



Tonawanda Landfill Vicinity Property

Environmental Monitoring Data Release

2015 Sampling Results

Tonawanda, NY

U.S. Army Corps of Engineers
Buffalo District

Building Strong®

May 2016

Formerly Utilized Sites Remedial Action Program

The Formerly Utilized Sites Remedial Action Program (FUSRAP) was initiated in 1974 to identify, investigate, and clean up or control sites throughout the United States that were contaminated as the result of activities related to the nation's early atomic energy and weapons program in the 1940s, 1950s, and 1960s. When implementing FUSRAP, the U.S. Army Corps of Engineers follows the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan. The Tonawanda Landfill Vicinity Property was designated into FUSRAP in 1992.

Site Description

The Tonawanda Landfill Vicinity Property consists of two parcels owned by the Town of Tonawanda: the Town of Tonawanda Landfill (Landfill Operable Unit [OU]) and the North Youngmann Commerce Center, formerly known as the Mudflats OU. In 2008, the Corps of Engineers issued a record of decision for the Mudflats OU. It stated that no action was required there under FUSRAP. The Landfill OU is currently in the proposed plan phase of the CERCLA investigation process.

The Landfill OU covers approximately 55 acres in the Town of Tonawanda, Erie County, New York. It is bordered by a residential area within the City of Tonawanda to the north and northwest, a railroad line to the east, and a National Grid utility corridor to the south. The FUSRAP-related constituents of concern (COCs) in soil on the Landfill OU are radium-226 (Ra-226), thorium-230 (Th-230), and uranium.

Purpose

The purpose of this environmental data release is to provide groundwater and surface water monitoring data collected for the Landfill OU in 2015. Included in this data release are the environmental monitoring data and the Corps of Engineers' interpretation of the results. The Corps of Engineers is posting this environmental data release on the Tonawanda Landfill Vicinity Property Web page at <http://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/TonawandaLandfill.aspx>, along with a fact sheet describing the annual environmental monitoring program.

Results and Interpretation

In March 2015, Corps of Engineers personnel collected groundwater and surface water samples from the Landfill OU locations shown on Figure 1. The Corps measured groundwater surface elevations in the permanent monitoring well and temporary well point (TWP) locations sampled during the spring 2015 monitoring event, as presented in Table 1. These elevations were plotted as groundwater contours, as shown in Figure 2. The data indicate that groundwater flow in the Landfill OU is generally toward the south or southwest, parallel to or away from the property's northwestern boundary.

Groundwater Results

Unfiltered and filtered groundwater sample results for the March 2015 annual monitoring event are presented in Tables 2 and 3, respectively. Concentrations of Ra-226 and Th-230 have consistently been at or near levels that are considered naturally occurring (background) in groundwater samples from all permanent monitoring well and TWP sample locations.

However, the Corps did detect elevated levels of uranium in groundwater samples from some of the permanent monitoring well and TWP locations. Figure 3 illustrates the total uranium concentrations in filtered groundwater samples the Corps of Engineers has collected over time.

While groundwater at the Landfill OU is not a drinking water source, the Corps screened detected uranium concentrations to compare them to the U.S. Environmental Protection Agency Maximum Contaminant Level (MCL) for total uranium of 30 micrograms per liter ($\mu\text{g/L}$). (The MCLs are the accepted regulatory contaminant guidelines for drinking water).

Uranium concentrations in groundwater samples collected in March 2015 from wells BM-4, BM-16, TWP-6, TWP-7, TWP-10, and TWP-13 exceeded the MCL for uranium. However, since groundwater is not used for drinking water purposes, exceedances of the total uranium MCL do not indicate an impact to human health.

Uranium concentrations in samples from wells BM-15, BM-17, BM-18, BM-19, L-2, L-3, TWP-1, TWP-9, and TWP-11 were below the total uranium MCL but were elevated above a typical background level of $5.0 \mu\text{g/L}$. The remaining wells exhibited uranium concentrations at or near background levels.

The two locations closest to and downgradient of the area with elevated uranium in soils, TWP-6 and TWP-7, have consistently exhibited the highest concentrations of uranium in groundwater. The observed consistency or reductions of uranium in groundwater and leachate samples in the soil-impact areas indicate the areal extent of uranium impacts is not expanding.

The site stormwater management (drainage controls) associated with landfill closure activities (grading and capping) should lower leachate levels in the landfill. Numerical groundwater modeling performed for the 2015 feasibility study predicts an eventual decline of 4 to 7 feet in leachate levels due to capping. This will also suppress the mobility of uranium-impacted leachate in the landfill. The 2015 sampling data indicate this is occurring, although groundwater and leachate levels (elevations) are generally consistent with those in past years.

Surface Water Results

Unfiltered surface water sample results for the March 2015 monitoring event are presented in Table 4. Corps of Engineers personnel collected surface water samples from three places on the Landfill OU. These included the northern drainage ditch and a ditch that drains the adjacent National Grid utility corridor into the northern drainage ditch (locations SW/SD-12, and SW-17). Corps personnel also sampled Two Mile Creek, in line with and downstream of the discharge from the northern drainage ditch (locations SW-18, SW-19, and SW-20). As with groundwater, concentrations of Ra-226 and Th-230 have consistently been very low, within the range of naturally occurring concentrations of these constituents in all surface water samples collected.

