

3.1.4 Surface-Water Data Interpretation and Evaluation

3.1.4.1 Surface-Water Quality Summaries

This section presents water quality summaries for selected analytes for the period January 1, 1997, through December 31, 2015 (CYs 1997–2015) for the automated surface-water monitoring locations collecting flow-paced composite samples in CY 2015. Radionuclides summarized include Pu, Am,¹² and total U. The POE metals (total Be, dissolved Cd, total Cr, and dissolved Ag) and nitrate+nitrite as N are also summarized.¹³ Additional analyses are also performed based on specific monitoring objectives. The results and evaluation for these additional analytes are presented in Sections 3.1.2.1 and 3.1.2.2 by monitoring objective.

The summary values in this section should not be confused with the RFLMA-required water-quality evaluations described in Attachment 2 in the RFLMA. The Pu, Am, and total U standards noted in this section apply only to POE (GS10, SW027, and SW093; Section 3.1.2.2) and POC (WALPOC and WOMPOC; Section 3.1.2.1) 30-day or 12-month rolling averages. Comparisons of standards to other summary statistics are noted in this section for reference only. POEs and POCs are highlighted in **bold** in the tables.

Radionuclides

The following summaries include all available results that were not rejected through the validation process.¹⁴ Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations, activities, and analytical errors are often greater than the precision presented. When a negative radionuclide result (e.g., -0.002 pCi/L) is reported by the laboratory due to blank correction, a value of 0.0 pCi/L is used for calculation purposes. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the “real” and “duplicate” values.¹⁵ When a sample has multiple “real” analyses (e.g., Site-requested “reruns”), the value used in calculations is the arithmetic average of the multiple “real” analyses.

The Pu/Am ratio is calculated for each sample by dividing the Pu result by the corresponding Am result. Ratios are calculated only for samples where *both* the Pu and Am results are greater than 0.015 pCi/L (generally the minimum detectable activity for Pu and Am analyses); this excludes ratios for very low results with high relative error.

¹² In this report, “plutonium” or “Pu” refers to plutonium-239,240; and “americium” or “Am” refers to americium-241.

¹³ Due to hold time requirements, the nitrate+nitrite as N summaries are based on grab sample results.

¹⁴ Summaries do not include supplemental post-closure grab samples for U from GS13 that were collected to assess modifications to the SPPTS; only routine continuous flow-paced samples are included.

¹⁵ Arithmetic averaging of radionuclide pairs is performed only when the RER is less than or equal to 5. If the RER is greater than 5, the radionuclide results are determined to be nonrepresentative. These results are not used for the calculation of summary statistics. A more thorough discussion of data management is given in Appendix B.1, “Surface-Water Analytical Data Evaluation Methods.”

Each table includes only those locations where samples were collected that were analyzed for the referenced analyte. Maps are also included showing monitoring locations and the corresponding median values of the referenced parameter. Only locations that had four or more individual results are mapped.

Table 38 shows pre-closure Pu activities. Table 39 shows that post-closure median Pu activities for all locations are below the RFLMA standard of 0.15 pCi/L. The 85th percentile activities are also below the standard for all locations except SW027. Figure 121 and Figure 122 show the pre- and post-closure median Pu activities, respectively.

*Table 38. Pre-Closure Summary Statistics for Pu-239,240 Analytical Results
(January 1, 1997–October 13, 2005)*

Location	Number of Samples	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	165	0.002	0.008	0.024
GS03	257	0.005	0.016	0.220
WOMPOC	NA	NA	NA	NA
WALPOC	NA	NA	NA	NA
GS05	NA	NA	NA	NA
GS08	118	0.004	0.013	0.864
GS10	266	0.054	0.207	2.27
GS11	89	0.002	0.009	0.070
GS13	NA	NA	NA	NA
GS31	26	0.017	0.094	0.348
GS59	30	0.000	0.004	0.020
SW027	71	0.049	0.199	13.2
SW093	284	0.010	0.063	4.18

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011.

Bold = POC or POE

NA = analyte not sampled

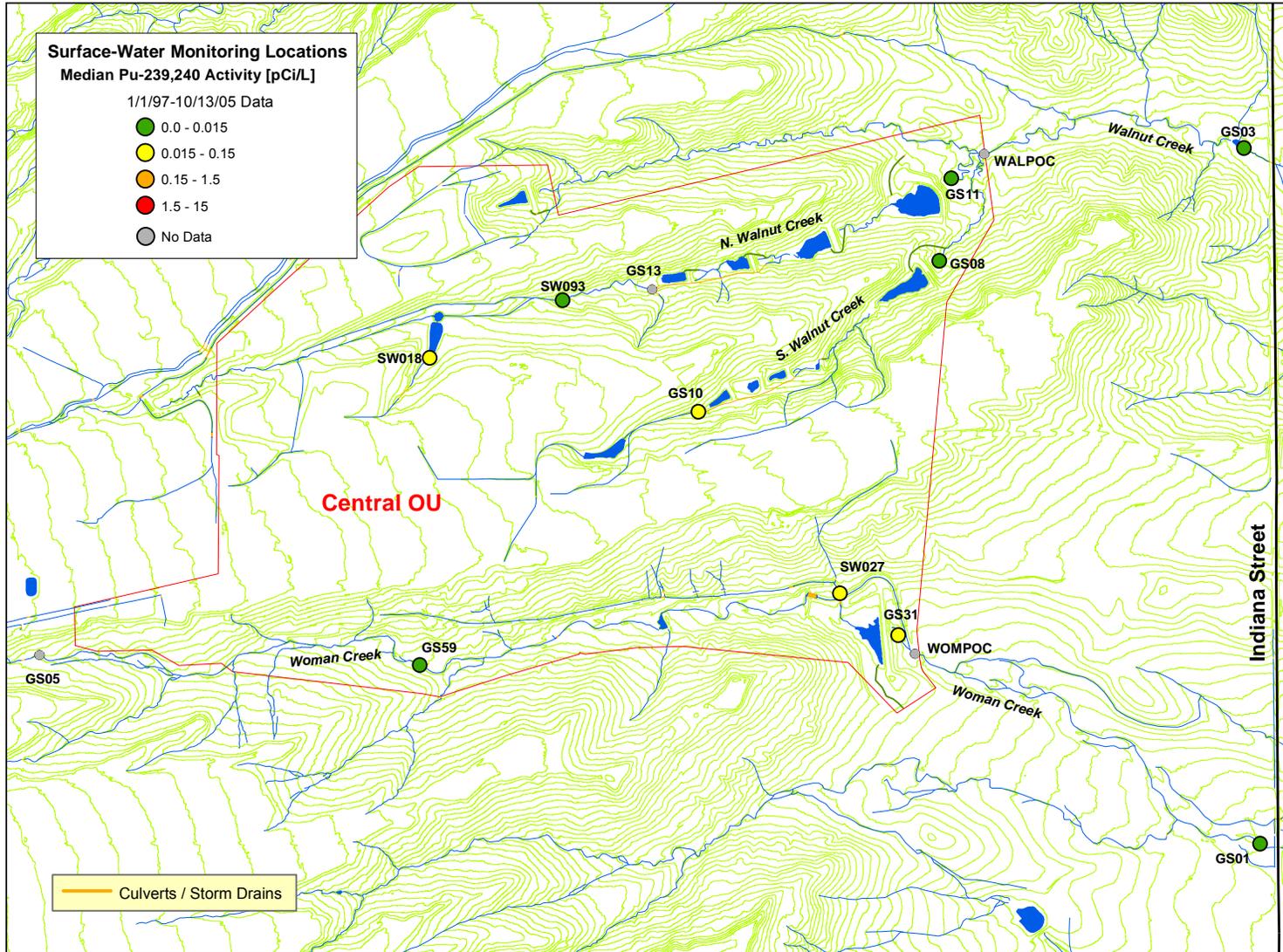
Table 39. Post-Closure Summary Statistics for Pu-239,240 Analytical Results
(October 13, 2005–December 31, 2015)

Location	Number of Samples	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	139	0.003	0.009	0.045
GS03	110	0.004	0.011	0.065
WOMPOC	73	0.004	0.012	0.084
WALPOC	59	0.007	0.020	0.065
GS05	NA	NA	NA	NA
GS08	80	0.005	0.021	1.04
GS10	178	0.011	0.061	5.28
GS11	73	0.005	0.023	0.074
GS13	NA	NA	NA	NA
GS31	40	0.008	0.054	1.36
GS59	NA	NA	NA	NA
SW027	20	0.133	0.559	5.59
SW093	157	0.005	0.019	0.861

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Bold = POC or POE

NA = analyte not sampled



Notes: Only locations with four or more results are mapped.

Figure 121. Median Pu-239,240 Activities for CY 1997–October 13, 2005

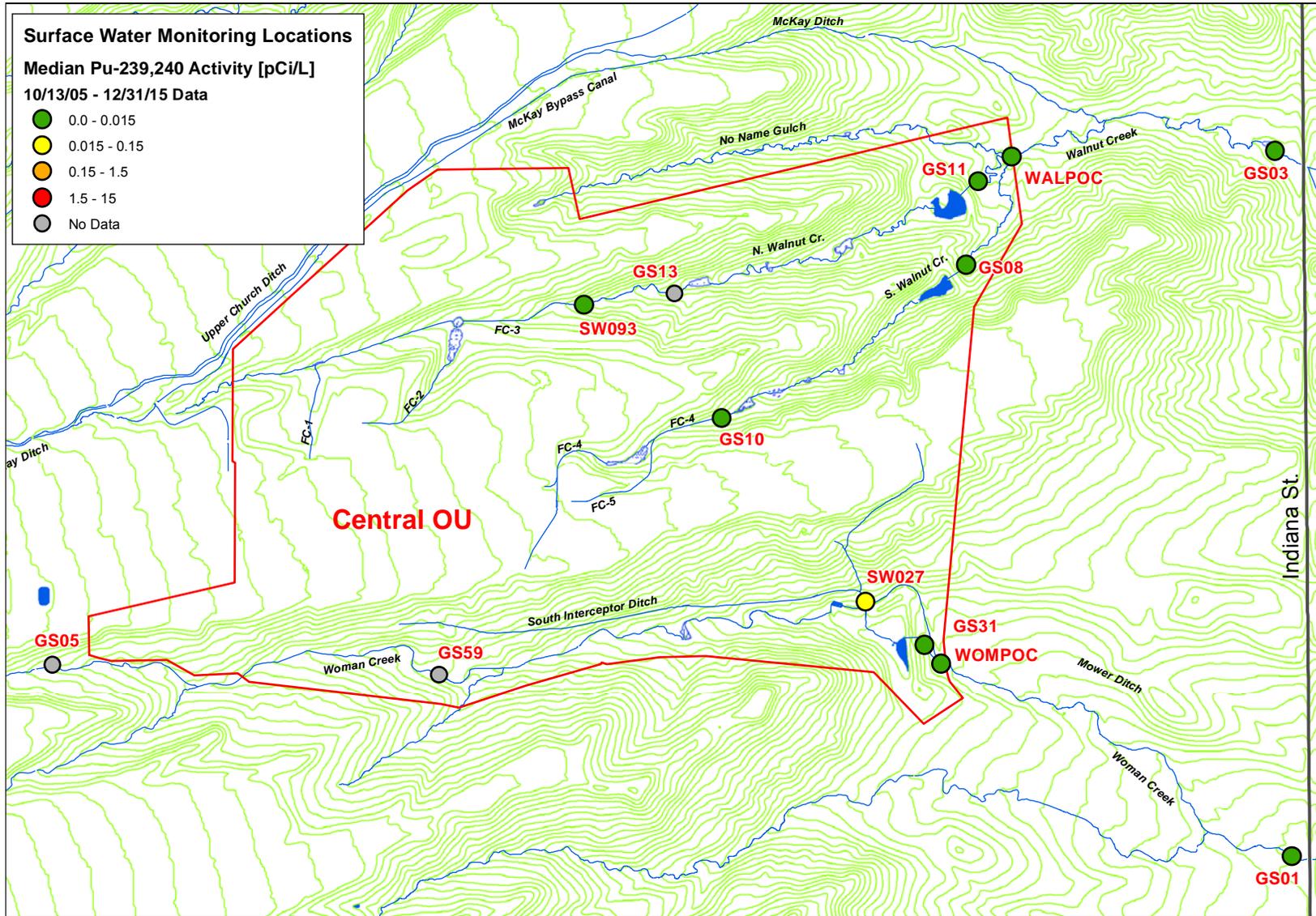


Figure 122. Post-Closure Median Pu-239,240 Activities

Table 40 shows pre-closure Am activities. Table 41 shows that post-closure median and 85th percentile Am activities for all locations are below the RFLMA standard of 0.15 pCi/L. Figure 123 and Figure 124 show median Am activities for pre- and post-closure, respectively.

*Table 40. Pre-Closure Summary Statistics for Am-241 Analytical Results
(January 1, 1997–October 13, 2005)*

Location	Number of Samples	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	164	0.001	0.008	0.054
GS03	258	0.006	0.018	0.066
WOMPOC	NA	NA	NA	NA
WALPOC	NA	NA	NA	NA
GS05	NA	NA	NA	NA
GS08	118	0.006	0.015	0.275
GS10	259	0.057	0.193	8.39
GS11	88	0.003	0.010	0.047
GS13	NA	NA	NA	NA
GS31	26	0.009	0.020	0.116
GS59	30	0.001	0.004	0.015
SW027	71	0.009	0.045	2.33
SW093	279	0.012	0.052	14.1

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011.

Bold = POC or POE

NA = analyte not sampled

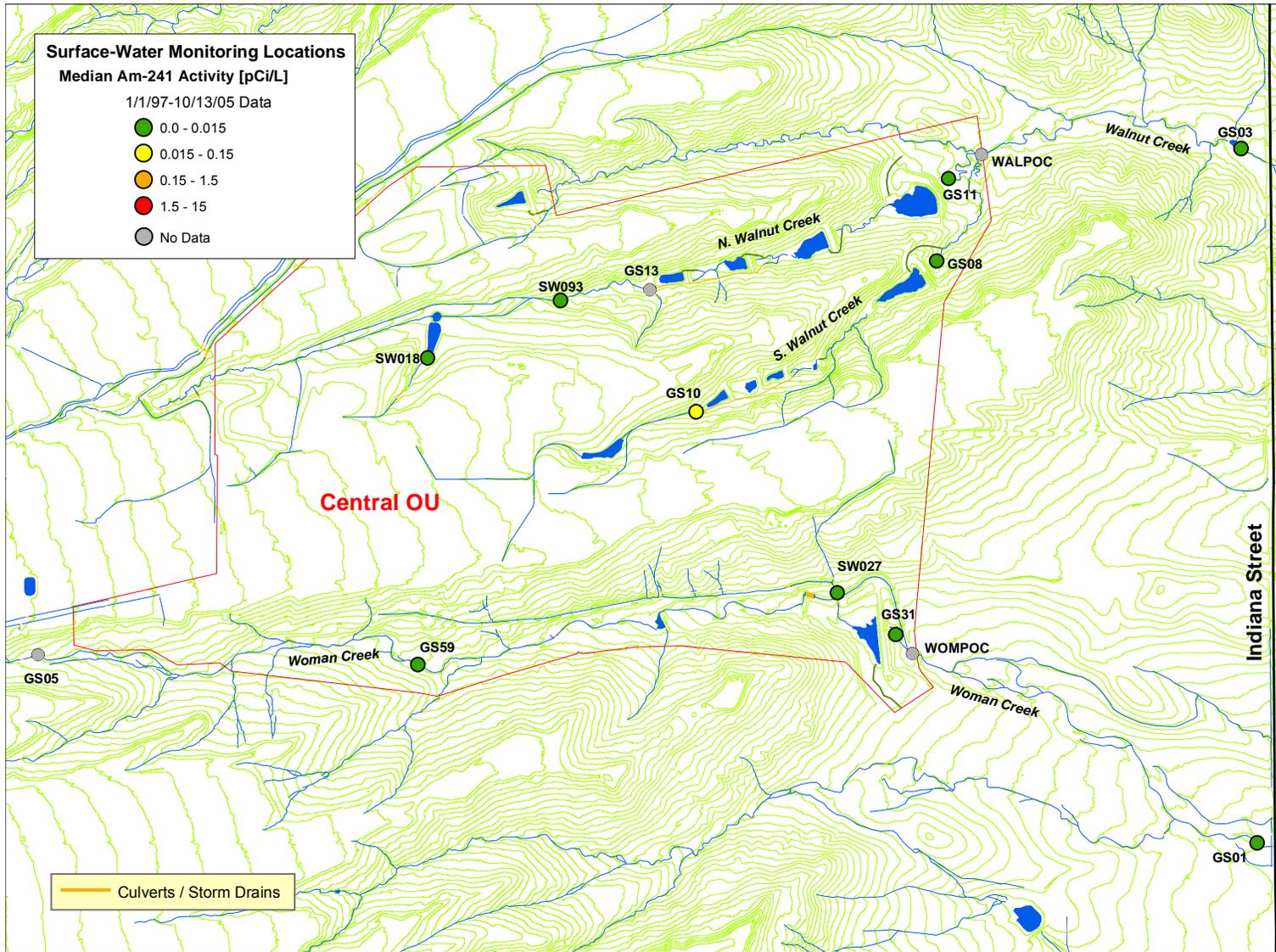
*Table 41. Post-Closure Summary Statistics for Am-241 Analytical Results
(October 13, 2005–December 31, 2015)*

Location	Number of Samples	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	139	0.002	0.007	0.057
GS03	110	0.002	0.009	0.036
WOMPOC	73	0.003	0.008	0.021
WALPOC	59	0.005	0.013	0.028
GS05	NA	NA	NA	NA
GS08	80	0.004	0.017	0.608
GS10	179	0.011	0.085	8.41
GS11	73	0.004	0.014	0.034
GS13	NA	NA	NA	NA
GS31	40	0.004	0.013	0.209
GS59	NA	NA	NA	NA
SW027	20	0.032	0.118	1.26
SW093	157	0.004	0.014	0.357

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

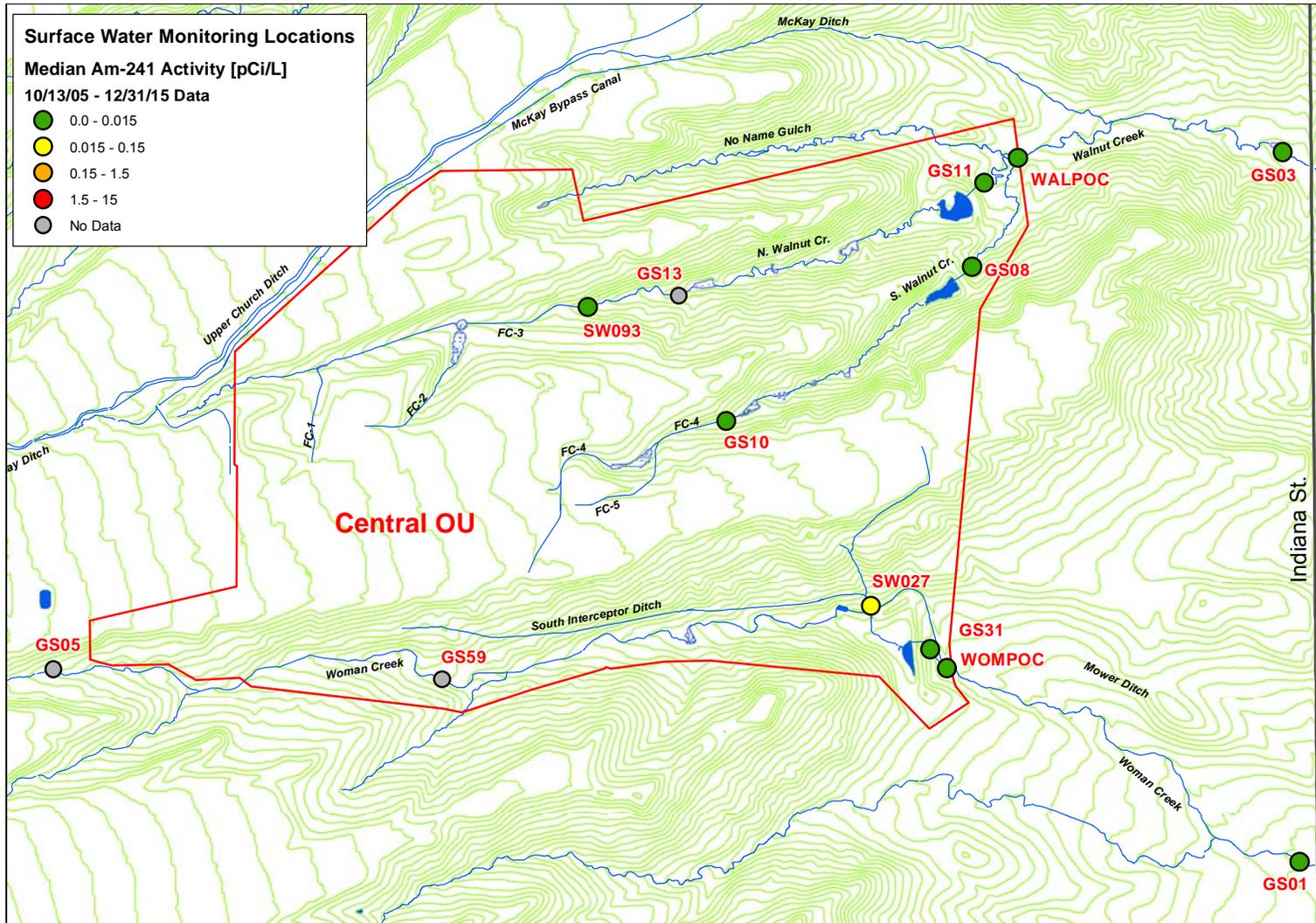
Bold = POC or POE

NA = analyte not sampled



Notes: Only locations with four or more results are mapped.

