL from the 1990s through 2011. However, LANL stopped providing this service and formally notified the Site of this change in 2013. Efforts to locate an alternative service provider had been underway for some time when this notification was received. “Normal” commercial laboratories that were contacted were not able to provide this kind of service; it is very specialized and requires advanced instruments and methods.

In 2013, Lawrence Berkeley National Laboratory (LBNL) confirmed their ability and availability to perform the required analyses and interpretations. Once a contract was in place, the first set of samples was submitted to LBNL for analysis, along with the published model—the method of interpreting the isotopic distributions—used by LANL to estimate natural and anthropogenic quantities in samples previously analyzed by that lab (Janecky 2005). Although there is more than one method of estimating anthropogenic vs. natural uranium, retaining consistency in this method is important because otherwise, changes that might be reported in the isotopic distribution at a given location could be related to the method of interpretation rather than to changes in water quality.

The first batch of samples submitted to LBNL represented water that had been collected since 2011 for this type of analysis (Table 112). These samples had been stored at 4 °C while efforts were underway to either secure a continuing commitment from LANL or identify an alternative laboratory. Most of these samples were focused on characterizing then-new surface water POC WALPOC, and some were also collected to inform the evaluation of uranium at POE GS10. The WALPOC samples were selected to represent a fairly broad range of flow conditions, and the analytical results showed a very consistent isotopic uranium distribution. As shown in this table, surface water at WALPOC was characterized as containing uranium that ranged from approximately 76 percent to 80 percent natural over a period of about 7 months.

Table 112. Summary of LBNL High-Resolution Uranium Isotopic Results for Samples Collected in 2011–Spring 2013

Sample Location	Date Collected	Total U (µg/L) <sup>a</sup>	Percent Natural	Percent Anthropogenic	Previous Number of Sample Events	Average Natural Percentage of Past Samples
WALPOC	9/22–9/27/2011 <sup>b</sup>	7.6	77.39%	22.61%	N/A	N/A
WALPOC	9/27–11/30/2011 <sup>b</sup>	10.2	77.57%	22.43%	N/A	N/A
WALPOC	1/3–2/23/2012 <sup>b</sup>	12.6	79.63%	20.37%	N/A	N/A
WALPOC	2/23–3/6/2012 <sup>b</sup>	12.2	79.48%	20.52%	N/A	N/A
WALPOC	3/6–3/21/2012 <sup>b</sup>	14.2	78.35%	21.65%	N/A	N/A
WALPOC	4/13/2012–4/21/2013 <sup>b</sup>	15.1	77.53%	22.47%	N/A	N/A
WALPOC	4/21–4/29/2013 <sup>b</sup>	12.6	77.79%	22.21%	N/A	N/A
WALPOC	5/3–5/7/2013 <sup>b</sup>	11.3	75.95%	24.05%	N/A	N/A
GS10	1/5–1/23/2012 <sup>b</sup>	11.1	52.59%	47.41%	8	68
GS10	3/6–3/21/2012 <sup>b</sup>	49.7	43.29%	56.71%	8	68
GS10	7/26–9/12/2012 <sup>b</sup>	38.7	64.33%	35.67%	8	68
GS10	4/29–5/3/2013 <sup>b</sup>	4.2	59.07%	40.93%	8	68
79102	5/14/2012	36.5	-0.50%	100.50%	1	0

**Notes:**

<sup>a</sup> Total uranium content as reported for split submitted to contract laboratory. LBNL is tasked with providing isotopic data and associated interpretation, not total uranium data. Previous samples representing some locations may predominantly represent pre-closure conditions. Average natural percentages provided incorporate all high-resolution uranium data for the given location received prior to the samples summarized in this table (including duplicates). Refer to previous reports for data for samples collected in earlier years. N/A: No previous data available.

<sup>b</sup> Flow-paced composite sample

Results from GS10 indicate a higher percentage of anthropogenic uranium than had been typical for this location. Previously, samples here were typically in the range of 60/40 to 70/30 natural to anthropogenic. One exception was for a sample collected in June 2011, when the range was approximately 51 percent natural and 49 percent anthropogenic. As seen in Table 112, uranium isotopic distributions at location GS10 were more variable in 2012. Anthropogenic content was estimated as ranging from the more typical (approximately 36 percent in the sample collected July 26, 2012) to representing the predominant form of uranium in a sample (57 percent in the April 29, 2013, sample).

One groundwater sample collected in May 2012 was also submitted to LBNL, and represents a well in the source area of the former SEPs. Evaluation well 79102 has previously been characterized as presenting uranium that is 100 percent anthropogenic, and essentially the same result was assigned to the 2012 sample. That previous sample was collected in June 2004. Given that the SEPs represent a source area for anthropogenic uranium contamination, these results are not surprising for groundwater from a well in this area.

A second batch of samples was submitted to LBNL in late 2013. These samples also focus largely on WALPOC and GS10, as well as selected locations near GS10 and two wells in the Solar Ponds source area. All were collected in 2013, many during or shortly after the elevated flow following the heavy September precipitation. Results are summarized below in Table 113.