The Corps of Engineers detected elevated levels of uranium in northern drainage ditch samples. Figure 4 illustrates the total uranium concentrations in surface water samples the Corps collected over time from water flowing from the northern drainage ditch into Two Mile Creek. For comparison purposes, the Corps screened the uranium concentrations against the total uranium MCL and the Canadian surface water quality guideline (CWQG) for protection of aquatic life of $15 \mu\text{g/L}$ for total uranium. (In 2011, the Canadian Council of Ministers of the Environment developed the CWQG to protect aquatic life, which includes aquatic plants, fish, insects, and other invertebrates that live in the water. The Corps used the CWQG here for screening purposes to

identify potential risks to aquatic life. Neither the U.S. Environmental Protection Agency nor individual states have developed corresponding surface water quality criteria for uranium.)

Uranium concentrations in samples collected in March 2015 from locations SW/SD-01, SW/SD-05, SW/SD-06, SW/SD-08, SW/SD-09, SW/SD-10, SW/SD-11, SW/SD-12, SW/SD-14, SW/SD-15, and SW/SD-16 in the northern drainage ditch exceeded both the MCL and CWQG. Concentrations in samples from locations SW/SD-02, SW/SD07, and SW/SD-13 exceeded the CWQG only. However, since the flow in the northern drainage ditch is either brief or intermittent and not a drinking water source or a viable aquatic habitat, these exceedances don't threaten human health or the environment. Also, uranium concentrations tend to decrease as surface water moves downstream along the length of the northern drainage ditch. Samples collected in March 2015 from Two Mile Creek had uranium concentrations below the MCL and CWQG.

Compared to previous spring sampling results (e.g., April 2012, 2013, and 2014), the March 2015 results for surface water in the area where FUSRAP-related materials are located shows elevated uranium. These higher concentrations reflect weather conditions during the previous winter of 2014–2015 (the Buffalo [Tonawanda] area had received below-average precipitation since mid-December 2014). The sampling occurred during the last week of March 2015. There had been only 6.5 inches of precipitation since January 1, 2015; normal precipitation is 8 inches. Below-average temperatures during January through March 2015 enhanced this 20 percent moisture deficit, promoting deeper frost penetration (frozen ground). Therefore, the uranium concentrations in groundwater appear coincident with previous sampling, yet the surface water collected from the Landfill OU in March 2015 did not reflect the seasonal dilution that normally occurs in the spring (i.e., less snow and frozen ground limited surface-water accumulations that normally dilute impacted discharges that flow from the SW/SD-01 and SW/SD-05 area).

Conclusion

The Corps of Engineers released the *Proposed Plan for the Landfill Operable Unit of the Tonawanda Landfill Vicinity Property* for public comment in September 2015. The proposed plan identified the Corps of Engineers' preferred alternative (Alternative 3: Targeted Shallow Removal and Off-Site Disposal) to address FUSRAP-related COCs in soil at the Landfill OU.

The Corps of Engineers also released the feasibility study (FS) for the Landfill OU of the Tonawanda Landfill Vicinity Property concurrent with the proposed plan. The FS documented the rationale and procedures used to identify, develop, screen, and evaluate remedial alternatives to address FUSRAP-related COCs at the Landfill OU of the Tonawanda Landfill Vicinity Property. The remedial alternative evaluations were based on the nature and extent of FUSRAP-related COCs and site-specific conditions as documented in the remedial investigation (RI) report, Tonawanda Landfill Vicinity Property (USACE 2005), and the Updated Baseline Risk Assessment (BRA) for the Landfill Operable Unit of the Tonawanda Landfill Vicinity Property (USACE 2012)

Findings from the RI report and Updated BRA indicated that FUSRAP-related COCs in soil posed unacceptable risk to potential future users of the Landfill OU, and therefore, soil was identified as a media of concern. The FS and proposed plan provide an analysis of site investigations that concluded groundwater (whether natural or as leachate) and surface water are not FUSRAP media of concern at the Landfill OU. Surface water in the drainage ditch is temporary in nature and not a drinking water source. Neither does it provide significant ecological habitat for aquatic life. Samples collected from Two Mile Creek, the most likely aquatic habitat into which the ditch discharges, exhibited uranium levels that were below the ecological screening level for aquatic life. Groundwater is not considered a viable drinking water source since natural groundwater conditions in the two uppermost water-bearing zones beneath the Tonawanda Landfill Vicinity Property exhibit high salinity, sulfate, and total dissolved solids concentrations. The groundwater within the landfill reveals contact with waste and is considered leachate that would require significant treatment to be a potable water source. In addition, the Landfill OU of the Tonawanda Landfill Vicinity Property is not within the

capture zone of current municipal or private drinking water well systems, and it is unlikely that it would be in the future due to the availability of fresh drinking water from off-site sources; for instance, the upper Niagara River provides a replaceable source for groundwater.