Figure 123. Median Am-241 Activities for CY 1997—October 13, 2005



Notes: Only locations with four or more results are mapped.

Figure 124. Post-Closure Median Am-241 Activities

Table 42 shows pre-closure U concentrations. Table 43 shows that for all locations post-closure median total U concentrations do not exceed the RFLMA standard of 16.8 µg/L. Recent data from several locations show total U levels in excess of 16.8 µg/L. These measurements are influenced by contributions of naturally occurring U in groundwater and hydrologic changes post-closure. Although the Site standard is 16.8 µg/L, it should be noted that the drinking water standard (i.e., the maximum contaminant level) is 30 µg/L. Figure 125 and Figure 126 show median total U activities for pre- and post-closure, respectively.

*Table 42. Pre-Closure Summary Statistics for Total U Analytical Results
(January 1, 1997–October 13, 2005)*

Location	Number of Samples	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
GS01	53	4.29	6.51	11.9
GS03	78	2.37	4.48	7.64
WOMPOC	NA	NA	NA	NA
WALPOC	NA	NA	NA	NA
GS05	NA	NA	NA	NA
GS08	118	1.83	3.09	9.88
GS10	266	4.48	7.15	20.5
GS11	89	3.00	4.29	5.62
GS13	68	11.7	17.2	33.0
GS31	26	3.48	4.22	6.27
GS59	31	0.93	1.74	4.66
SW027	71	2.06	4.47	8.70
SW093	284	3.99	6.35	11.1

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011.

Bold = POC or POE

NA = analyte not sampled

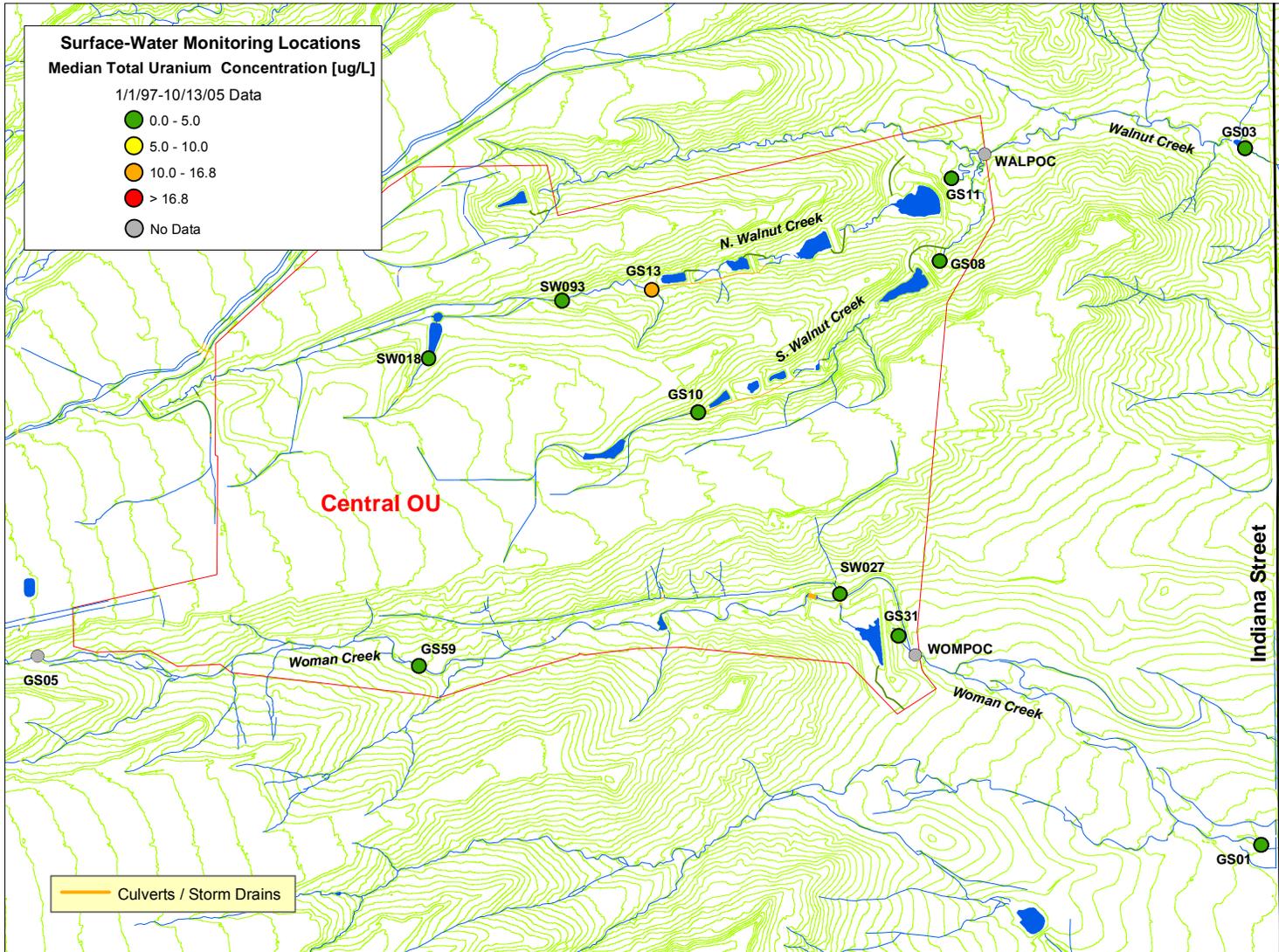
Table 43. Post-Closure Summary Statistics for Total U Analytical Results
(October 13, 2005–December 31, 2015)

Location	Number of Samples	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
GS01	139	3.82	6.39	11.3
GS03	111	6.86	10.4	18.8
WOMPOC	73	2.51	4.11	7.11
WALPOC	59	11.5	17.5	22.9
GS05	94	0.84	1.75	4.67
GS08	80	8.79	14.0	20.4
GS10	179	16.3	25.7	89.2
GS11	73	8.26	14.9	29.0
GS13	130	13.6	34.9	63.6
GS31	41	6.69	8.09	13.3
GS59	90	1.47	2.23	9.30
SW027	20	3.30	5.43	7.07
SW093	157	7.10	11.2	23.4

Notes: WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

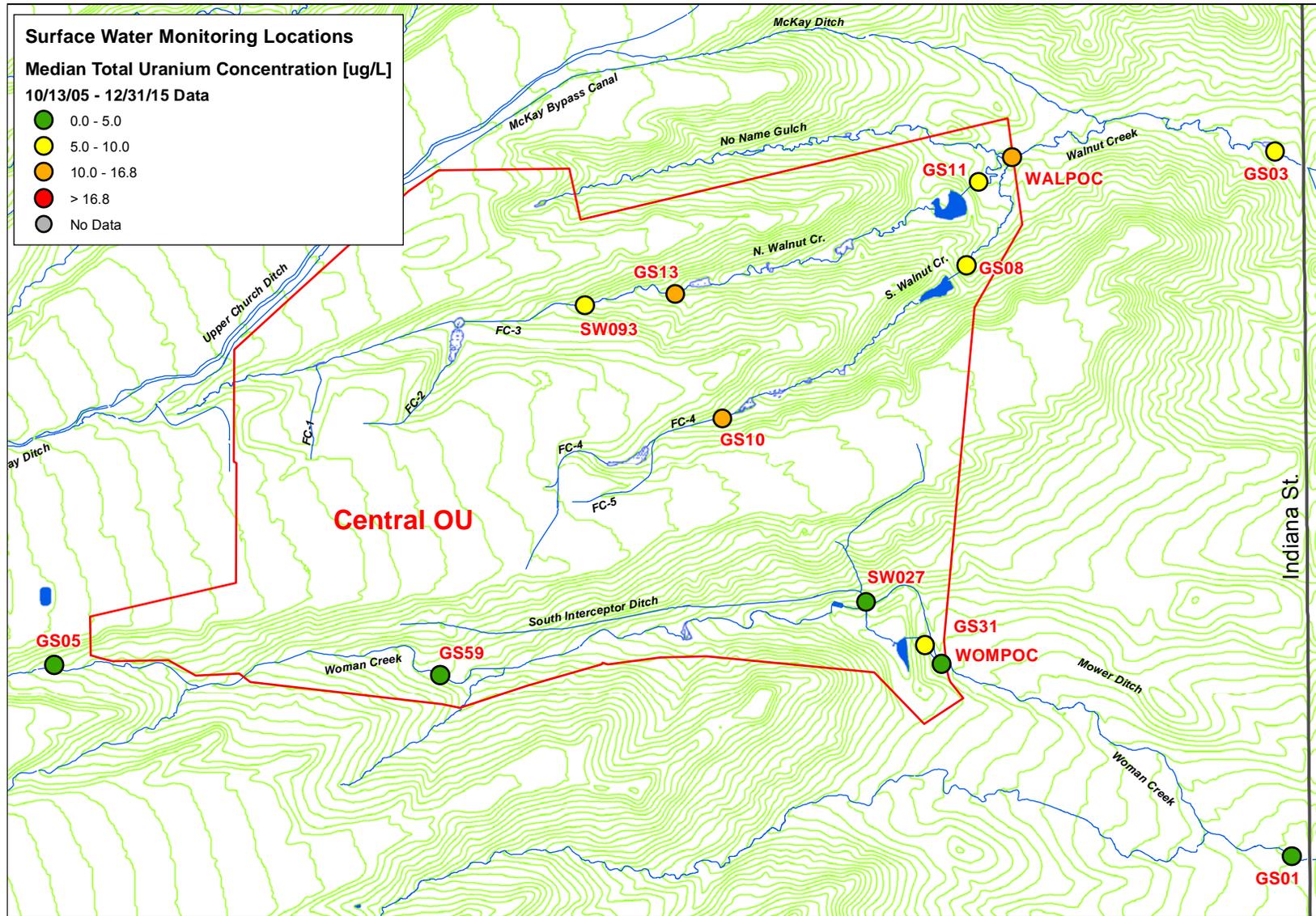
Bold = POC or POE

NA = analyte not sampled



Notes: Only locations with four or more results are mapped.

Figure 125. Median Total U Concentrations for CY 1997—October 13, 2005



Notes: Only locations with four or more results are mapped.

Figure 126. Post-Closure Median Total U Concentrations

Table 44 and Figure 127 show that post-closure median nitrate concentrations for most locations are below the standard of 10 mg/L. Location GS13 clearly shows the effects of the former Solar Ponds.

Table 44. Post-Closure Summary Statistics for Nitrate+Nitrite as Nitrogen Analytical Results (October 13, 2005–December 31, 2015)

Location	Number of Samples	Median (mg/L)	85th Percentile (mg/L)	Maximum (mg/L)
GS03	83	1.3	3.7	6.7
WALPOC	58	2.2	5.5	8.7
GS11	72	4.3	8.3	16
GS08	29	0.11	0.24	0.73
GS13	166	27	56	140
SW093	147	3.4	13.7	61

Notes: WALPOC began operation on September 9, 2011. Monitoring at GS03 was discontinued on October 1, 2015. **Bold** = POC or POE

Table 45 and Table 46 list the average Pu/Am activity ratios for locations where samples are analyzed for Pu and Am. A ratio greater than 1 indicates Pu activity in excess of Am activity. Conversely, a ratio less than 1 indicates Am activity in excess of Pu activity. Generally, Pu activities are greater than Am activities in surface water at the Site. Post-closure data show patterns similar to those of pre-closure data. With the recent reportable values at GS10, the ratio there has shifted measurably towards Am. Figure 128 and Figure 129 present pre- and post-closure average Am/Pu ratios, respectively.

Table 45. Pre-Closure Average Pu/Am Ratios for Analytical Results (January 1, 1997–October 13, 2005)

Location	Number of Samples ^a	Average Pu/Am Ratio
GS01	1	1.5
GS03	14	2.1
WOMPOC	NA	NA
WALPOC	NA	NA
GS05	NA	NA
GS08	5	8.9
GS10	196	1.3
GS11	b	b
GS13	NA	NA
GS31	4	3.9
GS59	b	b
SW027	26	4.9
SW093	95	1.8

Notes:

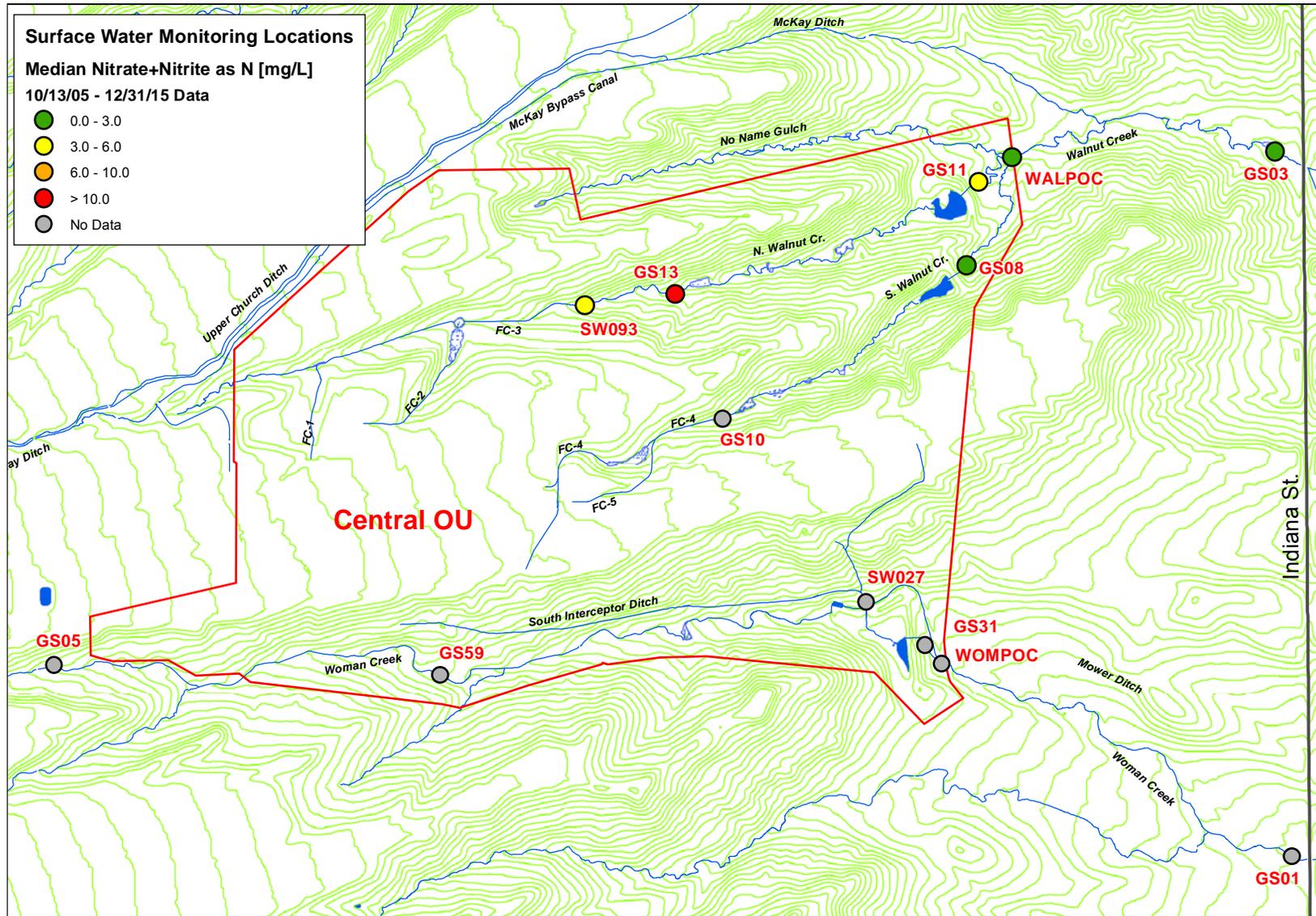
^a Number of samples in which both Pu and Am activities were greater than 0.015 pCi/L.

^b No results greater than 0.015 pCi/L.

WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011.

Bold = POC or POE

NA = Analyte not sampled



Notes: Only locations with four or more results are mapped.

Figure 127. Post-Closure Median Nitrate+Nitrite as Nitrogen Concentrations

Table 46. Post-Closure Average Pu/Am Ratios for Analytical Results
(October 13, 2005–December 31, 2015)

Location	Number of Samples ^a	Average Pu/Am Ratio
GS01	2	1.64
GS03	4	1.28
WOMPOC	2	3.45
WALPOC	6	1.6
GS05	NA	NA
GS08	11	1.54
GS10	60	0.9
GS11	7	1.63
GS13	NA	NA
GS31	6	4.92
GS59	NA	NA
SW027	15	5.26
SW093	13	2.01

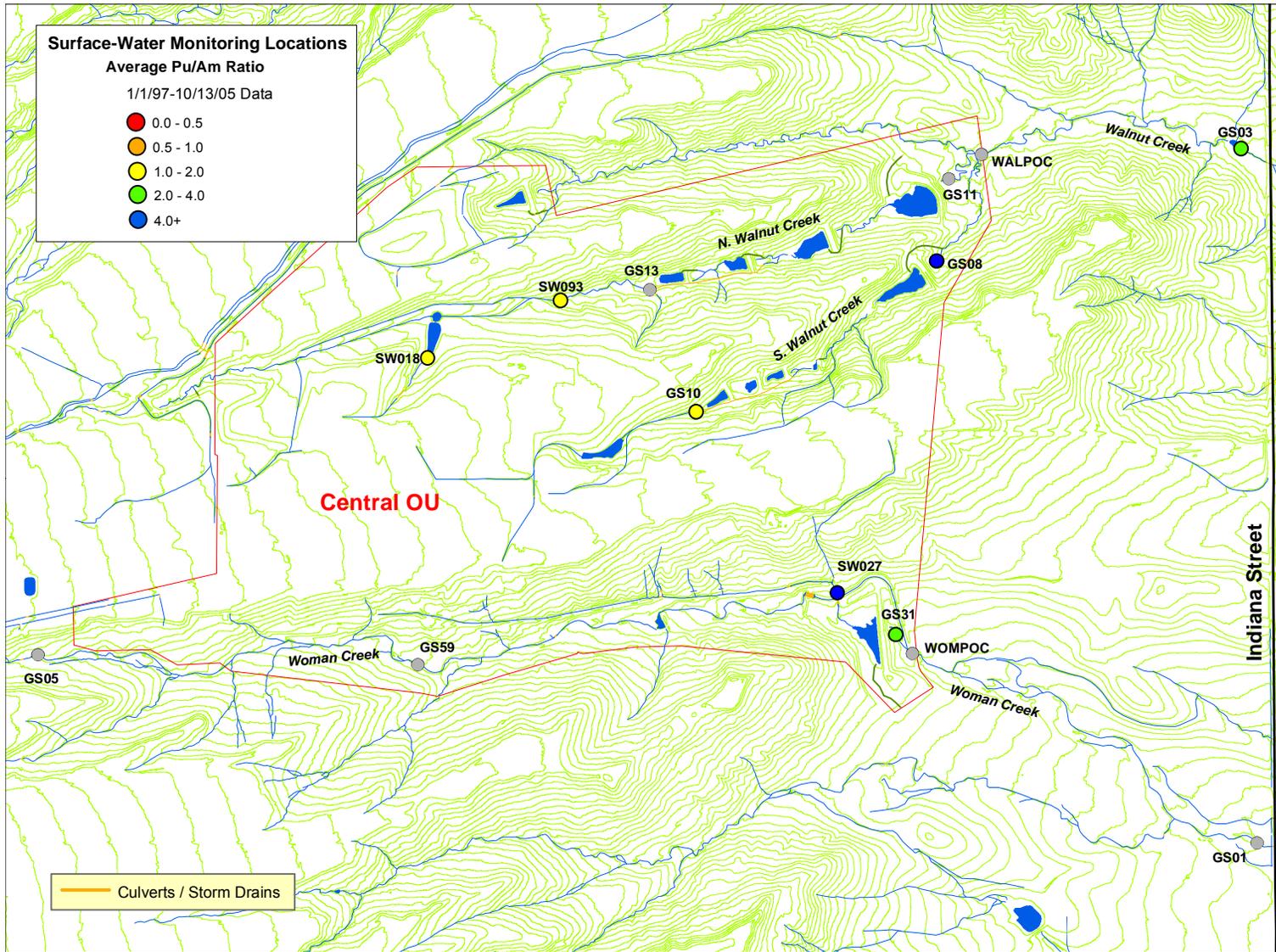
Notes:

^a Number of samples in which both Pu and Am activities were greater than 0.015 pCi/L.