Table 113. Summary of LBNL High-Resolution Uranium Isotopic Results for Samples Collected Later in 2013

Sample Location	Date Collected	Total U (µg/L) <sup>a</sup>	Percent Natural	Percent Anthropogenic	Previous Number of Sample Events	Average Natural Percentage of Past Samples
GS10	9/13–9/16/2013 <sup>b</sup>	5.55	70.12	29.88	12	64
GS10	9/24–10/16/2013 <sup>b</sup>	16.3	73.27	26.73	12	64
WALPOC	6/4–9/12/2013 <sup>b</sup>	3.21	76.55	23.45	8	78
WALPOC	9/13–9/14/2013 <sup>b</sup>	1.99	79.52	20.49	8	78
WALPOC	9/14–9/16/2013	2.55	77.46	22.54	8	78
WALPOC	9/16–10/25/2013 <sup>b</sup>	11.5	74.85	25.15	8	78
SEEP995A	9/30/2013	19.1	68.14	31.86		
SEEP995A	11/25/2013	27.8	59.67	40.33		
FC4EFF	9/30/2013	15.5	73.86	26.14		
FC4EFF	11/25/2013	24.9	71.17	28.83		
GS10	10/1/2013	15.4	71.19	28.82	12	64
GS10	10/1/2013	15.4	74.04	25.97	12	64
GS10	11/25/2013	23.7	71.46	28.54	12	64
79502	10/29/2013	12.3	96.81	3.19	N/A	N/A
79302	10/29/2013	266	87.14	12.86	N/A	N/A

**Notes:**

<sup>a</sup> Total uranium content as reported for split submitted to contract laboratory. LBNL is tasked with providing isotopic data and interpretation, not total uranium data. Previous samples representing some locations may predominantly represent pre-closure conditions. Average natural percentages provided incorporate all high-resolution uranium data for the given location received prior to the samples summarized in this table. Refer to previous reports for data for samples collected in earlier years. N/A: No previous data available.

<sup>b</sup> Flow-paced composite sample

The data in Table 113 is discussed further in Section 3.1.4 as part of the GS10 uranium evaluation.

Evaluation wells 79302 and 79502 are both in the former SEPs source area, similar to well 79102 (Table 112). However, well 79102 is on the north side of former Pond 207C (the westernmost pond, in the vicinity of the original 1950s ponds) while well 79302 is located near the northeastern corner of the SEPs complex (north of former Pond 207B-North) and well 79502 is located off the southeast corner of the complex (southeast of former Pond 207B-South). (Refer to Figure 4 for a well location map.)

Whereas the uranium in well 79102 was characterized (twice) as 100 percent anthropogenic, that in nearby well 79302 is estimated at about 87 percent natural. This suggests well 79302 is not as impacted by the SPP. However, as shown on Figure 232 and Figure 233, Evaluation well 79305 produces groundwater samples with the highest concentrations of nitrate of any of these wells, signifying contamination with the SPP. Concentrations of uranium, however, are much lower than in other SEP-area wells, and these isotopic data indicate the uranium here is not as clearly indicative of SPP contamination.

Well 79502 produces groundwater samples with relatively low concentrations of nitrate and uranium. Of the Evaluation wells monitoring this source area, this well produces groundwater with concentrations of nitrate and uranium that most closely resemble those from well P210189, which is actually located a short distance upgradient of former Pond 207C. Based on the data consistently reported by well 79502, a southeastern pathway for migration of the SPP toward

South Walnut Creek is interpreted to be insignificant. The uranium isotopic data summarized in Table 113 further support this interpretation. See Section 3.1.5 for additional discussion of groundwater quality in the SPP area.

A third batch of samples was being identified for LBNL analysis as 2013 ended. Some will date to 2013, including just following the heavy precipitation of September. These samples will be selected and submitted to LBNL in 2014, and potentially additional batches will be submitted in 2014. Results will be summarized in the annual report for 2014. The reports from LBNL on the two sample batches summarized above are provided in Appendix G.

## 3.2 Ecological Monitoring at RFS

### 3.2.1 Introduction

The Ecology group conducts ecological monitoring of the Site's ecological resources to ensure regulatory compliance and to preserve, protect, and manage those resources. Ecological monitoring is an integral aspect of determining whether the management objectives and goals for the natural resources at the Site are being achieved. This report summarizes the results of the vegetation, revegetation, and wildlife monitoring conducted at the Site during 2013. It also includes a brief summary of the monitoring conducted for Preble's meadow jumping mouse (*Zapus hudsonius preblei*; Preble's mouse) mitigation and wetland mitigation activities; however, the details of those monitoring efforts are summarized in separate regulatory reports provided to the appropriate agencies.

At an elevation of approximately 6,000 feet, the Site contains a unique ecotonal mixture of mountain and prairie plant species resulting from the topography of the area and its proximity to the mountain front. The POU, the area surrounding the COU (the general area where the former IA was once located), is one of the largest remaining undeveloped tracts of its kind along the Colorado Piedmont. A number of plant communities present in the COU and POU have been identified as increasingly rare and unique by the Colorado Natural Heritage Program (CNHP 1994, 1995). These communities include the xeric tallgrass prairie, tall upland shrubland, wetlands, and Great Plains riparian woodland communities. Small inclusions of a number of other increasingly rare plant communities are also found on the Site. Many of these communities support populations of increasingly rare animals as well, including the federally protected Preble's mouse, and other uncommon species such as the grasshopper sparrow (*Ammodramus savannarum*), loggerhead shrike (*Lanius ludovicianus*), Merriam's shrew (*Sorex merriami*), black-crowned night heron (*Nycticorax nycticorax*), hops blue butterfly (*Celastrina* sp.), and Arogos skipper (*Atrytone arogos*).

During 2007, transfer of portions of the POU was made to USFWS to create the Rocky Flats National Wildlife Refuge. As a result, the total acreage managed by LM is now approximately 1,308 acres in the COU. A summary of the ecological monitoring highlights from the 2013 field season is provided in the following sections. Full, detailed summaries, methodology, and analyses for each field monitoring effort are presented as stand-alone reports on the Ecology DVD included with this report.