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Insert Figure 1: Sampling Locations for 2015 Monitoring Event

Insert Figure 2: Groundwater Elevation Contour Map for March 2015

Table 1: Groundwater Elevations for March 2015 Monitoring Event

Well ID¹	Top of Casing Elevation (ft AMSL)	Depth to Water (ft from TOC)	Groundwater Elevation (ft AMSL)
BM-4	621.60	2.08	619.52
BM-15	606.20	15.40	590.80
BM-16	613.86	12.30	601.56
BM-17	621.73	7.20	614.53
BM-18	619.51	9.82	609.69
BM-19	610.20	3.27	606.93
L-1	616.12	4.59	611.53
L-2	622.03	3.30	618.73
L-3	621.34	2.44	618.90
TWP-4	622.47	3.11	619.36
TWP-5	622.93	3.46	619.47
TWP-6	619.92	0.34	619.58
TWP-7	619.62	0.10	619.52
TWP-8	620.36	1.15	619.21
TWP-9	620.56	1.75	618.81
TWP-10	620.15	0.75	619.40
TWP-11	622.43	1.65	620.78
TWP-13	622.27	2.70	619.57

AMSL = Above Mean Sea Level

TOC = Top of Casing

1. A groundwater elevation is not provided for TWP-1, as the measured water levels in TWP-1 are inconsistent with the surrounding monitoring wells and TWPs.

Table 2: Groundwater Analytical Results for Unfiltered Samples

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
BM-4	Sep-01	1.50	0.300	14.4	0.400	12.3	30.1
	Jul-09	0.312	0.248	13.1	1.31	14.2	28.0
	Apr-12	ND	0.00100	11.2	0.733	9.74	32.1
	Apr-13	ND	ND	14.2	0.766	11.9	31.8
	Apr-14	0.342	-0.0200	12.8	0.592	10.1	34.4
	Mar-15	1.33	0.0110	13.2	0.524	12.4	34.3
BM-15	Sep-01	0.600	0.100	7.40	0.400	6.00	14.8
	Jul-09	NC	NC	NC	NC	NC	NC
	Apr-12	0.356	0.157	7.84	0.201	5.95	16.1
	Apr-13	0.672	ND	7.23	0.243	4.25	16.5
	Apr-14	0.0555	-0.0380	6.53	0.299	4.49	15.4
	Mar-15	0.0844	-0.0350	5.78	0.211	3.51	13.9
BM-16	Sep-01	0.400	0.000	13.2	0.600	9.90	27.0
	Jul-09	0.712	0.170	14.3	0.940	11.3	26.5
	Apr-12	0.315	0.0660	13.6	0.499	12.0	36.3
	Apr-13	ND	ND	11.3	0.496	9.47	27.1
	Apr-14	0.238	0.0260	11.2	0.712	9.60	31.8
	Mar-15	0.484	0.0210	11.2	0.413	9.18	29.9
BM-17	Sep-01	1.50	0.300	9.20	0.700	8.00	22.5
	Jul-09	1.62	0.351	9.58	0.340	8.08	20.2
	Apr-12	0.470	0.0370	5.96	0.400	5.97	17.2
	Apr-13	0.331	ND	5.97	0.195	4.80	13.6
	Apr-14	0.128	-0.0860	4.48	0.0350	3.65	10.7
	Mar-15	0.184	-0.0140	3.45	0.2360	3.02	9.00
BM-18	Sep-01	2.20	0.400	12.2	0.600	10.0	30.7
	Jul-09	0.994	0.138	10.0	0.792	7.57	47.1
	Apr-12	0.0550	0.276	10.5	0.548	8.74	25.2
	Apr-13	0.353	ND	7.85	0.259	7.28	19.3
	Apr-14	0.215	-0.106	6.63	0.397	6.64	22.2
	Mar-15	0.248	0.0450	9.06	0.187	8.20	23.1
BM-19	Sep-01	0.700	0.100	12.1	0.700	10.6	34.8
	Jul-09	0.338	0.0779	12.0	0.610	10.6	27.1
	Apr-12	0.118	0.506	9.98	0.360	9.28	27.6
	Apr-13	ND	ND	10.4	0.649	9.38	28.3
	Apr-14	0.487	-0.0450	10.9	0.437	9.66	28.4
	Mar-15	0.0572	0.0660	10.8	0.436	9.15	29.5

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via Kinetic Phosphorescence Analysis (KPA).