WALPOC began operation on September 28, 2011, and WOMPOC began operation on September 9, 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

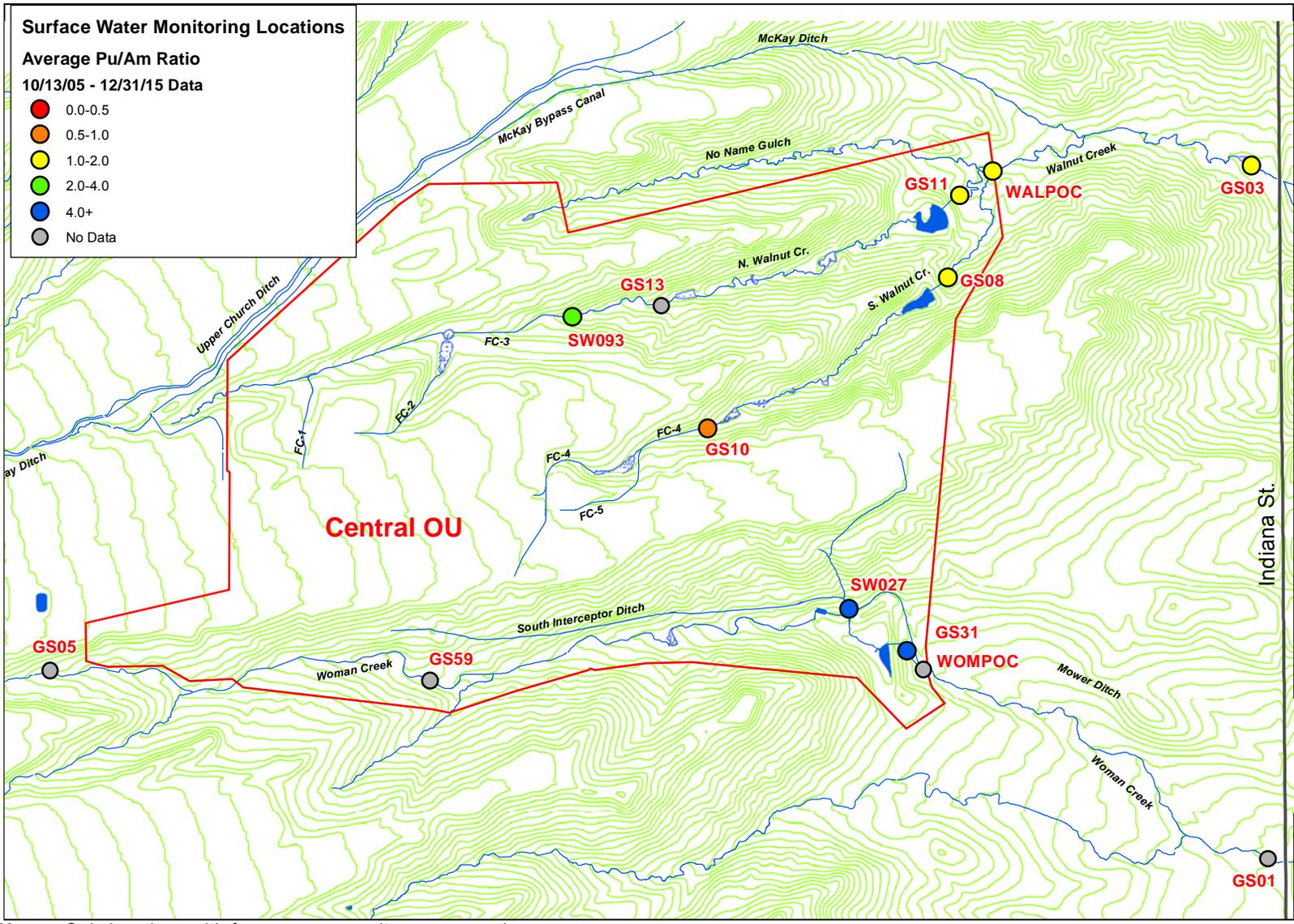
Bold = POC or POE

NA = Analyte not sampled



Notes: Only locations with four or more results are mapped.

Figure 128. Average Pu/Am Ratios for CY 1997—October 13, 2005



Notes: Only locations with four or more results are mapped.

Figure 129. Post-Closure Average Pu/Am Ratios

POE Metals

The following summaries include all results that were not rejected through the validation process. Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations and analytical errors are often greater than the precision presented. When a nondetect is returned from the laboratory for metals analyses, one-half the detection limit is used for calculations. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the “real” value and the “duplicate.”¹⁶ When a sample has multiple “real” analyses (Site-requested “reruns”), the value used in calculations is the arithmetic average of the multiple “real” analyses.

Table 47, Table 48, Table 49, Table 50, Table 51, and Table 52 present summary statistics for the POE metals. All three POE locations generally show reduced metals concentrations in the post-closure period.

*Table 47. Pre-Closure Summary Statistics for POE Metals Results from GS10
(January 1, 1997–October 13, 2005)*

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	263	32.3%	0.12	0.63	3.40
Dissolved Cd	259	59.1%	0.05	0.15	1.00
Total Cr	264	13.3%	2.40	9.72	80.10
Dissolved Ag	258	88.8%	0.11	0.18	1.10

*Table 48. Post-Closure Summary Statistics for POE Metals Results from GS10
(October 13, 2005–December 31, 2015)*

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	179	100.0%	0.50	0.50	0.50
Dissolved Cd	179	95.0%	0.06	0.06	0.34
Total Cr	179	79.3%	0.50	1.31	8.02
Dissolved Ag	179	98.9%	0.10	0.10	0.27

¹⁶ Arithmetic averaging of metal pairs is performed only when the relative percent difference (RPD) is less than 100 percent. If the RPD is greater than or equal to 100 percent, the metal results are determined to be nonrepresentative. The results are then not used for the calculation of summary statistics.

Table 49. Pre-Closure Summary Statistics for POE Metals Results from SW027
(January 1, 1997–October 13, 2005)

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	70	45.7%	0.09	0.41	1.30
Dissolved Cd	70	68.6%	0.05	0.13	0.70
Total Cr	70	8.6%	1.70	4.03	31.2
Dissolved Ag	68	85.3%	0.12	0.24	0.72

Table 50. Post-Closure Summary Statistics for POE Metals Results from SW027
(October 13, 2005–December 31, 2015)

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	20	95.0%	0.50	0.50	1.33
Dissolved Cd	19	100.0%	0.06	0.06	0.06
Total Cr	20	45.0%	1.44	2.62	21.9
Dissolved Ag	19	100.0%	0.10	0.10	0.10

Table 51. Pre-Closure Summary Statistics for POE Metals Results from SW093
(January 1, 1997–October 13, 2005)

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	284	35.2%	0.11	0.55	2.10
Dissolved Cd	284	68.7%	0.05	0.14	2.20
Total Cr	283	16.3%	2.00	7.40	34.90
Dissolved Ag	280	89.6%	0.10	0.18	1.03

Table 52. Post-Closure Summary Statistics for POE Metals Results from SW093
(October 13, 2005–December 31, 2015)

Analyte	Number of Samples	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	157	100.0%	0.50	0.50	2.50
Dissolved Cd	157	92.4%	0.06	0.06	1.40
Total Cr	157	70.1%	0.50	1.87	25.7
Dissolved Ag	157	100.0%	0.10	0.10	0.50

3.1.4.2 Surface-Water Loading Analysis

This section provides a summary of radionuclide loads (Am, Pu, and total U) for RFLMA POEs, POCs, and selected Adaptive Management Plan (AMP) locations. In September 2011, the two

new COU boundary POCs (WALPOC and WOMPOC) became operational. At the same time, locations GS08, GS11, and GS31 were discontinued as POCs; however, they continued to operate to provide data for the AMP. Locations GS01 and GS03 were operated and evaluated as POCs through September 8, 2013, and September 27, 2013, respectively. As agreed to by the AMP group, the remaining AMP monitoring at GS01 and GS03 was discontinued on October 1, 2015. All five of these non-RFLMA locations are included in this section. These locations all collect continuous flow-paced composite samples for laboratory analysis. The nature of the continuous sampling during all flow conditions allows for more accurate load estimations compared to storm-event or grab sampling.

Due to the interruptions in automated sampling during the September 2013 precipitation event and the corresponding lack of analytical data, for comparison purposes the start of the high runoff (generally late on September 11) through September 13, 2013, is not included in the evaluation in this section. Additionally, some data are estimated for the comparisons herein; under normal RFLMA data evaluation protocols, these estimated data would not be included.

This loading analysis should not be confused with the regulatory evaluation under RFLMA for POCs and POEs. RFLMA evaluation is based on water activity or concentration (i.e., pCi/L or µg/L, respectively) in comparison to applicable surface-water standards (see Section 3.1.2.1 and Section 3.1.2.2). This loading analysis is presented to show changes in the transport of Pu, Am, and U following Site closure. These changes in load, in conjunction with the RFLMA-required evaluation, can be used to support conclusions regarding the relative success and continued performance of the remedy.

To calculate load, the activity/concentration for each composite sample (pCi/L or µg/L) is multiplied by the corresponding stream discharge (liters [L]) during the composite sample period, to yield the load (picocuries [pCi] or micrograms [µg]). For radionuclides, the total pCi value is then converted to micrograms (µg) using the conversion factors in Table 53.¹⁷ A detailed description of the method for load estimation is given in Appendix B.¹⁸

Table 53. Activity-to-Mass Conversion Factors for Pu, Am, and U Isotopes

Analyte	Mass/Activity (grams/curie)
Pu-239,240	14.085
Am-241	0.292
U-233,234	1.6 E+02
U-235	4.63 E+05
U-238	2.98 E+06

Notes: Starting on April 1, 2009, U was analyzed as total U in µg/L.

¹⁷ In the following tables and plots, values are rounded for presentation.

¹⁸ Data are generally presented at varying precisions for presentation. Accuracy should not be inferred; both analytical and flow measurement error have not been quantified in this report.

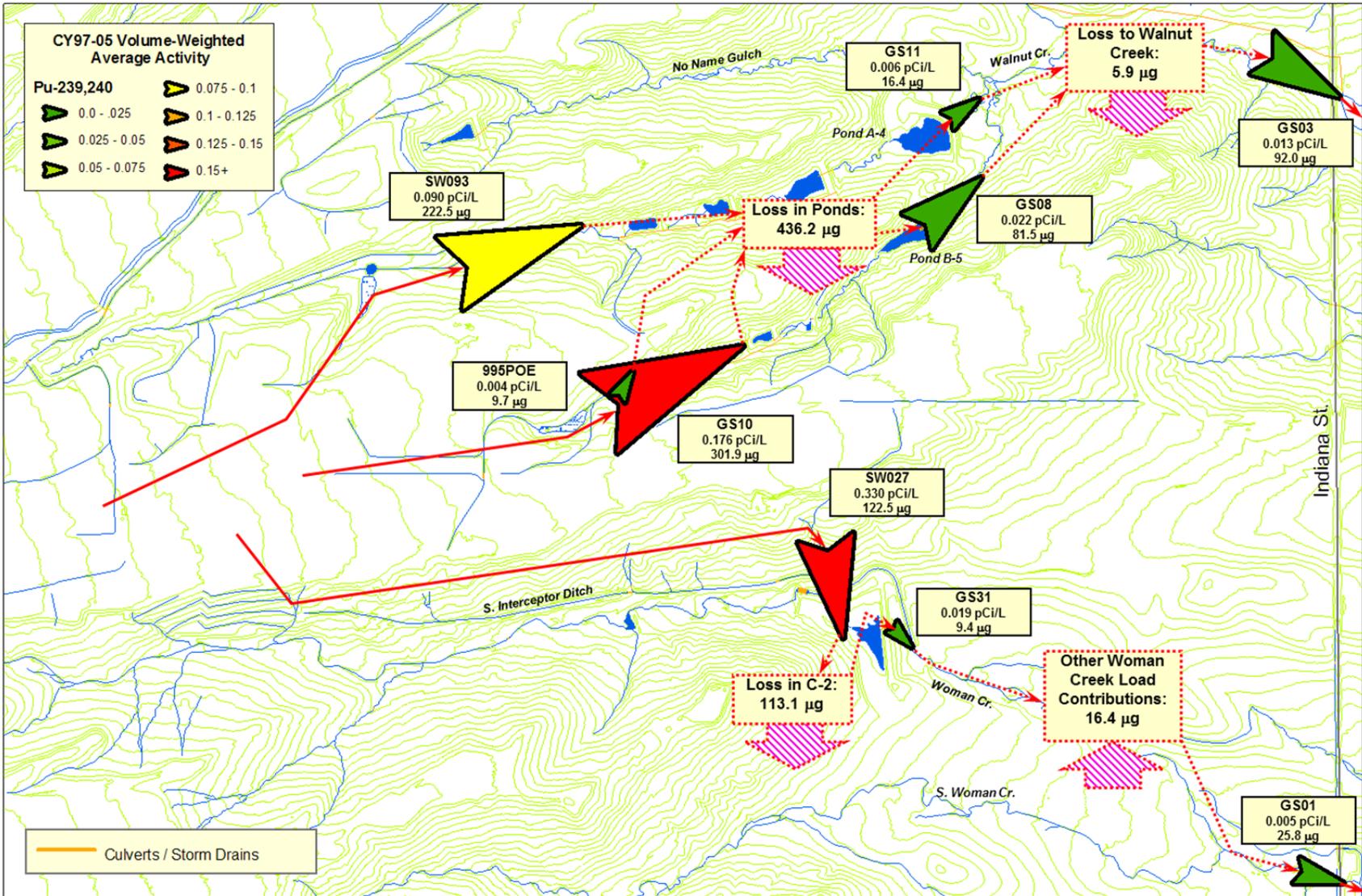
The Pu-239,240 conversion factor was derived from Table 2.7.2-2 in the April 1980 *Final Environmental Impact Statement (Final Statement to ERDA 1545-D)*, Rocky Flats Plant Site. The conversion factors for Am-241, U-233,234, U-235, and U-238 were taken from Title 40 *Code of Federal Regulations* Part 302.4 (40 CFR 302.4).¹⁹

Overall Site and Refuge Area

This section summarizes the calculated overall Pu, Am, and U loads for selected locations. Total U data collection began at GS01 and GS03 just prior to CY 2003; therefore, only CY 2003–2015 data are shown for U. POC locations WALPOC and WOMPOC were installed in September 2011; averages shown for WALPOC and WOMPOC use available data. The following points are noted:

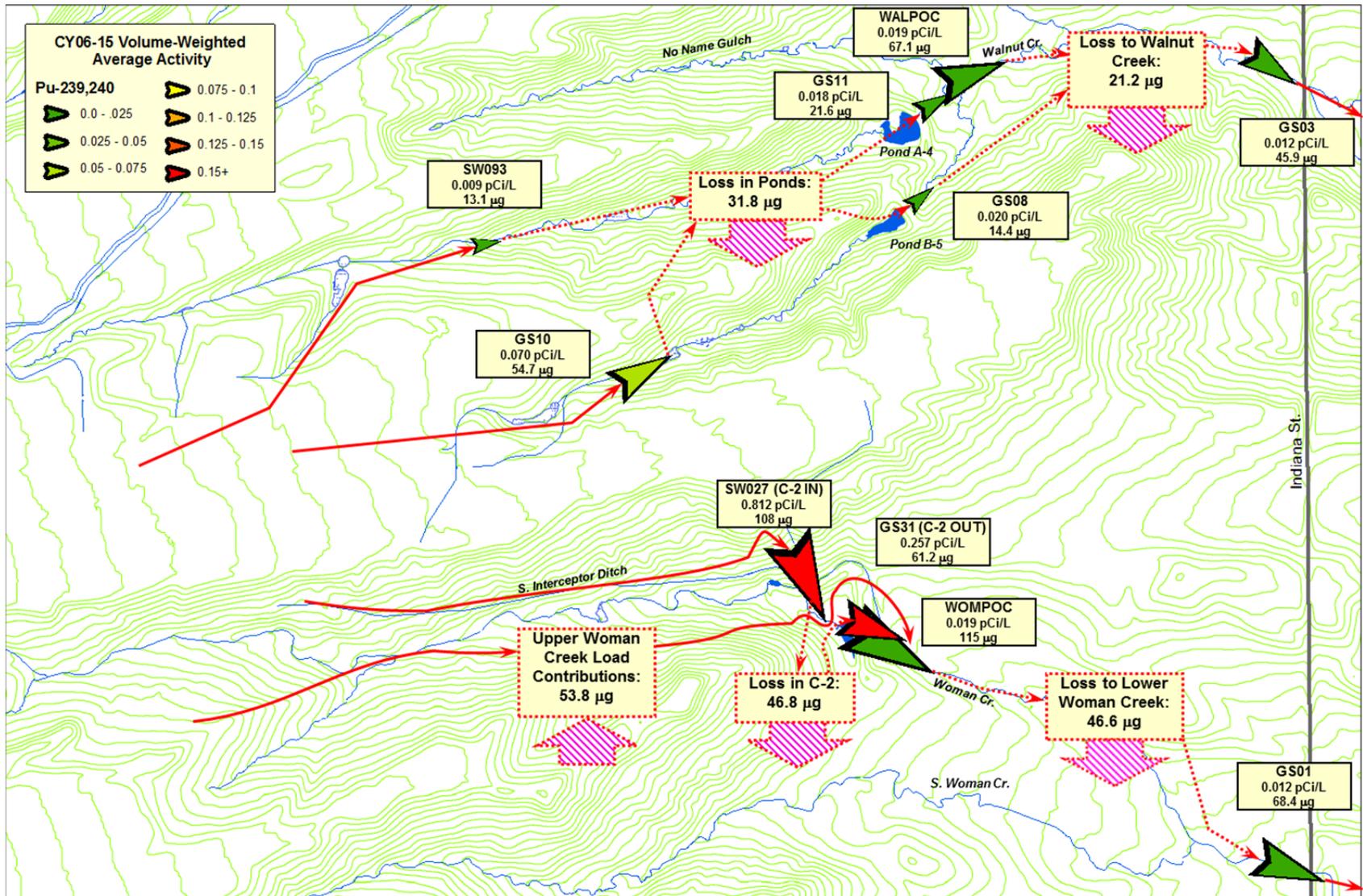
- Figure 130, Figure 131, Figure 132, and Figure 133 show a measurable reduction in post-closure average annual Pu and Am loads at all locations in Walnut Creek, except for GS11. The load reductions are between 50 percent and 96 percent for GS03, GS08, GS10, and SW093. Similarly, activity has been essentially unchanged (GS03 and GS08) or reduced between 48 percent and 92 percent (GS10 and SW093).
- The post-closure Pu and Am activities at GS11 are measurably higher than pre-closure. However, only Pu loads have increased, while Am loads have decreased. This difference is likely the result of water with high relative Am concentrations from the B771/B774 project reaching Pond A-4. Although all of the water in Pond A-4 was treated to meet water-quality standards, water with activities higher than normal was observed at GS11. These increases are also attributed to slightly higher activities observed during the extremely high flows in September 2013 and the spring of 2015. The highest measured post-closure activities at GS11 are 0.074 pCi/L Pu and 0.034 pCi/L Am.
- At location SW027, while average Pu and Am loads are approximately unchanged, concentrations have increased since relatively cleaner runoff from the 400 Area has been eliminated. It should be noted that almost 95 percent of the post-closure load at SW027 occurred during the spring of 2015, an extended period of frequent storms and near-continuous runoff. In fact, the runoff measured at SW027 during the April 17, 2015–July 14, 2015, period was 40 percent greater than the ***total for any entire calendar year in the last 20 years***.
- For lower Woman Creek (GS01 and GS31), post-closure Pu/Am loads and activities have both increased in comparison to pre-closure levels. At GS31, this is due to the higher than average loads to Pond C-2 in 2015 (SW027 is the influent to Pond C-2, see above) and the fact that Pond C-2 was able to remove only approximately one-half of the influent load. At GS01, activity and load increases are likely due to increased transport of diffuse, low-level contamination in the much larger flow volumes measured here, especially during the spring of 2015. It should be noted that the GS01 post-closure volume-weighted average Pu and Am activities of 0.012 and 0.006 pCi/L, respectively, are significantly below the RFLMA standard of 0.15 pCi/L and within the analytical measurement error for each analyte.