Table 2: Groundwater Analytical Results for Unfiltered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
L-1	Sep-01	0.300	0.300	1.80	0.100	1.40	3.60
	Jul-09	0.873	0.172	0.571	0.130	0.568	1.01
	Apr-12	0.0560	0.0770	0.744	0.0360	0.921	1.43
	Apr-13	ND	ND	0.935	ND	1.02	3.41
	Apr-14	-0.193	0.0540	1.290	-0.0580	1.35	3.21
	Mar-15	2.830	0.0340	1.820	0.0930	1.55	4.88
L-2	Sep-01	0.700	1.10	1.10	0.100	1.60	4.50
	Jul-09	0.453	0.124	2.75	0.361	1.78	6.40
	Apr-12	0.349	0.201	11.1	0.723	9.48	29.8
	Apr-13	ND	ND	9.04	0.547	10.0	31.4
	Apr-14	0.191	0.109	7.47	0.447	7.96	24.2
	Mar-15	-0.0600	0.084	3.86	0.134	3.74	11.6
L-3	Sep-01	0.900	3.00	58.2	2.50	58.3	175
	Jul-09	1.35	0.261	3.54	0.272	2.99	7.37
	Apr-12	0.148	0.112	1.62	0.0800	1.61	5.13
	Apr-13	ND	ND	2.25	ND	2.65	6.78
	Apr-14	0.260	0.0100	1.64	0.0300	1.83	5.49
	Mar-15	ND	0.0240	1.78	0.0750	2.11	6.15
TWP-1	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.273	-0.0100	2.97	0.160	2.78	8.72
	Apr-13	ND	ND	1.31	0.0950	1.75	5.30
	Apr-14	0.112	0.0310	2.41	0.321	2.05	7.73
	Mar-15	0.200	-0.0220	3.28	0.194	2.72	7.73
TWP-4	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.304	0.218	0.159	0.00900	0.110	0.386
	Apr-13	ND	ND	0.345	ND	0.289	0.800
	Apr-14	0.605	-0.00900	0.0370	0.143	0.0490	0.470
	Mar-15	-0.0680	-0.0220	0.264	0.0200	0.205	0.613
TWP-5	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.174	0.181	0.113	-0.0100	0.0640	0.434
	Apr-13	ND	ND	ND	ND	0.382	0.816
	Apr-14	0.237	-0.0340	0.177	0.000	0.240	0.603
	Mar-15	ND	0.0320	0.284	0.0160	0.0560	1.17
TWP-6	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.208	0.0390	44.3	2.80	45.2	128
	Apr-13	0.688	ND	39.5	1.90	39.1	118
	Apr-14	0.507	-0.0840	28.4	1.77	32.1	89.9
	Mar-15	0.642	-0.0280	15.2	0.850	16.6	51.6

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

Table 2: Groundwater Analytical Results for Unfiltered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
TWP-7	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.422	0.175	30.2	1.53	32.0	91.7
	Apr-13	ND	ND	70.0	3.39	69.7	216
	Apr-14	0.0629	-0.00700	51.9	2.83	54.5	183
	Mar-15	0.601	0.0110	40.9	1.97	41.0	129
TWP-8	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.145	0.219	5.03	0.238	4.77	13.5
	Apr-13	ND	ND	9.61	0.576	10.3	30.4
	Apr-14	-0.217	-0.00700	0.782	0.0700	0.902	2.96
	Mar-15	0.140	-0.0190	1.03	0.0840	0.859	3.06
TWP-9	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	-0.0500	0.0530	3.35	0.170	2.92	9.17
	Apr-13	ND	ND	2.93	ND	2.91	6.93
	Apr-14	0.185	0.0640	1.96	0.0770	1.98	4.49
	Mar-15	0.129	-0.0540	2.90	0.241	2.50	7.96
TWP-10	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	NC	NC	NC	NC	NC	NC
	Apr-13	ND	ND	5.21	0.345	4.42	14.8
	Apr-14	0.247	-0.0450	11.6	0.143	6.16	18.6
	Mar-15	0.768	ND	13.7	0.510	8.79	26.0
TWP-11	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	-0.120	0.234	2.68	0.109	2.42	3.23
	Apr-13	ND	ND	3.28	ND	2.75	7.82
	Apr-14	0.127	0.0600	3.88	0.115	2.38	8.56
	Mar-15	0.406	0.0530	3.71	0.264	3.26	9.40
TWP-13	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	0.149	0.0240	15.5	0.488	15.9	57.5
	Apr-13	ND	ND	16.3	1.13	16.1	45.5
	Apr-14	0.118	-0.0290	16.7	0.697	16.0	53.6
	Mar-15	0.408	0.0430	11.6	0.735	11.8	38.7