¹⁹ The U-234 conversion factor was used to represent U-233,234 due to the small relative abundance of U-233.



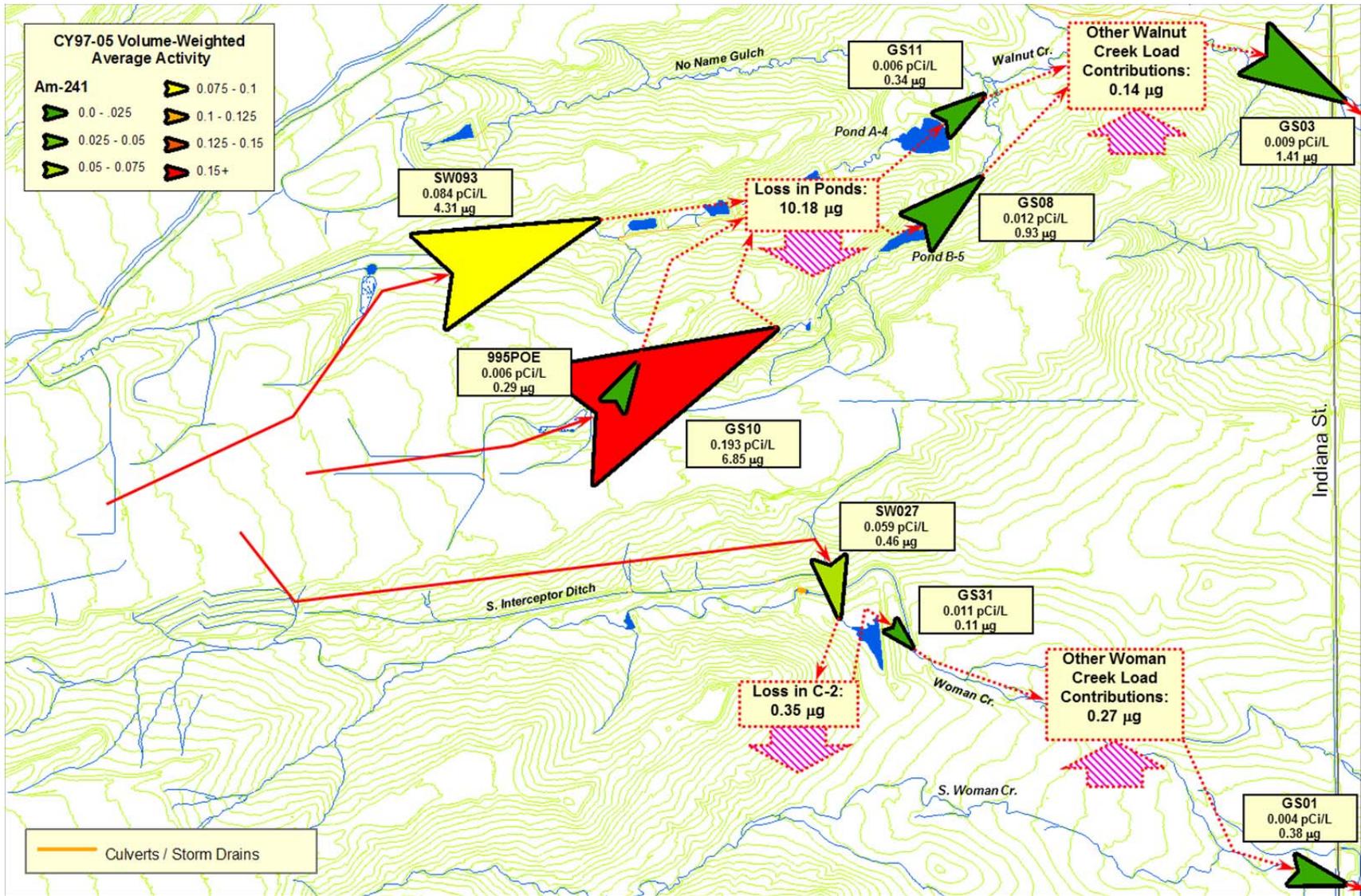
Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend.

Figure 130. Relative Average Annual Pu Loading Schematic: CY 1997–2005



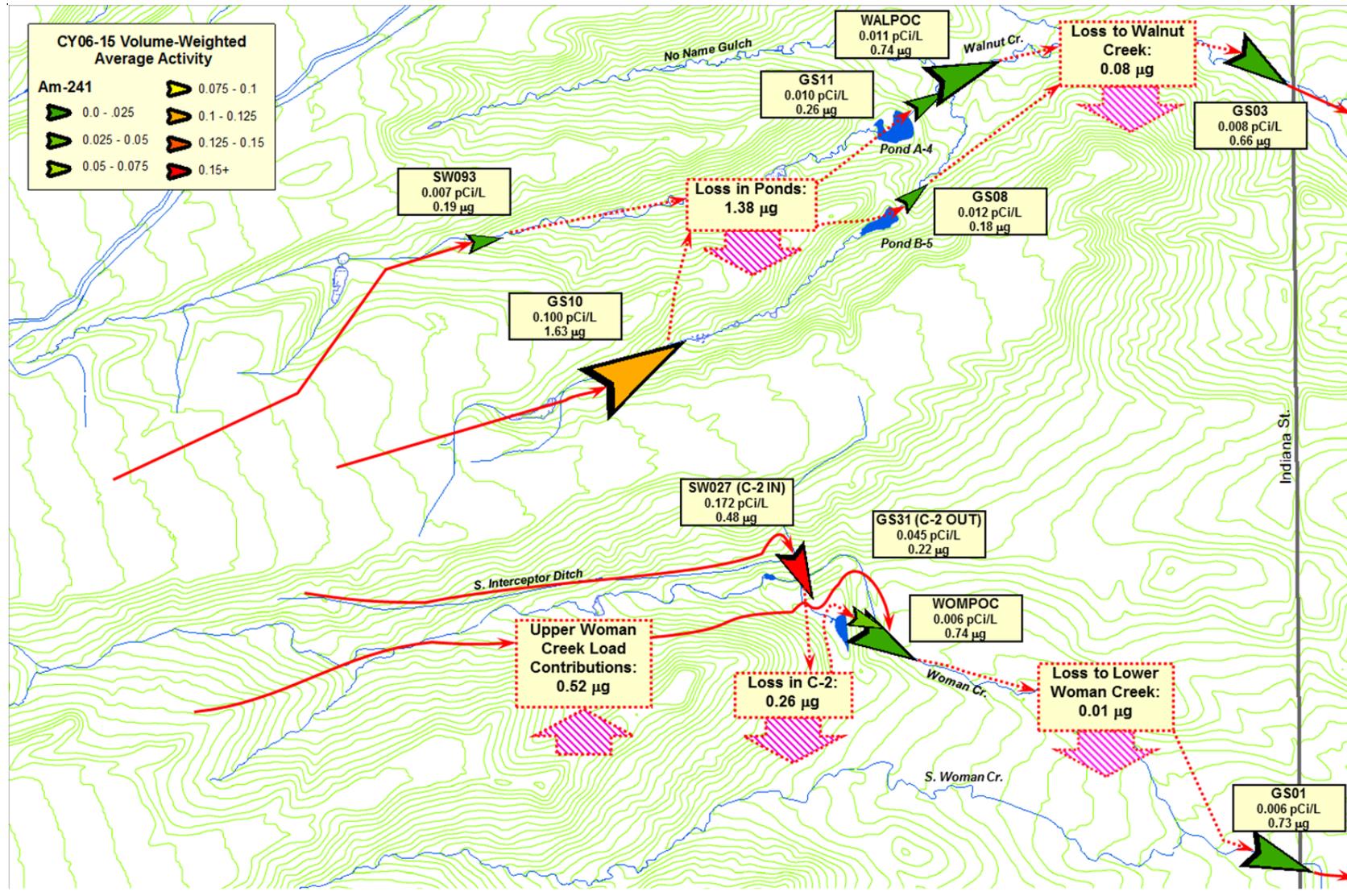
Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend. Monitoring at WALPOC began in September 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 131. Relative Average Annual Pu Loading Schematic: CY 2006–2015



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend.

Figure 132. Relative Average Annual Am Loading Schematic: CY 1997–2005



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend. Monitoring at WALPOC began in September 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

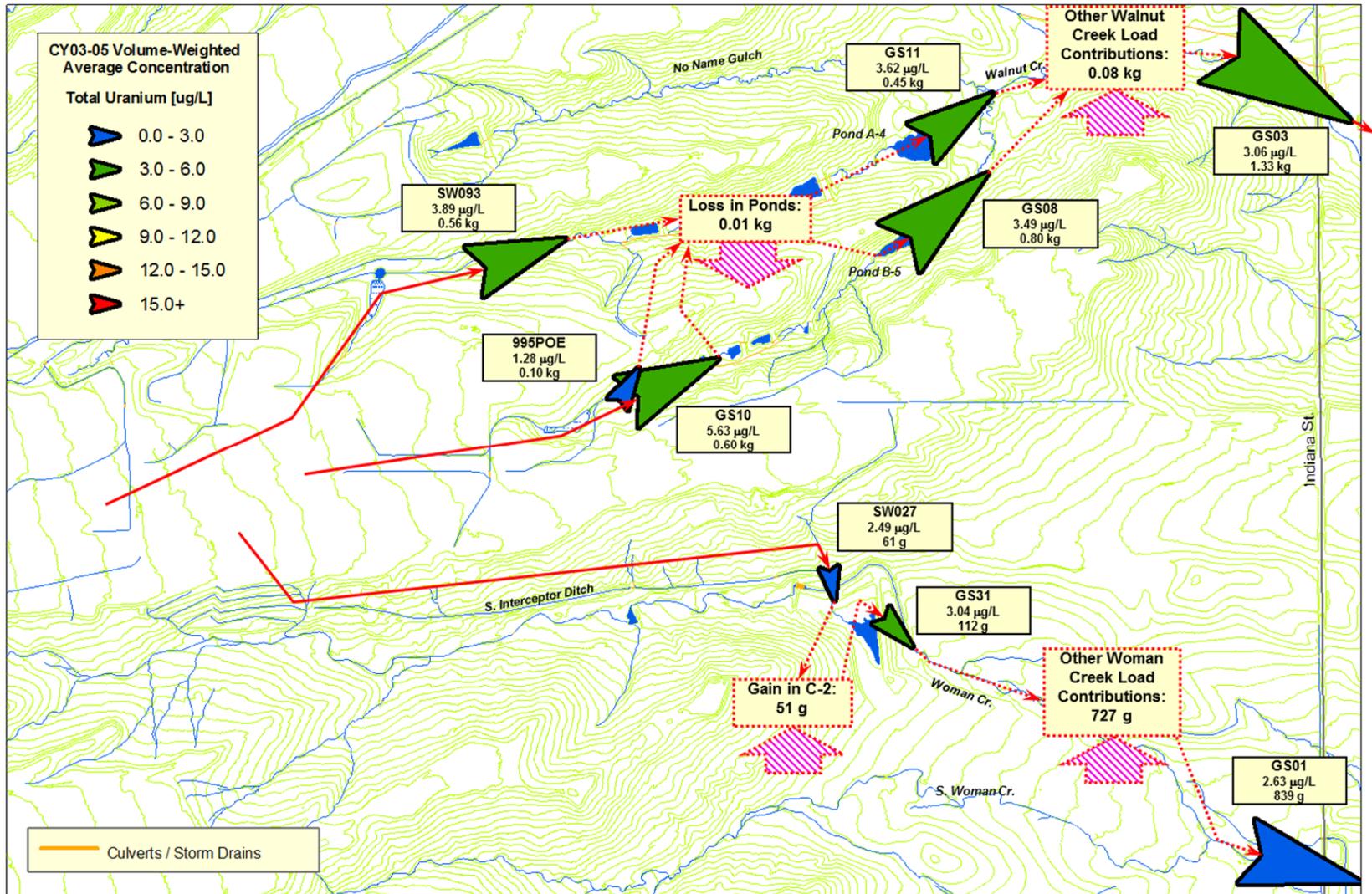
Figure 133. Relative Average Annual Am Loading Schematic: CY 2006–2015

- Figure 134 and Figure 135 show a measurable increase, from pre-closure to post-closure, in average annual total U concentrations at all sampling locations in Walnut Creek. The individual increases ranged from a 66 percent increase at SW093 to a 156 percent increase at both GS08 and GS10. This increase is primarily due to the reduction of runoff in streamflow and the corresponding proportional increase of groundwater seepage with relatively high concentrations of naturally occurring U. This concentration variability may also be a result of the intermittent mobilization or sequestration of U from stream sediments as those sediments naturally transition from reducing to oxidizing conditions, and vice versa.
- For locations SW027 (influent to Pond C-2) and GS31 (effluent from Pond C-2), total U loads have decreased, while concentrations have increased. Again, with the removal of 400 Area contributions, load was reduced by eliminating the U associated with building footing drain contributions. Conversely, the elimination of relatively cleaner runoff water had the larger and opposite effect of reducing dilution of the remaining U load, and therefore increasing concentration.
- For lower Woman Creek (GS01), total U loads and concentrations have changed to a lesser extent (10 percent increase and 17 percent decrease, respectively). This is likely due to transport of naturally occurring U in the much larger flow volumes measured at GS01, a location not significantly affected by the former IA.

Walnut and Woman Creeks at Indiana Street

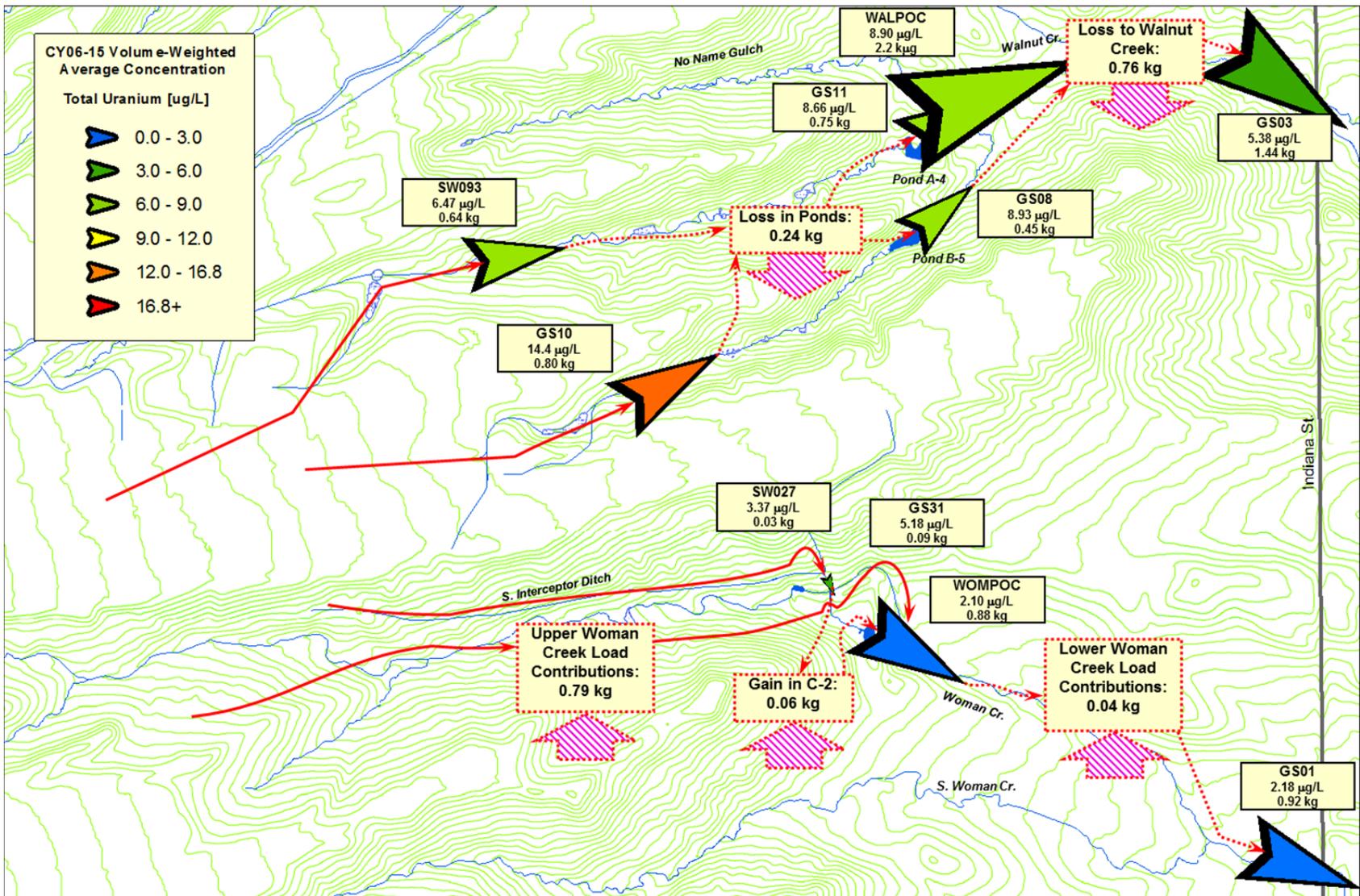
This section summarizes the calculated Pu, Am, and U loads from Walnut and Woman Creeks at Indiana Street. Total U data collection began at GS01 and GS03 just prior to CY 2003; therefore, only CY 2003–2015 data are shown for U. Figure 136, Figure 137, Figure 138, Figure 139, Figure 140, Figure 141, and Figure 142 illustrate the load data. Annual load data are tabulated for Am and Pu in micrograms in Table 54 and for U in kilograms (kg) in Table 55. The following points are noted:

- The higher 2007, 2010, 2013, and 2015 Pu and Am loads in Woman Creek at Indiana Street (Figure 137 and Figure 139) can be attributed primarily to high-flow volumes and, to a lesser extent, increases in activity. For example, 2015 flow volumes at GS01 are more than 5 times the average; however, 2015 Pu activity is less than 3 times the average. Post-closure average annual volume-weighted Pu and Am activities at GS01 are 0.006 and 0.005 pCi/L, respectively, well below the water-quality standard of 0.15 pCi/L.
- Similarly, the higher 2010, 2013, and 2015 Pu and Am loads in Walnut Creek at Indiana Street (Figure 137 and Figure 139) can also be attributed primarily to high-flow volumes and, to a lesser extent, increases in activity. For example, 2015 flow volumes at GS03 are more than 3 times the average; however, 2015 Pu activity is only 1.5 times the average. Post-closure average annual volume-weighted Pu and Am activities at GS03 are 0.008 and 0.005 pCi/L, respectively, well below the water-quality standard of 0.15 pCi/L.
- Figure 138 and Figure 140 show a significant post-closure reduction in both Pu and Am loads in Walnut Creek at Indiana Street (50 percent and 53 percent, respectively).



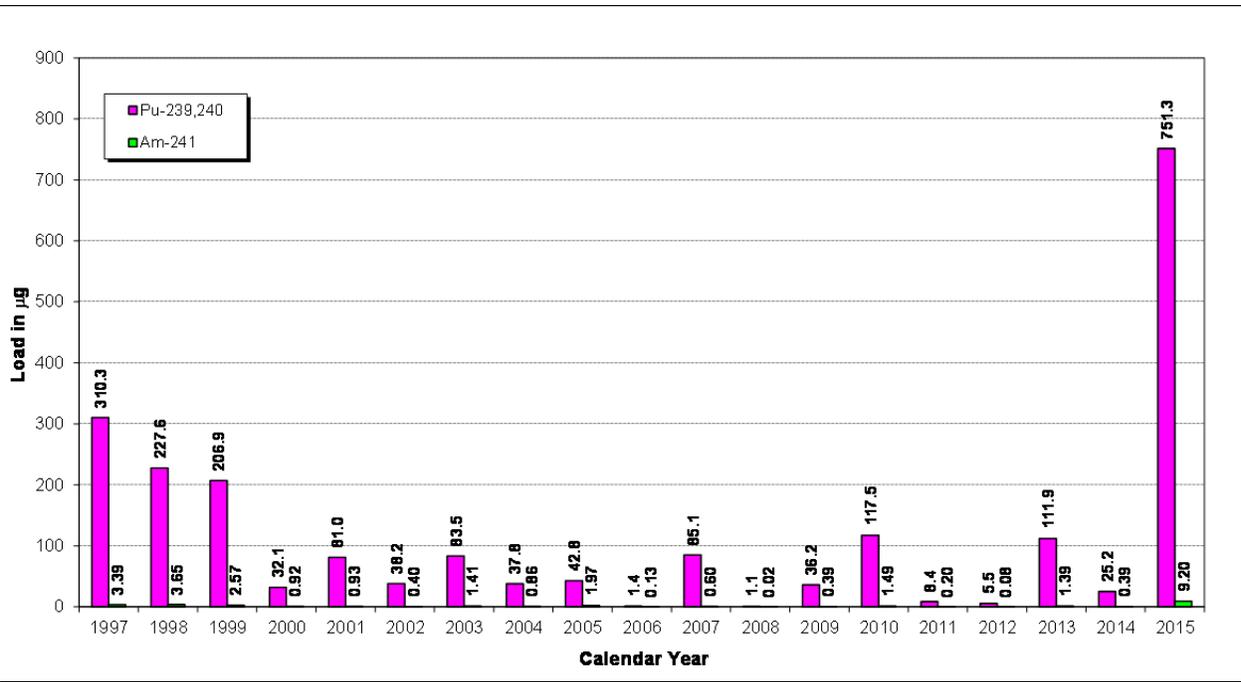
Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend.

Figure 134. Relative Average Annual Total U Loading Schematic: CY 2003–2005



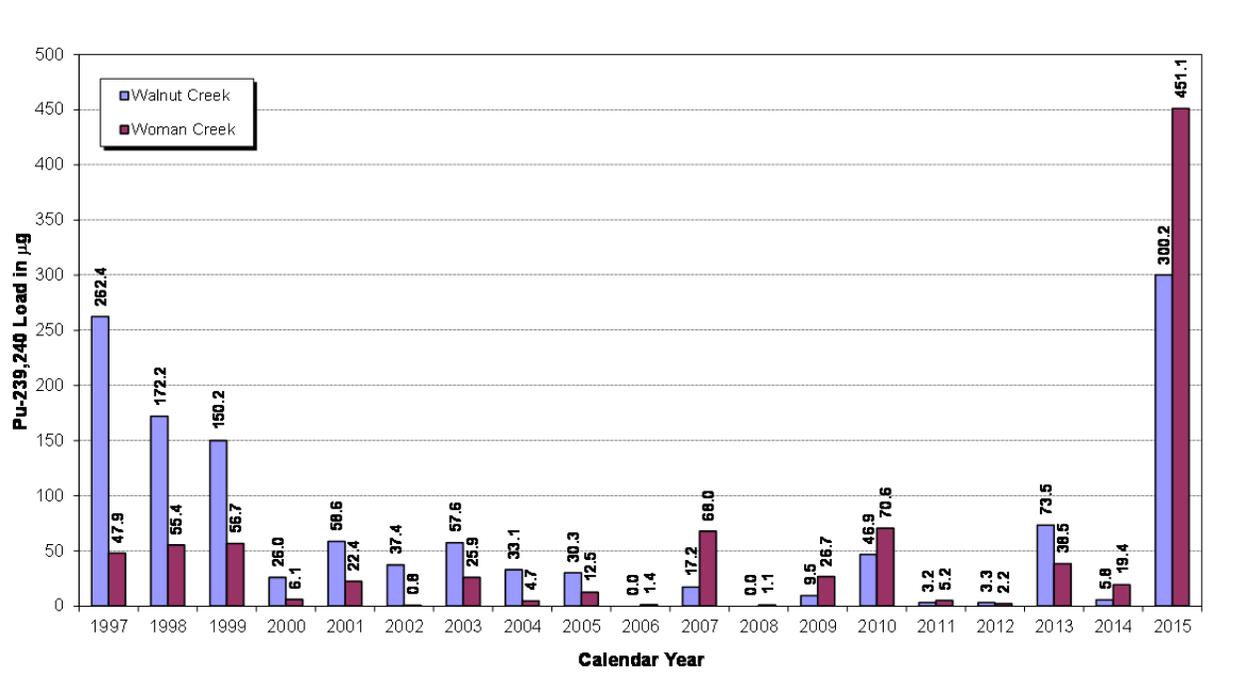
Notes: Location symbols are sized proportional to the calculated average annual load and colored according to the activity ranges in the legend. Monitoring at WALPOC began in September 2011. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 135. Relative Average Annual Total U Loading Schematic: CY 2006–2015



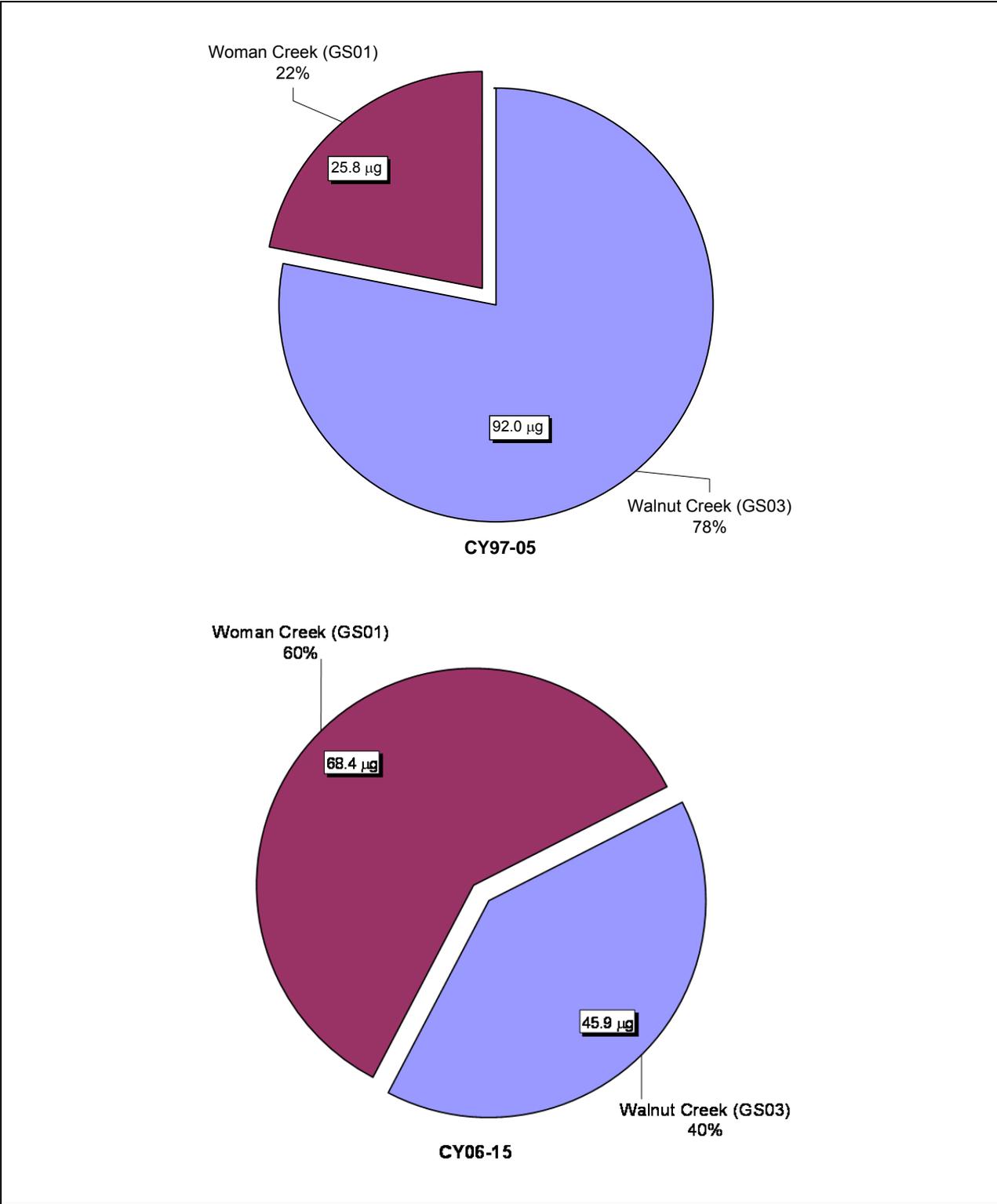
Notes: Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 136. Combined Annual Pu and Am Loads from Walnut and Woman Creeks at Indiana Street: CY 1997–2015



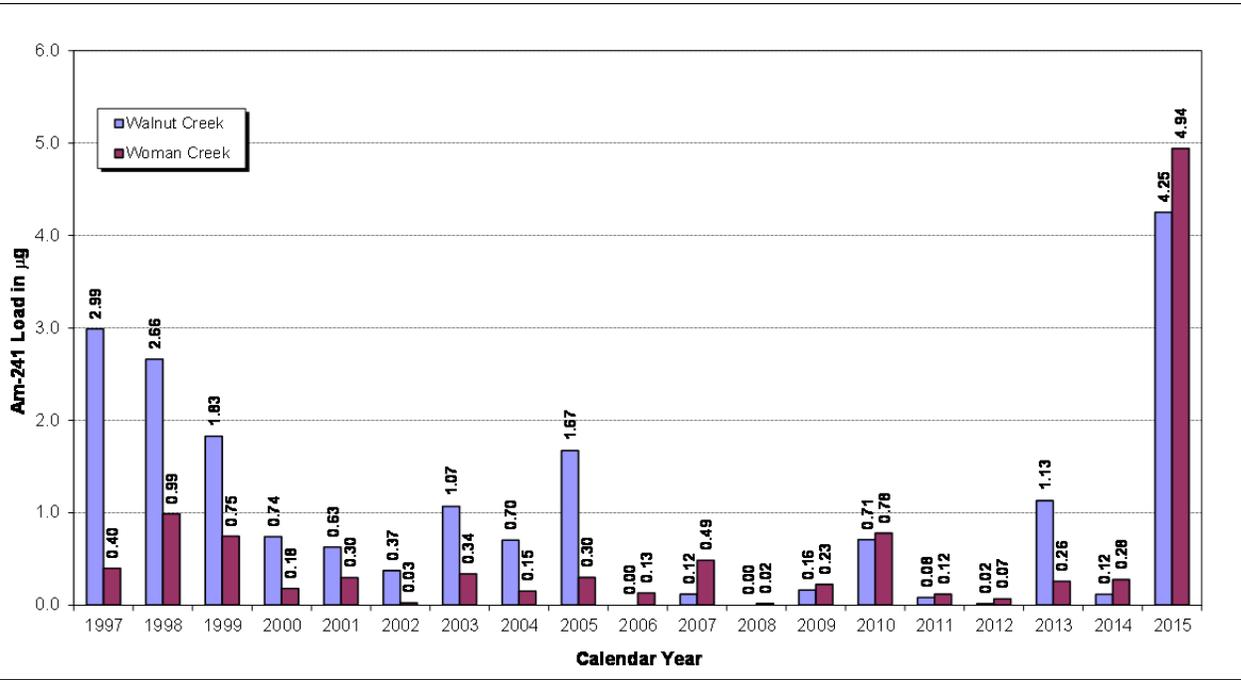
Notes: Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 137. Annual Pu Loads from Walnut and Woman Creeks at Indiana Street: CY 1997–2015



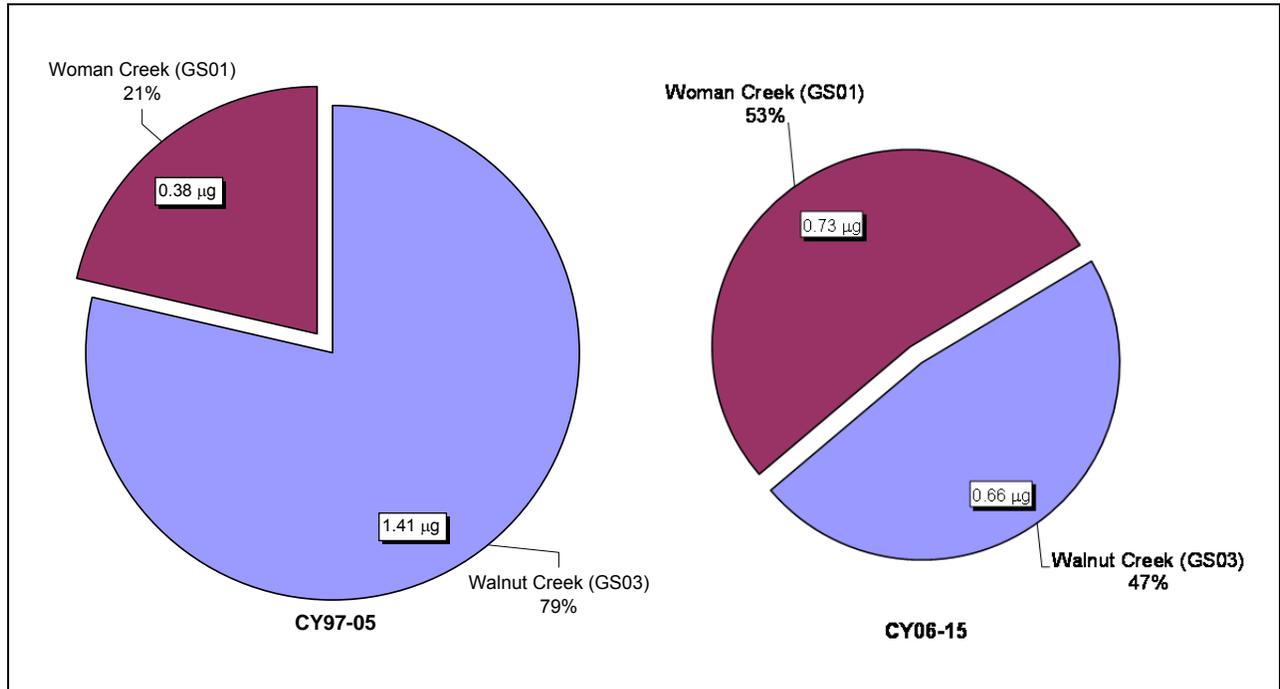
Notes: Pie chart diameters are relative to total load.
 Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 138. Relative Average Annual Pu Load Totals from Walnut and Woman Creeks at Indiana Street



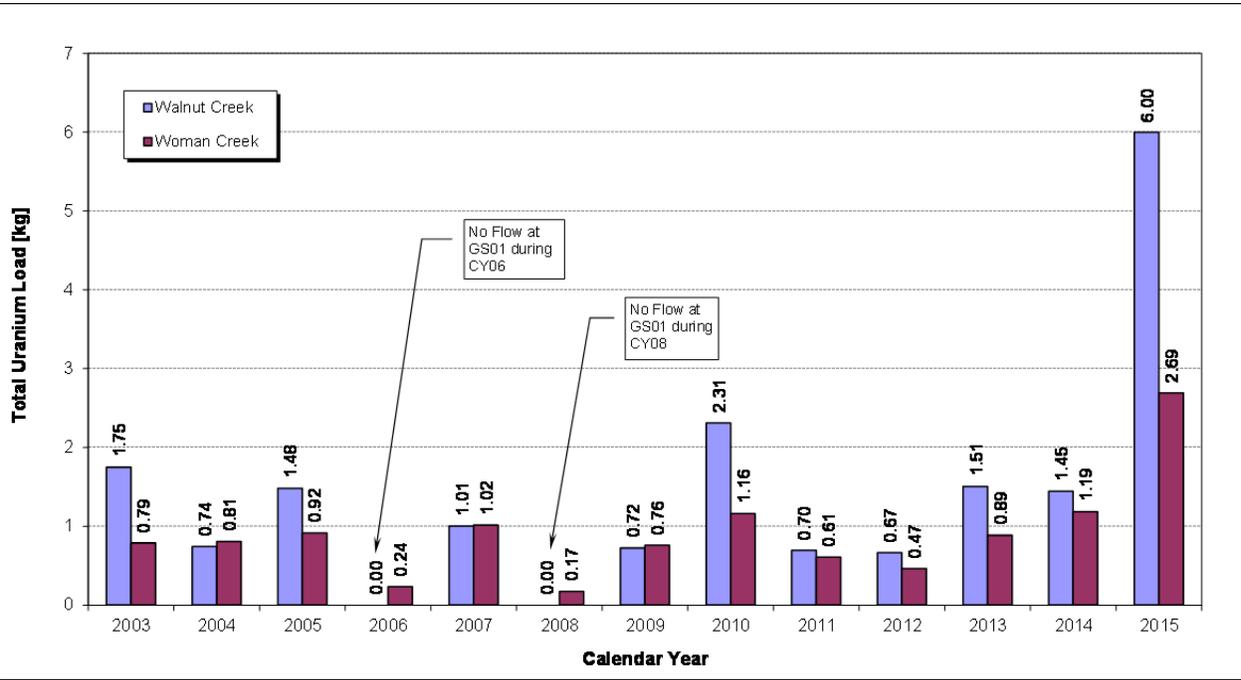
Notes: Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 139. Annual Am Loads from Walnut and Woman Creeks at Indiana Street: CY 1997–2015