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

Table 3: Groundwater Analytical Results for Filtered Samples

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
BM-4	Sep-01	0.700	0.100	12.2	0.800	11.6	32.1
	Jul-09	0.800	0.247	13.0	0.504	11.8	26.7
	Apr-12	0.423	0.161	12.3	0.196	10.6	30.9
	Apr-13	ND	ND	14.0	0.654	11.8	32.6
	Apr-14	0.192	-0.0410	11.6	0.539	9.82	33.9
	Mar-15	0.117	-0.0140	14.7	0.403	12.6	34.0
BM-15	Sep-01	0.600	0.100	6.30	0.400	5.10	15.4
	Jul-09	NC	NC	NC	NC	NC	NC
	Apr-12	0.108	0.111	7.98	0.209	5.14	16.5
	Apr-13	ND	ND	7.07	ND	4.21	16.4
	Apr-14	0.327	-0.0710	7.14	0.127	4.08	15.8
	Mar-15	1.02	-0.0500	5.33	0.275	4.58	12.9
BM-16	Sep-01	0.400	0.100	13.3	0.900	9.60	27.0
	Jul-09	0.548	0.107	12.3	1.31	11.9	29.3
	Apr-12	0.201	-0.0100	15.2	0.455	12.2	34.1
	Apr-13	ND	ND	11.1	0.551	8.79	29.7
	Apr-14	0.0583	-0.0420	12.9	0.530	10.3	31.2
	Mar-15	0.335	0.0200	12.1	0.610	9.90	30.3
BM-17	Sep-01	1.00	0.100	9.30	0.600	7.90	24.0
	Jul-09	0.360	0.184	6.71	0.645	6.95	18.4
	Apr-12	0.695	0.0740	6.15	0.402	6.38	19.9
	Apr-13	ND	ND	6.08	ND	5.43	14.2
	Apr-14	0.369	0.0120	4.70	0.308	3.03	10.5
	Mar-15	-0.0190	0.280	4.24	0.233	3.59	9.90
BM-18	Sep-01	0.900	0.000	10.4	0.700	8.90	31.0
	Jul-09	0.898	0.229	10.5	0.609	9.46	35.4
	Apr-12	0.159	0.180	9.30	0.492	8.33	23.9
	Apr-13	ND	ND	9.50	0.400	9.25	23.4
	Apr-14	0.000	-0.0100	6.27	0.403	6.98	22.2
	Mar-15	0.0900	0.0340	7.90	0.761	7.06	21.5
BM-19	Sep-01	0.400	0.100	13.0	0.600	10.4	31.6
	Jul-09	0.440	0.265	14.5	0.554	10.8	25.4
	Apr-12	0.162	0.0840	10.9	0.569	9.57	14.9
	Apr-13	ND	ND	11.5	0.587	10.3	27.6
	Apr-14	0.730	-0.00100	10.2	0.474	10.2	30.8
	Mar-15	-0.104	-0.0460	11.5	0.640	9.50	28.8

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

2. April 2010 Total U result for these locations was calculated using the specific activities for each uranium isotope from 10CFR71, Appendix A.

Table 3: Groundwater Analytical Results for Filtered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
L-1	Sep-01	0.500	0.100	1.80	0.100	2.00	2.90
	Jul-09	0.990	0.291	1.94	0.0864	0.481	0.915
	Apr-12	-0.170	0.137	0.298	0.0410	0.750	1.58
	Apr-13	ND	ND	1.24	ND	0.888	3.31
	Apr-14	0.248	0.0130	1.36	0.0420	0.930	3.22
	Mar-15	0.487	-0.0380	1.52	0.0850	1.71	4.65
L-2	Sep-01	0.500	0.100	0.500	0.000	0.600	1.60
	Jul-09	1.33	0.231	3.88	0.260	4.46	49.5
	Apr-12	0.000	0.150	10.8	0.632	9.89	29.7
	Apr-13	ND	ND	9.71	0.406	9.46	30.3
	Apr-14	0.0639	0.0100	8.10	0.246	8.27	24.6
	Mar-15	0.117	-0.0310	3.80	0.223	3.79	11.1
L-3	Sep-01	0.500	0.500	46.8	3.40	46.9	133
	Jul-09	1.18	0.217	2.19	0.279	2.85	6.61
	Apr-12	0.0500	-0.0100	1.85	0.0750	2.09	5.73
	Apr-13	ND	ND	2.38	ND	2.03	6.97
	Apr-14	0.942	-0.0390	1.50	0.109	1.38	5.74
	Mar-15	0.599	-0.0290	2.06	0.211	1.78	6.09
TWP-1 ²	Apr-10	0.230	0.0800	2.87	0.110	2.43	7.20
	Apr-12	0.112	0.158	3.48	0.111	3.02	8.87
	Apr-13	ND	ND	4.09	ND	3.35	9.07
	Apr-14	0.111	0.0270	2.78	0.147	2.40	7.95
	Mar-15	0.540	0.0280	2.65	0.169	2.49	8.27
TWP-4 ²	Apr-10	0.270	0.110	3.20	0.170	3.84	11.4
	Apr-12	0.515	0.000	0.151	0.000	0.0970	0.461
	Apr-13	ND	ND	0.288	ND	0.182	0.723
	Apr-14	0.0578	-0.00600	0.168	0.0190	0.0750	0.402
	Mar-15	1.43	-0.04800	0.276	0.00500	0.169	0.524
TWP-5 ²	Apr-10	ND	ND	0.370	ND	0.380	1.12
	Apr-12	0.617	0.0420	0.0550	-0.0100	0.104	0.462
	Apr-13	ND	ND	0.347	ND	ND	0.897
	Apr-14	0.207	0.0560	0.151	-0.0170	0.0870	0.633
	Mar-15	-0.195	-0.0380	0.0840	-0.0330	0.293	1.11

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

2. April 2010 Total U result for these locations was calculated using the specific activities for each uranium isotope from 10CFR71, Appendix A.