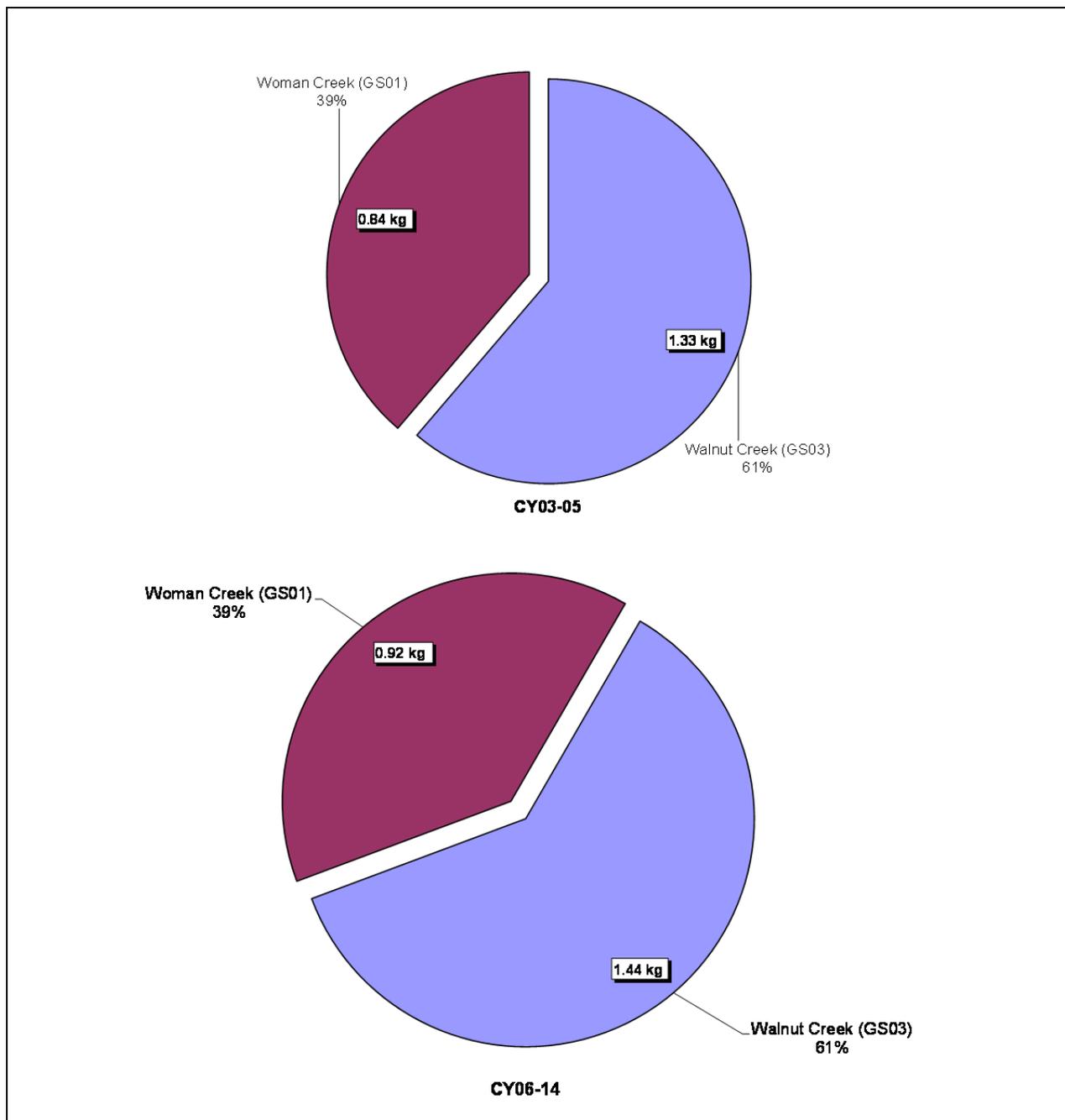
Notes: Pie chart diameters are relative to total load. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 140. Relative Average Annual Am Load Totals from Walnut and Woman Creeks at Indiana Street



Notes: Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 141. Annual Total U Loads from Walnut and Woman Creeks at Indiana Street: CY 2003–2015



Notes: Pie chart diameters are relative to total load.
Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Figure 142. Relative Average Annual Total U Load Totals from Walnut and Woman Creeks at Indiana Street

- Walnut Creek accounts for nearly 80 percent of both the Pu (Figure 138) and Am (Figure 140) loads at Indiana Street pre-closure. However, post-closure Walnut Creek accounts for only 40 percent of the Pu and 47 percent of the Am load at Indiana Street. This is the result of wet year load increases in Woman Creek coupled with the reduction in runoff and transport in Walnut Creek due to the effectiveness of remedial actions, revegetation, and erosion control measures.

- Walnut Creek accounts for 61 percent of both the pre-closure and post-closure U loads at Indiana Street (Figure 142). Although U concentration has increased in Walnut Creek post-closure, reduced flow volumes have resulted in comparable average annual loads.

Table 54. Pu and Am Loads from Walnut and Woman Creeks at Indiana Street: CY 1997–2015

Calendar Year	Pu-239,240 (µg)			Am-241 (µg)		
	Walnut Creek (GS03)	Woman Creek (GS01)	Total	Walnut Creek (GS03)	Woman Creek (GS01)	Total
1997	262.4	47.9	310.3	2.99	0.40	3.39
1998	172.2	55.4	227.6	2.66	0.99	3.65
1999	150.2	56.7	206.9	1.83	0.75	2.57
2000	26.0	6.1	32.1	0.74	0.18	0.92
2001	58.6	22.4	81.0	0.63	0.30	0.93
2002	37.4	0.8	38.2	0.37	0.03	0.40
2003	57.6	25.9	83.5	1.07	0.34	1.41
2004	33.1	4.7	37.8	0.70	0.15	0.86
2005	30.3	12.5	42.8	1.67	0.30	1.97
2006	0.0; No Flow	1.4	1.4	0.00; No Flow	0.13	0.13
2007	17.2	68.0	85.1	0.12	0.49	0.60
2008	0.0; No Flow	1.1	1.1	0.00; No Flow	0.02	0.02
2009	9.5	26.7	36.2	0.16	0.23	0.39
2010	46.9	70.6	117.5	0.71	0.78	1.49
2011	3.2	5.2	8.4	0.08	0.12	0.20
2012	3.3	2.2	5.5	0.02	0.07	0.08
2013	73.5	38.5	111.9	1.13	0.26	1.39
2014	5.8	19.4	25.2	0.12	0.28	0.39
2015	300.2	451.1	751.3	4.25	4.94	9.20
Total	1,287	917	2,204	19.3	10.7	30.0

Notes: During CY 1997 (through September 30, 1997), flows from Woman Creek were routinely diverted to Mower Ditch for subsequent monitoring at GS02 (discontinued location). Therefore, the load calculated for Woman Creek at Indiana Street (GS01) includes the water that was measured at GS02. The estimated load diverted to GS02 is calculated by multiplying the CY 1997 volume-weighted activities at GS01 by the streamflow volume measured at GS02, and converting for units. This diverted load is then added to the calculated load at GS01 to obtain the total CY 1997 load at GS01. For subsequent water years, the Mower diversion structure was upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch. Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

Table 55. Total U Loads from Walnut and Woman Creeks at Indiana Street: CY 2003–2015

Calendar Year	Total U (kg)		
	Walnut Creek (GS03)	Woman Creek (GS01)	Total
2003	1.75	0.79	2.54
2004	0.74	0.81	1.55
2005	1.48	0.92	2.40
2006	0; No flow	0.24	0.24
2007	1.01	1.02	2.02
2008	0; No flow	0.17	0.17
2009	0.72	0.76	1.49
2010	2.31	1.16	3.47
2011	0.70	0.61	1.31
2012	0.67	0.47	1.13
2013	1.51	0.89	2.39
2014	1.45	1.19	2.63
2015	6.00	2.69	8.69
Total	18.3	11.7	30.0

Notes: Monitoring at GS01 and GS03 was discontinued on October 1, 2015.

COU Boundary POCs (Site POCs)

This section summarizes the calculated Pu, Am, and U loads from Walnut and Woman Creeks at the eastern COU boundary. POCs WALPOC and WOMPOC began operating in September 2011. Figure 143, Figure 144, Figure 145, and Figure 146, as well as Table 56 and Table 57 present the load data. POCs WALPOC and WOMPOC show both loads and activities/concentrations that follow similar patterns and are comparable to the downstream locations at Indiana Street (GS03 and GS01; see the next two sections).

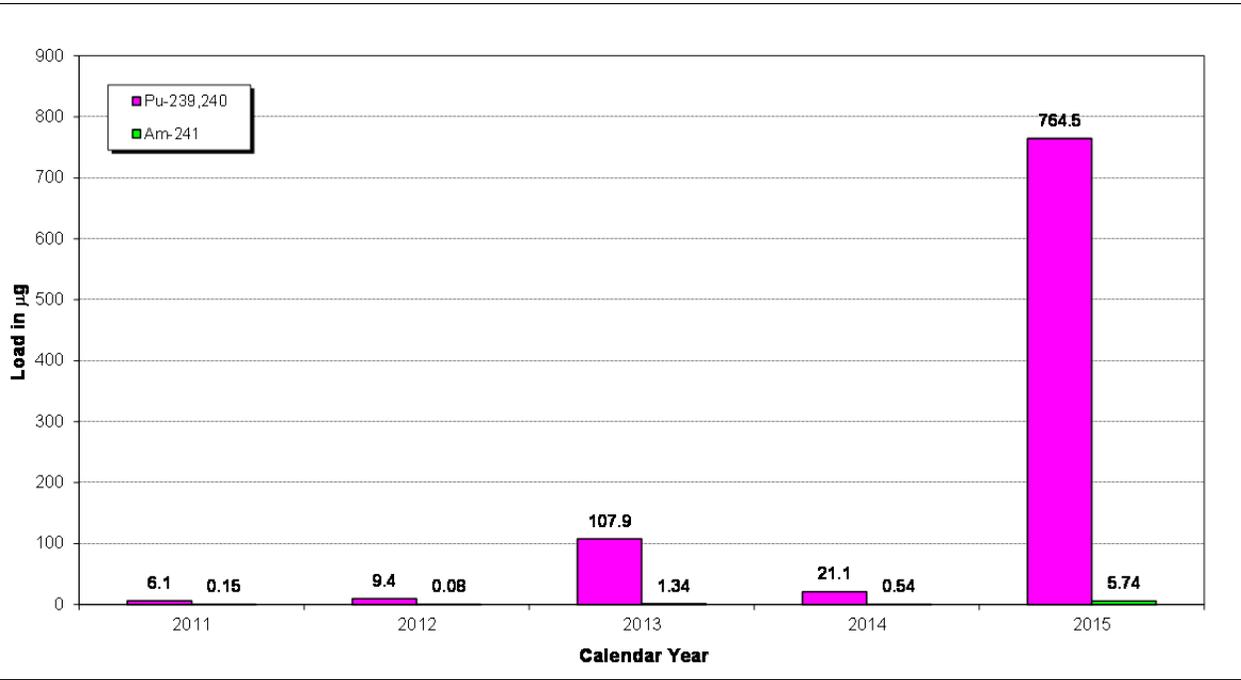


Figure 143. Combined Annual Pu and Am Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

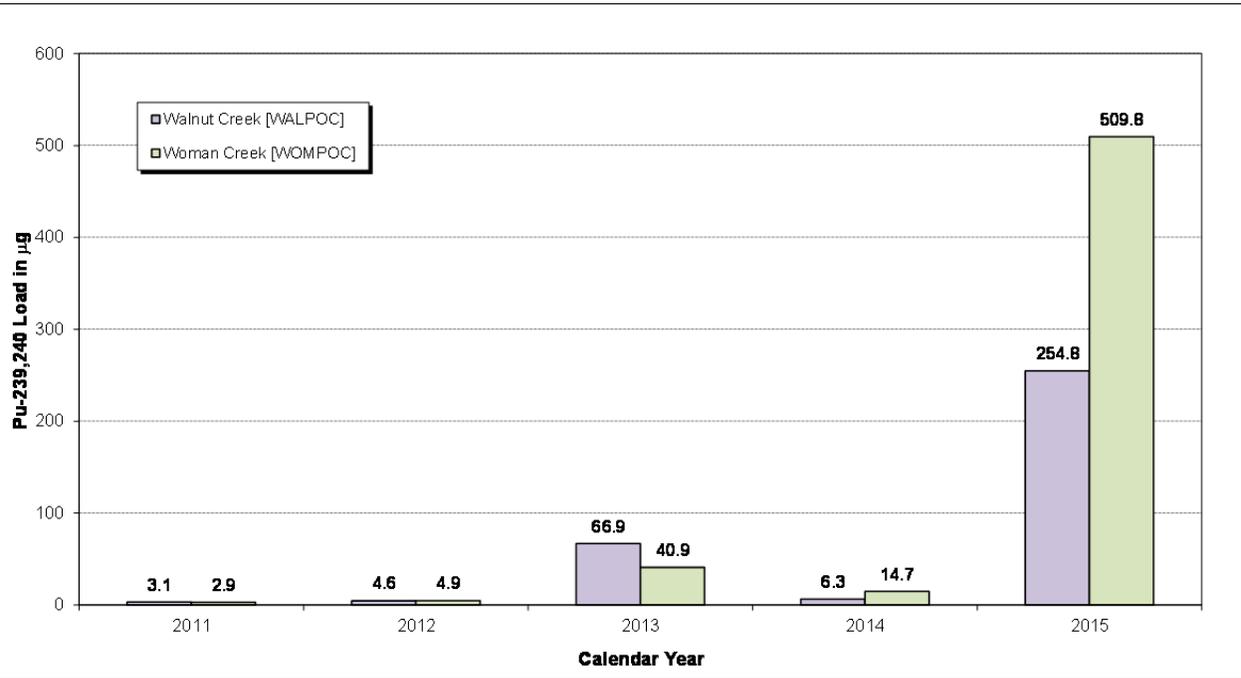


Figure 144. Annual Pu Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

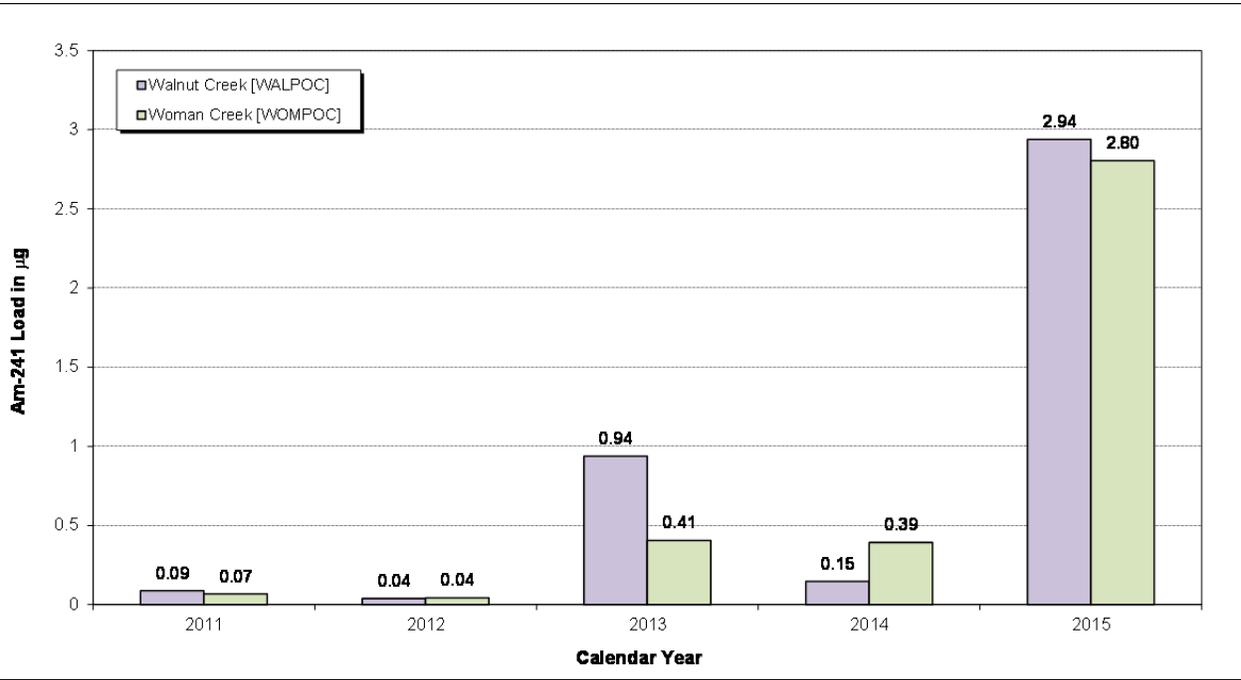


Figure 145. Annual Am Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

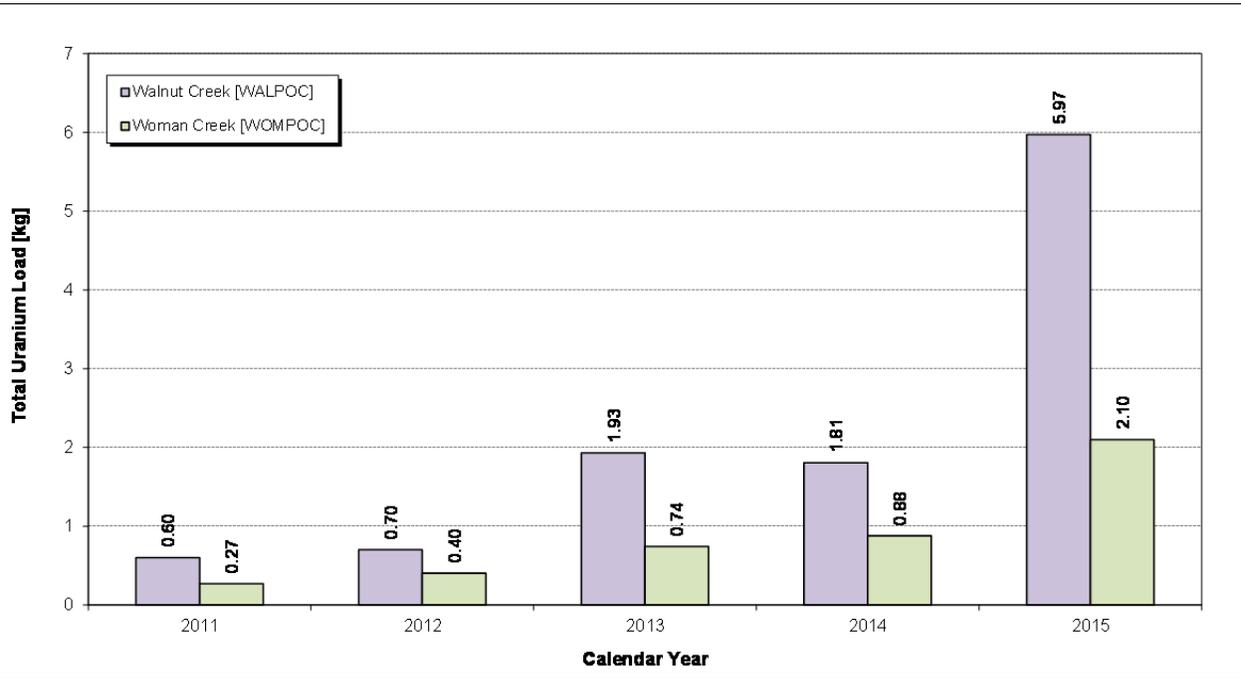


Figure 146. Annual Total U Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

Table 56. Offsite Pu and Am Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

Calendar Year	Pu-239,240 (µg)			Am-241 (µg)		
	Walnut Creek (WALPOC)	Woman Creek (WOMPOC)	Total	Walnut Creek (WALPOC)	Woman Creek (WOMPOC)	Total
2011	3.1 ^a	2.9 ^a	6.1	0.09 ^a	0.07 ^a	0.15
2012	4.6	4.9	9.4	0.04	0.04	0.08
2013	66.9	40.9	107.9	0.94	0.41	1.34
2014	6.3	14.7	21.1	0.15	0.39	0.54
2015	254.8	509.8	764.5	2.94	2.80	5.74
Total	336	573	909	4.15	3.71	7.86

Notes:

^a Partial data

Table 57. Total U Loads from Walnut and Woman Creeks at Eastern COU Boundary: CY 2011–2015

Calendar Year	Total U (kg)		
	Walnut Creek (WALPOC)	Woman Creek (WOMPOC)	Total
2011	0.60 ^a	0.27 ^a	0.87 ^a
2012	0.70	0.40	1.11
2013	1.93	0.74	2.68
2014	1.81	0.88	2.69
2015	5.97	2.10	8.07
Total	11.0	4.40	15.4

Notes:

^a Partial data

Lower Walnut Creek

This section summarizes the calculated Pu, Am, and U loads in Walnut Creek at GS03 (Walnut Creek at Indiana Street), WALPOC (Walnut Creek at the eastern COU boundary), GS08 (Pond B-5 outlet), and GS11 (Pond A-4 outlet). Because WALPOC began operating on September 9, 2011, it is only included in selected tables and figures at this time. The data are presented in Table 58, Table 59, and Table 60 and are depicted on Figure 147 through Figure 156. Total U data collection at GS03 began on November 5, 2002; thus, only CY 2003–2015 data are shown. The following points are noted:

- Annual Pu and Am loads can vary by up to two orders of magnitude year to year (Figure 147). Pre-closure, the significant annual variability in Pu and Am loads is due mostly to variation in measured Pu and Am activities. Post-closure, load variation is due to large runoff variation, and not due to significant variation in measured activities.
- Combined post-closure Pu and Am loads from Ponds A-4 and B-5 have been reduced 63 percent and 65 percent, respectively (Figure 150 and Figure 153).