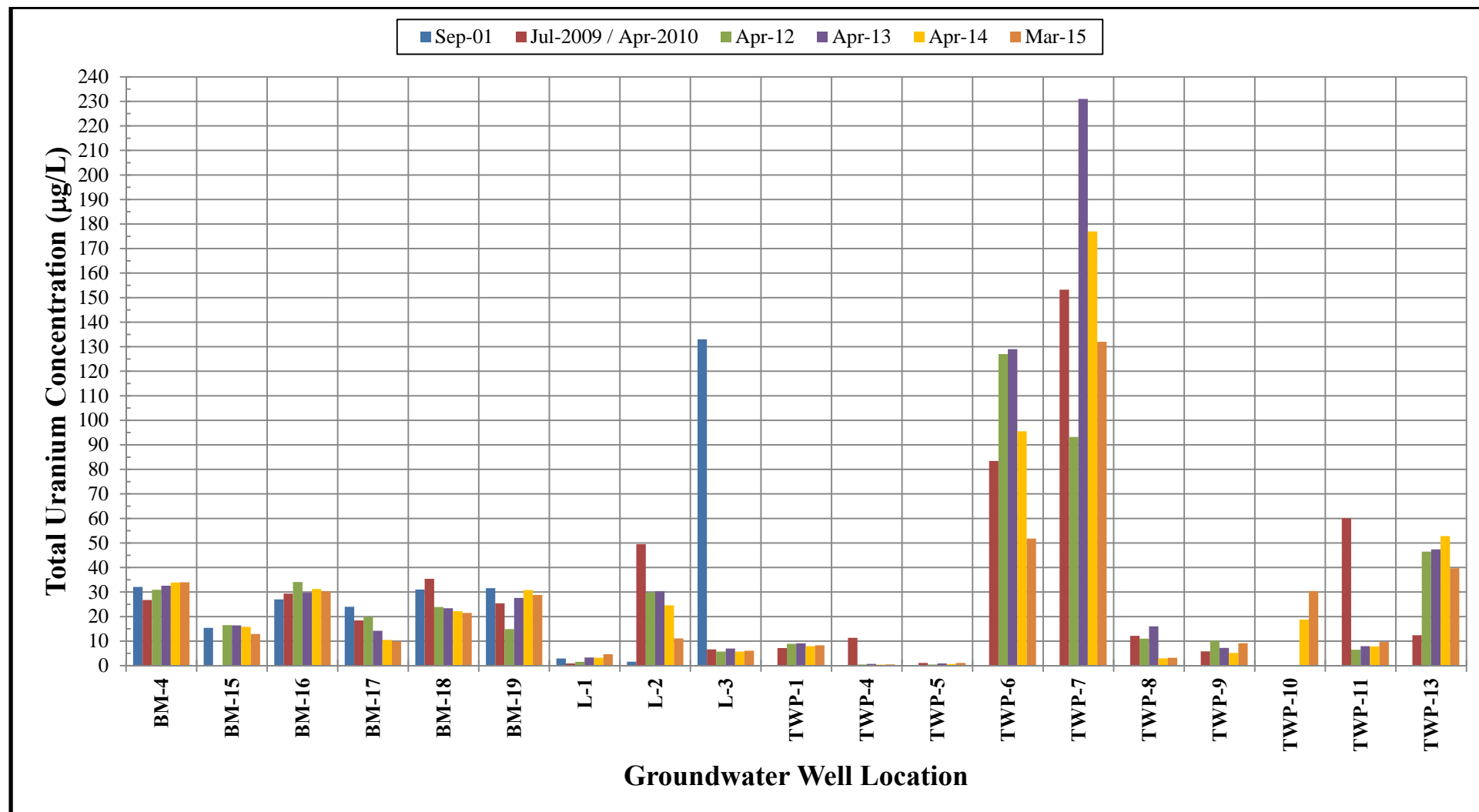
Table 3: Groundwater Analytical Results for Filtered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
TWP-6 ²	Apr-10	0.280	0.150	28.1	0.850	28.2	83.4
	Apr-12	0.487	0.174	49.3	2.52	46.7	127
	Apr-13	ND	ND	39.2	1.87	37.5	129
	Apr-14	0.0560	0.00200	28.5	1.59	28.1	95.5
	Mar-15	0.185	-0.0590	17.0	0.540	17.9	51.8
TWP-7 ²	Apr-10	ND	ND	50.7	1.99	51.8	153
	Apr-12	0.100	0.174	29.1	2.17	30.4	93.2
	Apr-13	ND	ND	71.4	5.40	73.4	231
	Apr-14	0.0578	0.00700	62.5	3.11	60.6	177
	Mar-15	0.499	0.0210	42.8	2.20	39.8	132
TWP-8 ²	Apr-10	0.170	0.0700	4.21	0.240	4.10	12.2
	Apr-12	-0.160	0.175	3.88	0.0400	6.74	11.0
	Apr-13	ND	ND	5.61	0.227	5.89	16.0
	Apr-14	0.0627	0.00800	0.632	0.0270	1.06	2.95
	Mar-15	0.335	-0.0130	1.36	0.0930	1.16	3.22
TWP-9 ²	Apr-10	ND	0.440	2.14	0.220	1.95	5.84
	Apr-12	0.231	0.0770	3.43	0.234	2.83	10.1
	Apr-13	ND	ND	2.83	ND	2.40	7.25
	Apr-14	0.253	0.00200	1.69	0.0370	1.49	5.18
	Mar-15	0.331	0.0370	3.62	0.191	3.19	9.15
TWP-10	Apr-10	NC	NC	NC	NC	NC	NC
	Apr-12	NC	NC	NC	NC	NC	NC
	Apr-13	NC	NC	NC	NC	NC	NC
	Apr-14	0.231	-0.0460	8.95	0.325	4.98	18.8
	Mar-15	NA	NA	17.9	0.669	11.4	30.4
TWP-11 ²	Apr-10	0.260	0.0800	70.2	0.950	20.3	60.0
	Apr-12	0.169	0.134	2.29	0.0570	2.42	6.47
	Apr-13	ND	ND	3.17	ND	2.87	7.91
	Apr-14	-0.0640	0.00200	3.65	0.236	2.54	7.83
	Mar-15	-0.258	ND	3.87	0.135	2.99	9.64
TWP-13 ²	Apr-10	0.230	0.0900	4.52	0.170	4.19	12.4
	Apr-12	0.146	0.123	13.7	0.865	13.1	46.5
	Apr-13	ND	ND	14.4	0.591	15.5	47.4
	Apr-14	0.369	-0.0240	16.1	0.898	17.3	52.8
	Mar-15	0.777	ND	13.5	0.737	14.3	39.7