- Pre-closure Pu and Am loads from Pond B-5 are significantly greater than loads from Pond A-4 (Table 58 and Table 59), a result of both higher activities and larger discharge volumes.²⁰ However, post-closure loads from Pond A-4 are generally greater than from Pond B-5, primarily due to larger flow volumes, and not due to higher activities.

Table 58. Pu Loads at GS03, GS08, GS11, and WALPOC: CY 1997–2015

Calendar Year	Pu-239,240 (µg)				
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC WALPOC	Walnut Creek (GS03)
1997	59.2	8.8	68.0	NA	262.4
1998	20.0	22.4	42.4	NA	172.2
1999	23.8	261.4	285.2	NA	150.2
2000	28.4	244.6	273.0	NA	26.0
2001	4.7	32.3	37.0	NA	58.6
2002	0.1	7.8	7.9	NA	37.4
2003	7.3	111.5	118.8	NA	57.6
2004	2.2	27.1	29.3	NA	33.1
2005	2.2	17.9	20.1	NA	30.3
2006	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0	NA	0.0 No flow
2007	7.8	1.9	9.6	NA	17.2
2008	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0	NA	0.0 No flow
2009	2.3	3.0	5.3	NA	9.5
2010	6.4	5.4	11.9	NA	46.9
2011	1.0	1.8	2.8	3.1 ^a	3.2
2012	2.1	1.1	3.3	4.6	3.3
2013	37.3	6.3	43.6	67.0	73.5
2014	2.2	7.0	9.2	6.3	5.8
2015	157	117	274	255	300 ^a
Total	364	878	1,242	336^a	1,287^a

Notes: Monitoring at GS03 was discontinued on October 1, 2015.

^a Partial data

²⁰ Prior to closure, Pond B-5 received effluent from the Site WWTP and also received higher runoff from impervious surfaces (parking lots, buildings). After closure, with the WWTP and former IA removed, Pond A-4 receives more flow than Pond B-5.

Table 59. Am Loads at GS03, GS08, GS11, and WALPOC: CY 1997–2015

Calendar Year	Am-241 (µg)				
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC WALPOC	Walnut Creek (GS03)
1997	0.70	0.25	0.95	NA	2.99
1998	1.25	0.35	1.60	NA	2.66
1999	0.20	1.81	2.01	NA	1.83
2000	0.02	3.14	3.16	NA	0.74
2001	0.11	0.46	0.57	NA	0.63
2002	0.04	0.25	0.29	NA	0.37
2003	0.18	0.54	0.72	NA	1.07
2004	0.14	0.58	0.73	NA	0.70
2005	0.43	0.97	1.39	NA	1.67
2006	0.0 No A-4 discharge	0.0; No B-5 discharge	0.00	NA	0.0 No flow
2007	0.02	0.03	0.05	NA	0.12
2008	0.0 No A-4 discharge	0.0; No B-5 discharge	0.00	NA	0.0 No flow
2009	0.09	0.02	0.11	NA	0.16
2010	0.14	0.11	0.25	NA	0.71
2011	0.05	0.02	0.07	0.09 ^a	0.08
2012	0.06	0.01	0.07	0.04	0.02
2013	0.61	0.20	0.81	0.94	1.13
2014	0.05	0.10	0.15	0.15	0.12
2015	1.56	1.36	2.91	2.94	4.25 ^a
Total	5.65	10.2	15.9	4.15 ^a	19.3 ^a

Notes: Monitoring at GS03 was discontinued on October 1, 2015.

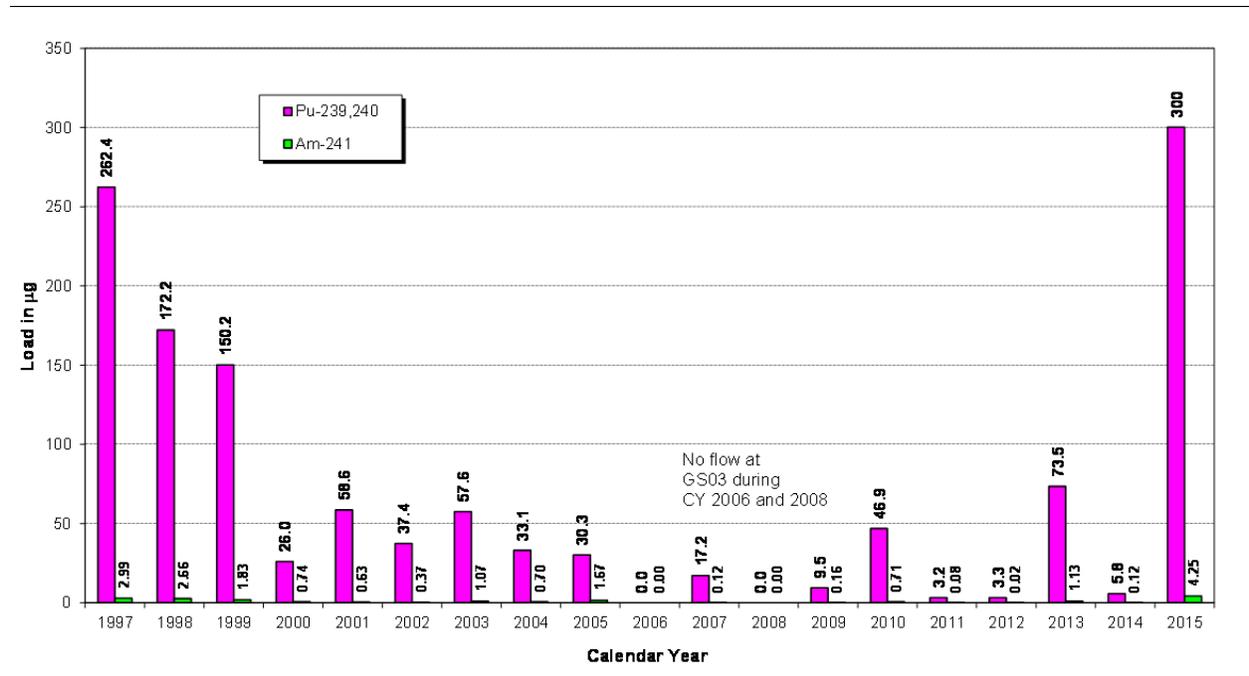
^a Partial data

Table 60. Total U Loads at GS03, GS08, GS11, and WALPOC: CY 2003–2015

Calendar Year	Total U (kg)				
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC WALPOC	Walnut Creek (GS03)
2003	0.86	0.61	1.47	NA	1.75
2004	0.32	0.39	0.71	NA	0.74
2005	0.16	1.39	1.55	NA	1.48
2006	0.0; No A-4 discharge	0.0; No B-5 discharge	0.00	NA	0.0 No flow
2007	0.41	0.48	0.89	NA	1.01
2008	0.0; No A-4 discharge	0.0; No B-5 discharge	0.00	NA	0.0 No flow
2009	0.41	0.32	0.73	NA	0.72
2010	1.20	0.75	1.95	NA	2.31
2011	0.43	0.31	0.75	0.60 ^a	0.70
2012	0.38	0.13	0.51	0.70	0.67
2013	0.97	0.41	1.38	1.93	1.51
2014	0.90	0.40	1.29	1.81	1.45
2015	2.79	1.72	4.51	5.97	6.00 ^a
Total	8.83	6.90	15.7	11.0^a	18.3^a

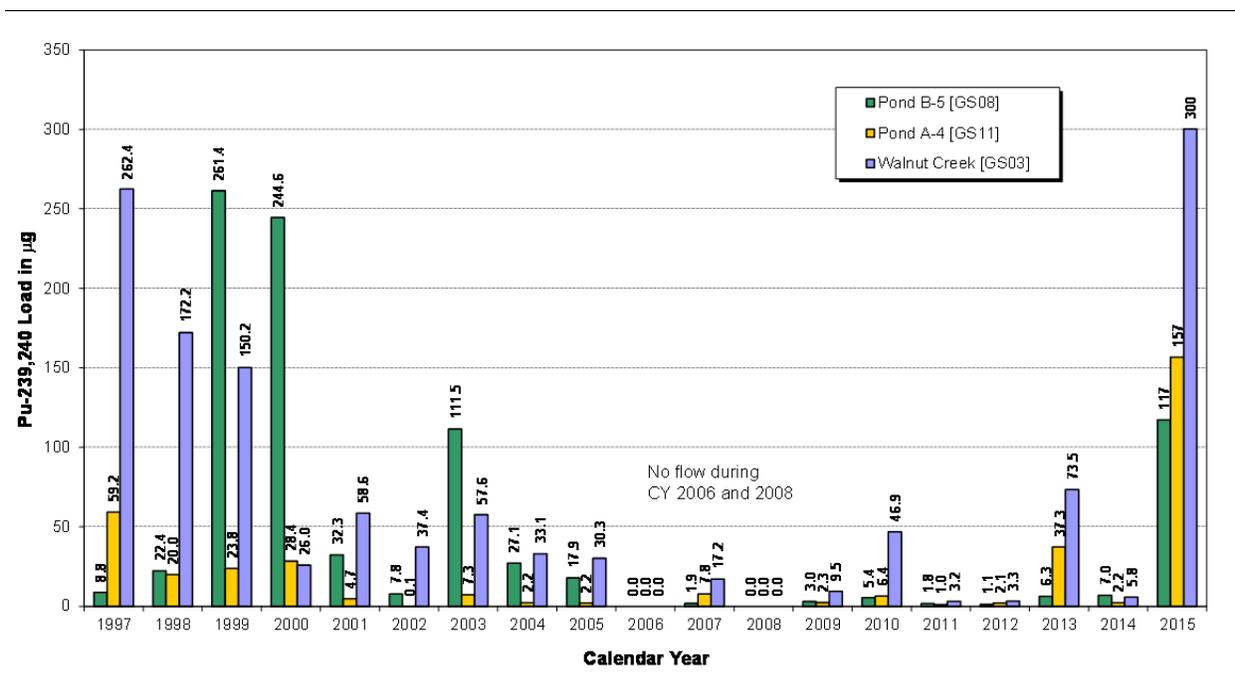
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

^a Partial data



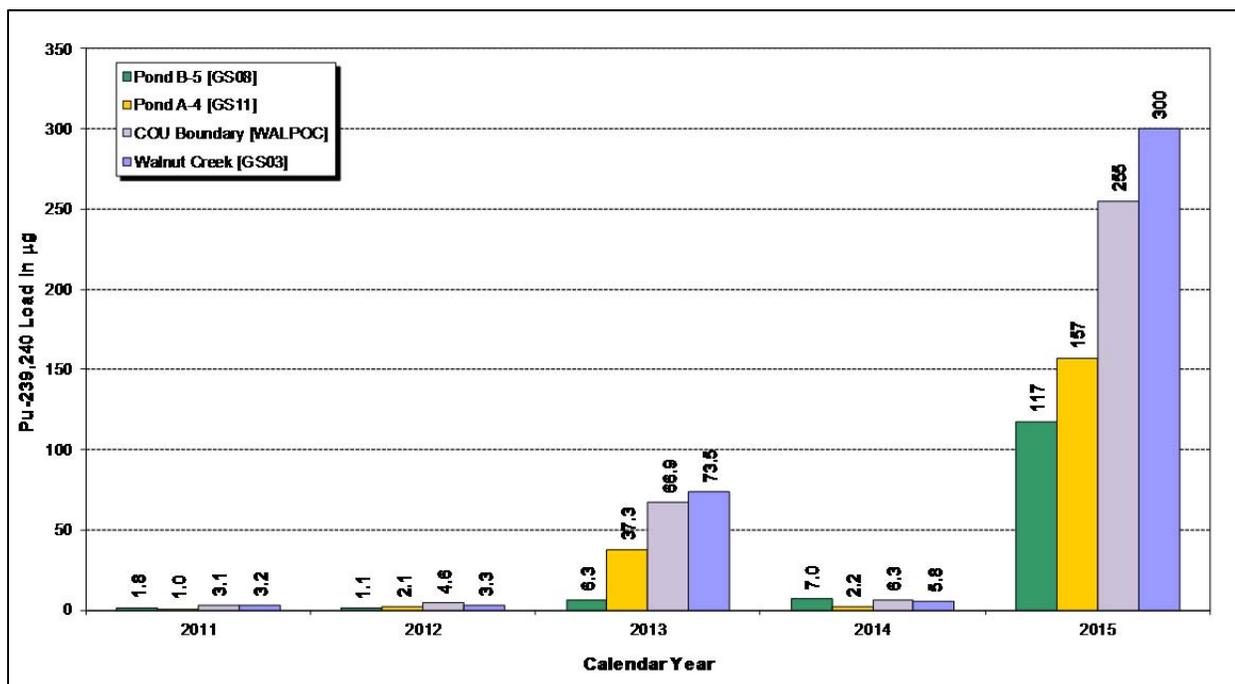
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 147. Annual Pu and Am Loads at GS03: CY 1997–2015



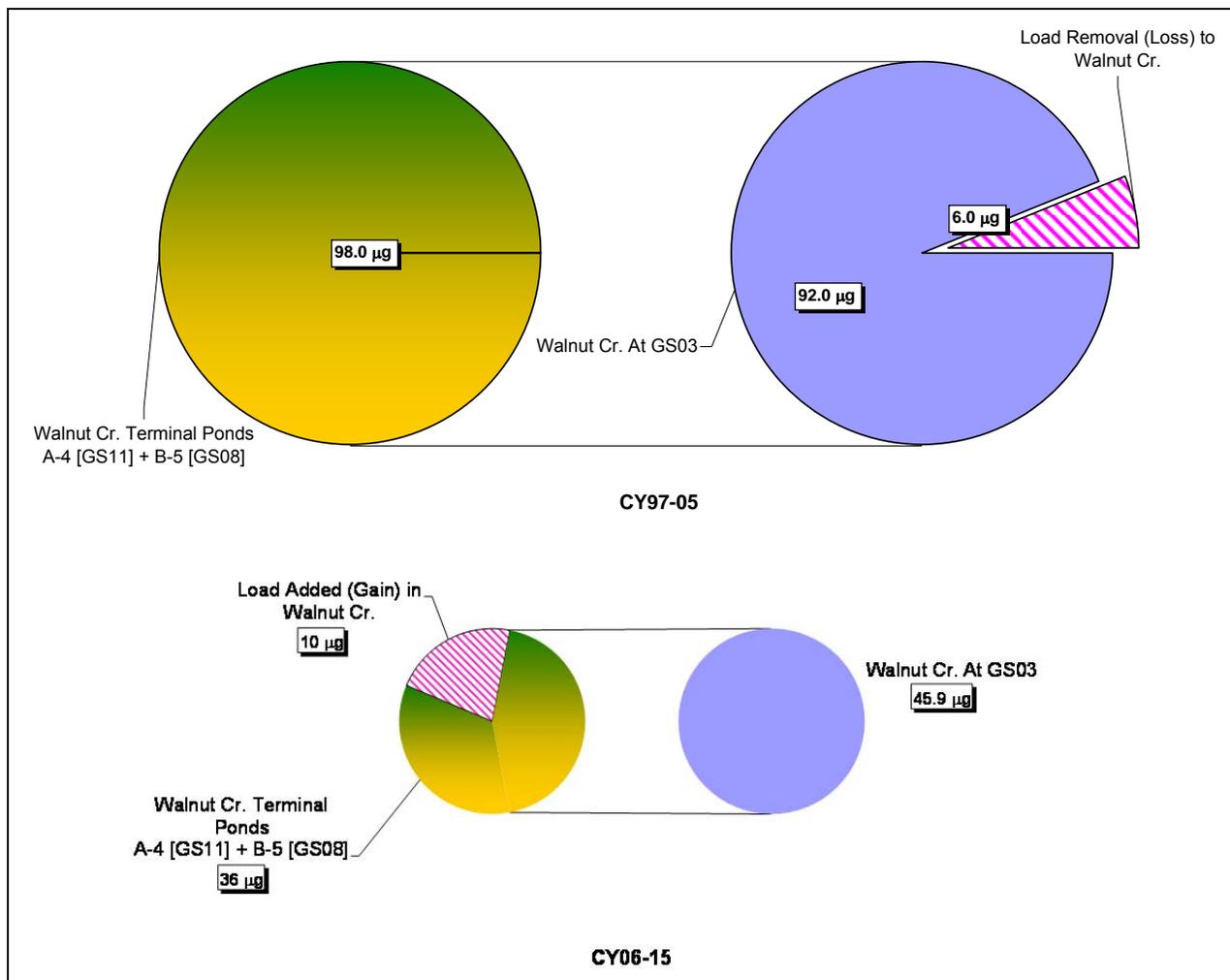
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 148. Annual Pu Loads at GS03, GS08, and GS11: CY 1997–2015



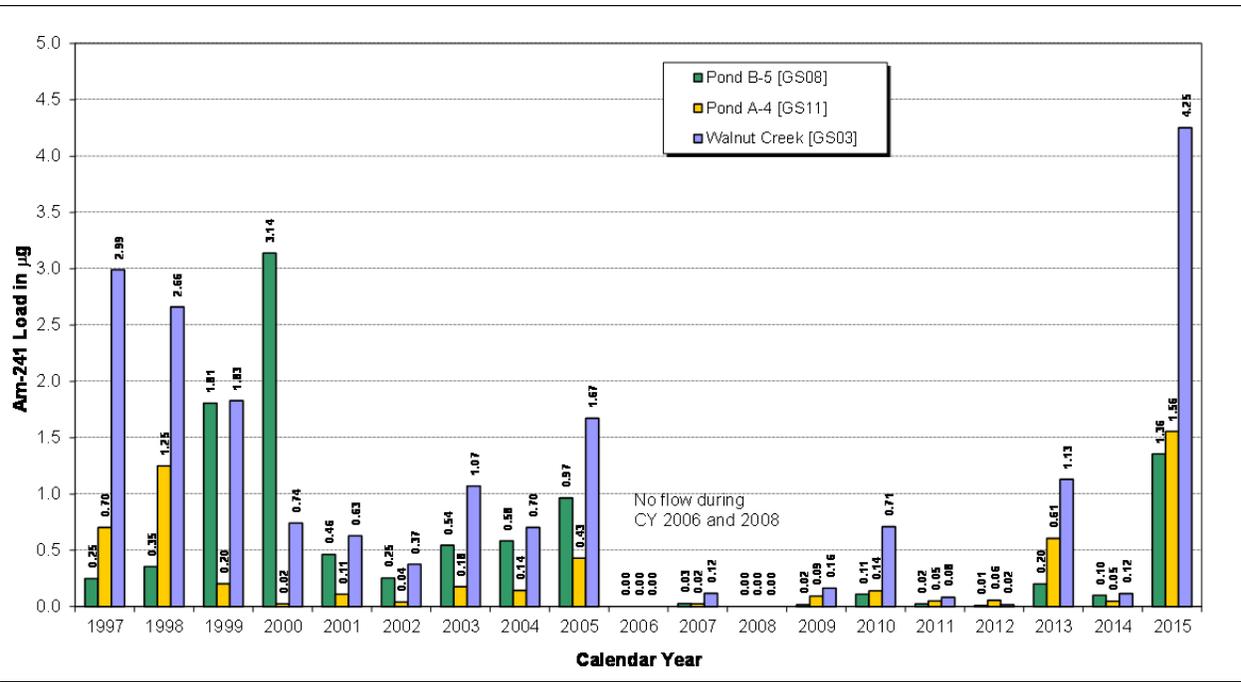
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 149. Annual Pu Loads at GS03, GS08, GS11, and WALPOC: CY 2011–2015



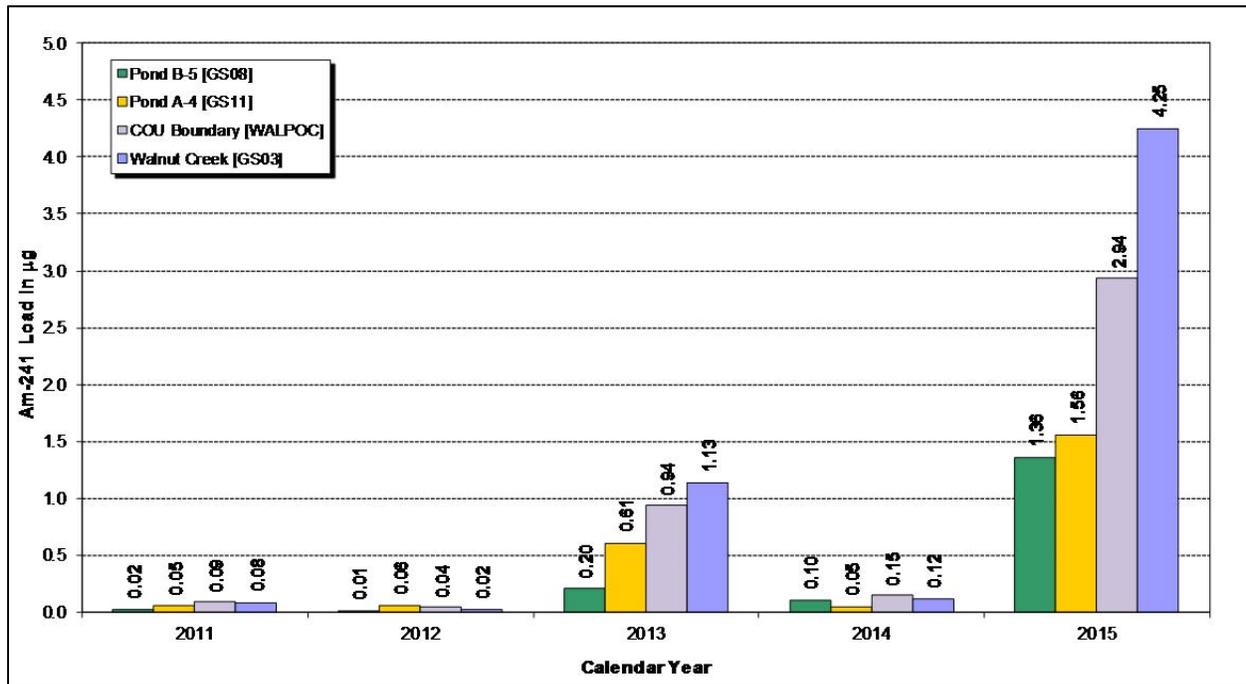
Notes: Pie chart diameters are relative to total load.
Monitoring at GS03 was discontinued on October 1, 2015.