pCi/L = picocuries per liter
µg/L = micrograms per liter
NC = Not collected
ND = Not detected

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.
2. April 2010 Total U result for these locations was calculated using the specific activities for each uranium isotope from 10CFR71, Appendix A.

Figure 3: Total Uranium Concentrations in Filtered Groundwater Samples Over Time



NOTE: 2014 was the first year that a filtered groundwater sample could be collected from location TWP-10.

Table 4: Surface Water Analytical Results for Unfiltered Samples

Location	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
SW/SD-01	Jul-09	0.608	0.0889	57.8	4.74	56.9	144
	Apr-12	0.249	0.107	70.8	3.71	68.3	252
	Apr-13	ND	ND	46.9	2.65	43.9	127
	Nov-13	NA	NA	20.8	1.15	23.1	76.6
	Apr-14	0.414	-0.00600	10.0	0.559	11.8	35.2
	Mar-15	0.227	0.0160	84.5	4.30	85.4	243.0
SW/SD-02	Jul-09	0.342	0.311	19.9	1.49	19.6	44.3
	Apr-12	0.112	0.168	2.91	0.133	2.81	9.08
	Apr-13	ND	ND	3.21	ND	2.87	8.48
	Nov-13	NA	NA	2.53	0.0740	2.31	8.55
	Apr-14	0.329	-0.0250	2.05	0.0850	1.71	6.31
	Mar-15	0.119	-0.0250	7.07	0.267	6.85	21.3
SW/SD-05	Jul-09	1.51	0.164	61.4	6.44	61.9	162
	Apr-12	0.597	0.173	49.8	2.46	48.2	145
	Apr-13	ND	ND	38.9	2.12	37.9	117
	Nov-13	NA	NA	10.6	0.622	10.8	36.9
	Apr-14	0.119	0.00200	12.0	0.491	11.5	37.1
	Mar-15	0.549	0.0240	97.3	5.15	102	298
SW/SD-06	Jul-09	0.436	0.104	27.6	1.86	28.5	76.1
	Apr-12	0.0830	0.206	8.40	0.514	8.98	24.2
	Apr-13	0.171	ND	6.76	0.609	7.10	16.7
	Nov-13	NA	NA	52.9	3.44	51.9	179
	Apr-14	0.291	0.0350	5.77	0.270	6.05	20.0
	Mar-15	0.264	-0.0200	37.4	2.68	39.4	119
SW/SD-07	Jul-09	1.21	0.0579	6.49	0.989	5.56	23.4
	Apr-12	0.217	0.224	7.87	0.423	7.47	24.5
	Apr-13	ND	ND	6.03	0.460	5.02	16.6
	Nov-13	NA	NA	49.3	2.65	46.5	154
	Apr-14	0.315	0.0510	5.87	0.335	5.85	17.5
	Mar-15	0.714	0.0830	8.18	0.566	9.49	28.7
SW/SD-08	Jul-09	0.603	0.170	5.93	0.565	5.53	19.3
	Apr-12	-0.130	0.331	7.64	0.415	8.65	25.6
	Apr-13	ND	ND	12.8	0.697	12.3	39.6
	Nov-13	NA	NA	20.9	1.54	21.5	72.2
	Apr-14	0.301	-0.0140	14.5	0.819	15.5	50.5
	Mar-15	0.608	ND	39.4	1.79	40.0	130.

pCi/L = picocuries per liter
µg/L = micrograms per liter
ND = Not detected
NA = Not analyzed

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

Table 4: Surface Water Analytical Results for Unfiltered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
SW/SD-09	Jul-09	0.363	0.0722	7.30	0.289	6.23	108
	Apr-12	0.0460	0.271	9.19	0.499	8.55	30.3
	Apr-13	ND	ND	18.7	0.719	19.1	54.9
	Nov-13	NA	NA	22.1	1.25	20.4	72.3
	Apr-14	0.131	-0.0270	11.4	0.643	11.6	38.8
	Mar-15	0.528	0.0380	33.1	1.370	34.5	109
SW/SD-10	Jul-09	1.90	0.157	7.98	0.269	8.02	49.2
	Apr-12	0.346	0.170	4.34	0.344	4.99	15.7
	Apr-13	0.338	ND	17.2	0.472	16.3	42.7
	Nov-13	NA	NA	6.95	0.596	6.75	20.7
	Apr-14	0.0729	0.0220	7.64	0.472	7.37	24.9
	Mar-15	0.296	0.0400	20.2	1.04	20.2	63.0
SW/SD-11	Jul-09	0.741	0.325	5.44	0.485	4.70	19.2
	Apr-12	0.333	0.124	9.83	0.548	8.74	31.3
	Apr-13	ND	ND	17.1	1.22	18.7	50.8
	Nov-13	NA	NA	22.2	1.30	20.3	70.6
	Apr-14	0.450	0.0390	12.5	1.27	12.7	40.9
	Mar-15	-0.225	0.00500	41.1	2.06	39.6	117
SW/SD-12	Nov-11	0.177	0.118	0.195	0.0330	0.0680	0.289
	Apr-12	-0.0900	0.234	-0.0700	0.0120	0.143	0.356
	Apr-13	ND	ND	10.5	0.702	9.75	27.4
	Nov-13	NA	NA	1.32	0.159	1.86	4.92
	Apr-14	0.211	-0.0100	1.60	0.0580	1.39	4.51
	Mar-15	0.834	0.0250	11.8	0.570	11.5	36.2
SW/SD-13	Nov-11	-0.0890	0.107	6.29	0.112	6.05	18.7
	Apr-12	-0.0900	0.238	4.82	0.369	4.77	14.6
	Apr-13	0.344	ND	14.8	0.490	13.3	42.7
	Nov-13	NA	NA	6.46	0.421	5.79	21.9
	Apr-14	-0.0840	-0.00700	5.81	0.310	5.71	17.2
	Mar-15	0.517	0.5140	8.35	0.492	8.25	24.4
SW/SD-14	Nov-11	0.147	0.0740	0.0890	0.000	0.0960	0.292
	Apr-12	0.0920	0.127	0.0540	0.0330	0.311	0.395
	Apr-13	ND	ND	6.34	ND	6.10	19.1
	Nov-13	NA	NA	6.68	0.366	7.92	22.0
	Apr-14	0.784	0.00200	3.95	0.122	2.42	9.71
	Mar-15	0.387	0.0440	11.0	0.781	10.8	30.8

pCi/L = picocuries per liter

µg/L = micrograms per liter

ND = Not detected

NA = Not analyzed

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

Table 4: Surface Water Analytical Results for Unfiltered Samples (continued)

Well	Month & Year	Ra-226 (pCi/L)	Th-230 (pCi/L)	U-234 (pCi/L)	U-235 (pCi/L)	U-238 (pCi/L)	Total U (µg/L) ¹
SW/SD-15	Nov-11	-0.0440	0.0690	0.261	0.0670	0.231	0.905
	Apr-12	-0.130	0.251	4.99	0.317	4.43	1.02
	Apr-13	ND	ND	6.09	0.194	5.69	16.6
	Nov-13	NA	NA	5.38	0.218	4.67	15.4
	Apr-14	0.405	0.00100	3.50	0.132	3.52	13.2
	Mar-15	-0.228	0.0250	11.1	0.798	11.3	33.6
SW/SD-16	Nov-11	0.198	0.0270	0.247	0.0590	0.239	0.634
	Apr-12	-0.160	0.0360	0.193	0.0110	0.298	0.902
	Apr-13	ND	ND	5.75	0.413	5.34	16.6
	Nov-13	NA	NA	4.52	0.298	5.20	15.2
	Apr-14	0.0800	-0.0100	4.27	0.207	3.91	12.4
	Mar-15	0.370	0.0100	9.62	0.367	9.76	31.0
SW-17	Nov-13	NA	NA	2.19	0.131	1.63	4.16
	Apr-14	0.502	0.0240	0.912	0.0910	0.662	2.86
	Mar-15	0.211	0.0320	2.02	0.217	1.24	4.14
SW-18	Nov-13	NA	NA	1.46	0.0920	1.21	3.77
	Apr-14	0.382	-0.0100	1.14	0.000	0.954	2.55
	Mar-15	0.0190	ND	1.33	0.0680	1.26	3.59
SW-19	Nov-13	NA	NA	1.58	0.0730	1.49	4.11
	Apr-14	0.198	0.00200	1.25	0.0570	1.06	3.95
	Mar-15	0.057	-0.0230	3.36	0.218	3.33	8.60
SW-20	Nov-13	NA	NA	1.15	0.0530	1.16	3.44
	Apr-14	0.000	-0.0920	2.40	0.0840	2.41	6.11
	Mar-15	0.453	ND	1.29	0.0900	1.07	2.30

pCi/L = picocuries per liter
µg/L = micrograms per liter
ND = Not detected
NA = Not analyzed

1. Unless stated otherwise, total uranium was analyzed for separately via KPA.

Figure 4: Total Uranium Concentrations in Unfiltered Surface Water Samples Over Time