Figure 150. Relative Average Annual Pu Load Totals at GS03, GS08, and GS11



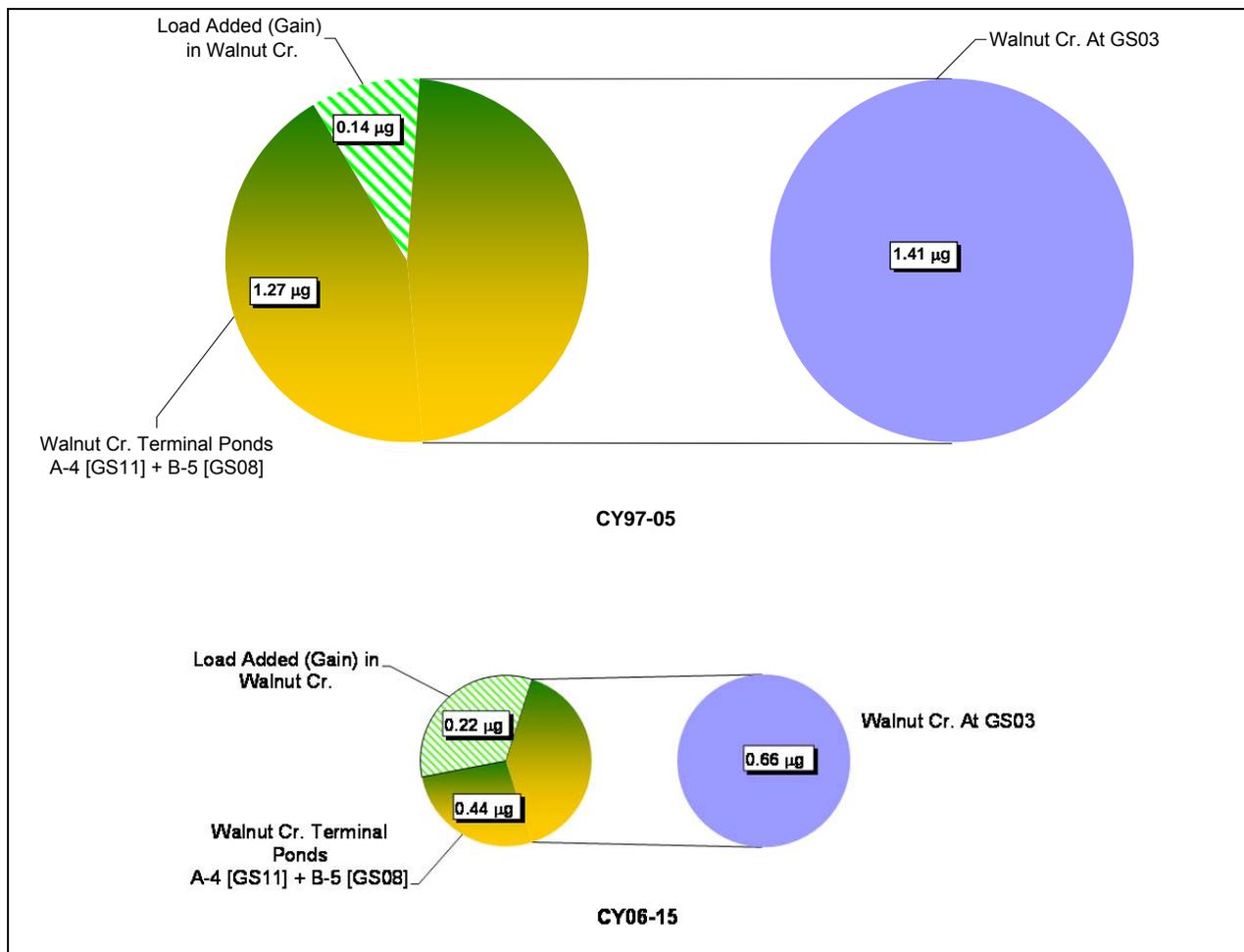
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 151. Annual Am Loads at GS03, GS08, and GS11: CY 1997–2015



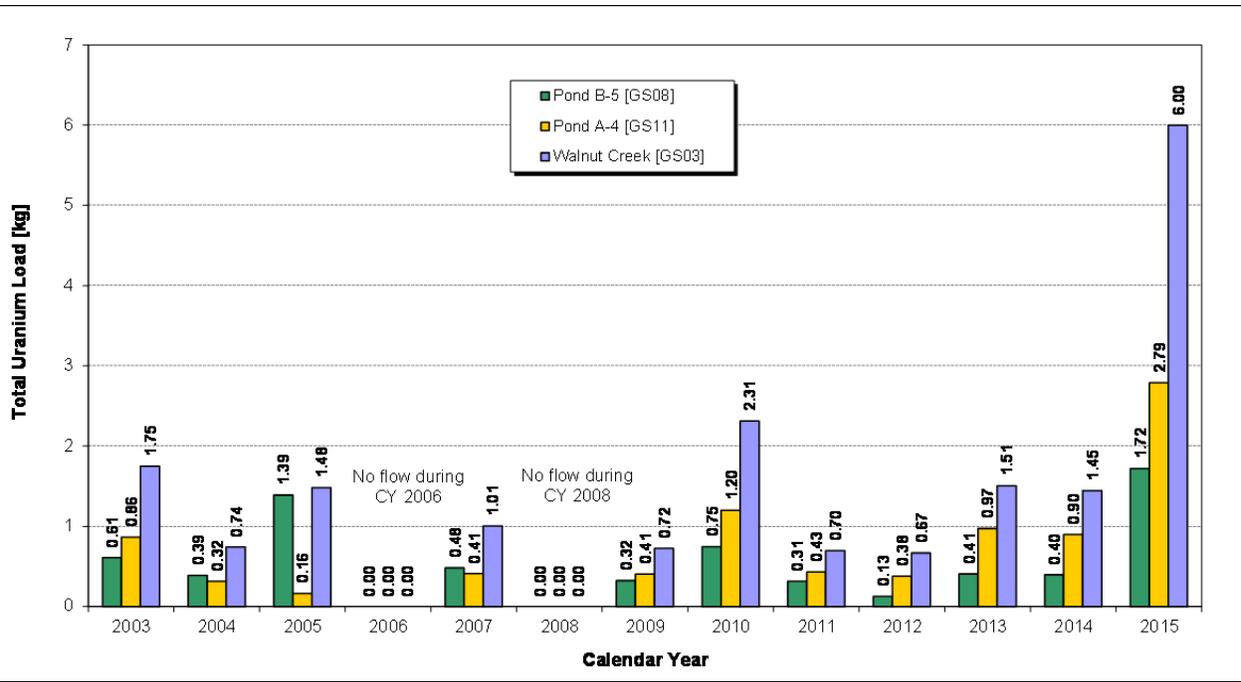
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 152. Annual Am Loads at GS03, GS08, GS11, and WALPOC: CY 2011–2015



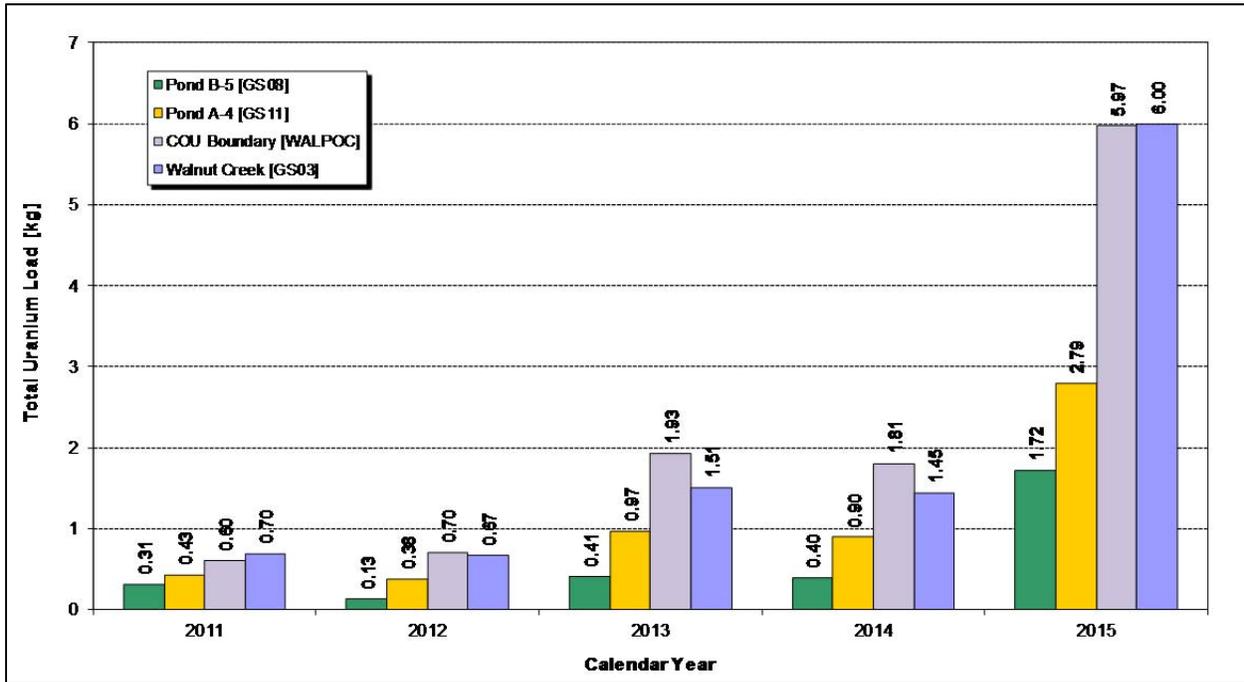
Notes: Pie chart diameters are relative to total load.
Monitoring at GS03 was discontinued on October 1, 2015.

Figure 153. Relative Average Annual Am Load Totals at GS03, GS08, and GS11



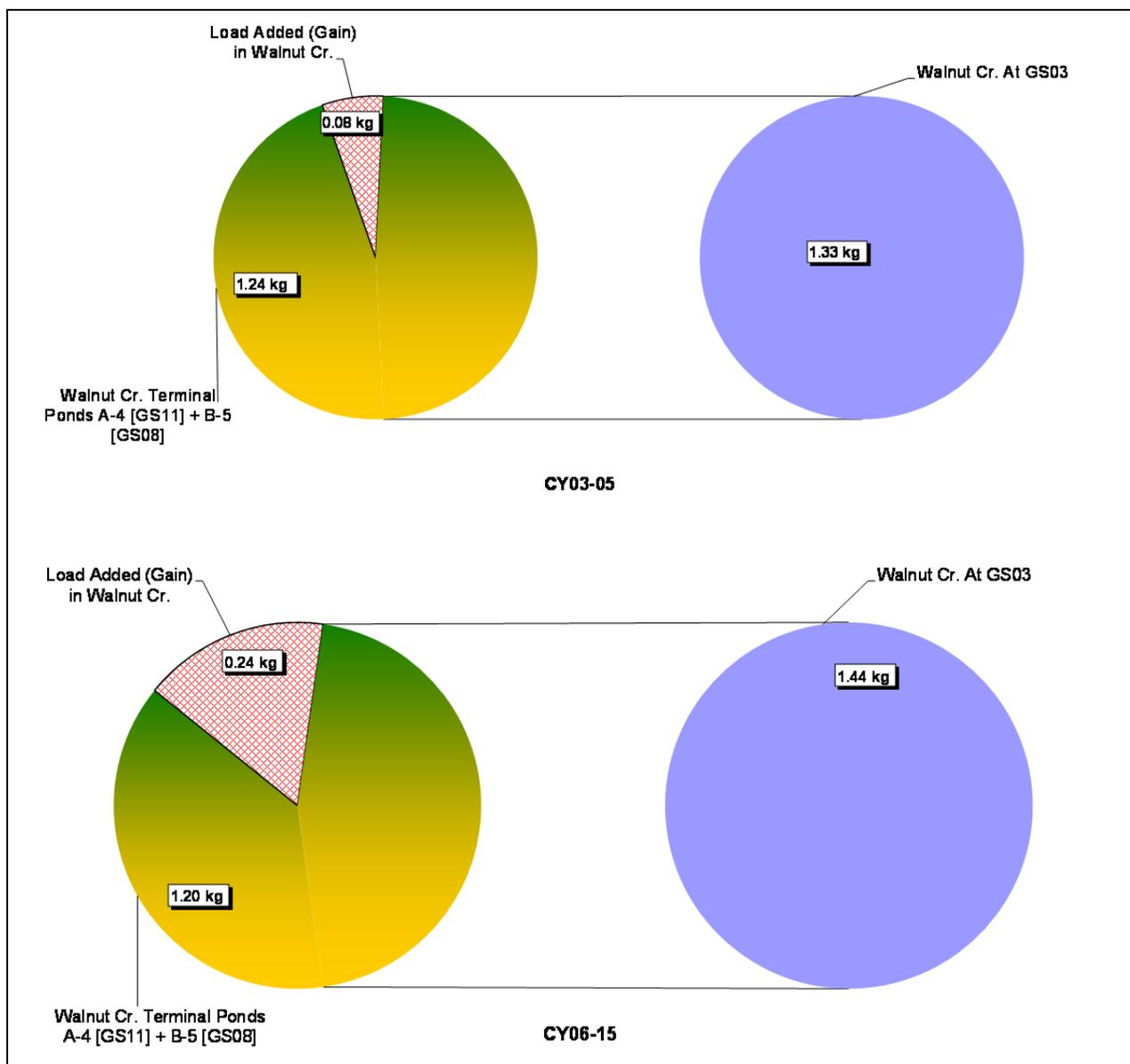
Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 154. Annual Total U Loads at GS03, GS08, and GS11: CY 2003–2015



Notes: Monitoring at GS03 was discontinued on October 1, 2015.

Figure 155. Annual Total U Loads at GS03, GS08, GS11, and WALPOC: CY 2011–2015



Notes: Pie chart diameters are relative to total load.
Monitoring at GS03 was discontinued on October 1, 2015.

Figure 156. Relative Average Annual Total U Load Totals at GS03, GS08, and GS11

Lower Woman Creek

This section summarizes the calculated Pu, Am, and U loads in Woman Creek at GS01 (Woman Creek at Indiana Street), WOMPOC (Woman Creek at the eastern COU boundary), and GS31 (Pond C-2 outlet). Since WOMPOC began operating on September 28, 2011, it is only included in selected tables and figures at this time. The data are presented in Table 61, Table 62, and Table 63, and depicted on Figure 157 through Figure 166. Total U data collection began at GS01 on February 3, 2003; therefore, only CY 2003–2014 data are shown. The following points are noted:

- Annual Pu and Am loads vary by up to two orders of magnitude year to year (Figure 158 and Figure 161). As described previously, this significant annual variability in Pu and Am loads is primarily due to large variation in stream discharge, and not due to large variation in Pu and Am activity.
- Total Pu and Am loads from Pond C-2 (Table 61, Figure 160, Table 62, and Figure 163), show a significant increase post-closure. Almost all of this increase can be attributed to the spring of 2015. Influent loads from the SID (location SW027) during 2015 were more than an order of magnitude higher than the post-closure average, while 2015 effluent loads were similarly elevated, and only approximately one-half the load was removed by the pond. It is important to note that Pu and Am activities at the downstream POC (WOMPOC) remained well below the standard of 0.15 pCi/L.
- Total U load for CY 2003–2015 from Pond C-2 is significantly less than the load at GS01 (Figure 164 and Figure 166), indicating a gain of load most likely from naturally occurring U in the rest of the Woman Creek drainage. Post-closure, Pond C-2 accounts for approximately 10 percent of the U load at GS01 and 15 percent of the U load at WOMPOC.

Table 61. Pu Loads at GS01, WOMPOC, and GS31: CY 1997–2015

Calendar Year	Pu-239,240 (µg)		
	Pond C-2 (GS31)	POC WOMPOC	Woman Creek (GS01)
1997	16.7	NA	47.9
1998	2.2	NA	55.4
1999	26.9	NA	56.7
2000	0.0; No C-2 discharge	NA	6.1
2001	11.0	NA	22.4
2002	0.2	NA	0.8
2003	11.0	NA	25.9
2004	11.5	NA	4.7
2005	5.0	NA	12.5
2006	0.0; No C-2 discharge	NA	1.4
2007	0.0; No C-2 discharge	NA	68.0
2008	0.0; No C-2 discharge	NA	1.1
2009	4.1	NA	26.7
2010	0.4	NA	70.6
2011	1.0	2.9 ^a	5.2
2012	0.3	4.9	2.2
2013	7.8	40.9	38.5
2014	1.9	14.7	19.4
2015	597	510	451 ^a
Total	697	573 ^a	917 ^a

Notes:

^a Partial data

During CY 1997 (through September 30, 1997), flows from Woman Creek were routinely diverted to Mower Ditch for subsequent monitoring at GS02 (discontinued location). Therefore, the load calculated for Woman Creek at Indiana Street (GS01) includes the water that was measured at GS02. The estimated load diverted to GS02 is calculated by multiplying the CY 1997 volume-weighted activities at GS01 by the streamflow volume measured at GS02, and converting for units. This diverted load is then added to the calculated load at GS01 to obtain the total CY 1997 load at GS01. For subsequent water years, the Mower diversion structure was upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch.

Monitoring at GS01 was discontinued on October 1, 2015.

Table 62. Am Loads at GS01, WOMPOC, and GS31: CY 1997–2015

Calendar Year	Am-241 (µg)		
	Pond C-2 (GS31)	POC WOMPOC	Woman Creek (GS01)
1997	0.17	NA	0.40
1998	0.27	NA	0.99
1999	0.13	NA	0.75
2000	0.00; No C-2 discharge	NA	0.18
2001	0.14	NA	0.30
2002	<0.01	NA	0.03
2003	0.09	NA	0.34
2004	0.11	NA	0.15
2005	0.04	NA	0.30
2006	0.0; No C-2 discharge	NA	0.13
2007	0.0; No C-2 discharge	NA	0.49
2008	0.0; No C-2 discharge	NA	0.02
2009	0.03	NA	0.23
2010	0.02	NA	0.78
2011	0.01	0.07 ^a	0.12
2012	0.00	0.04	0.07
2013	0.03	0.41	0.26
2014	0.02	0.39	0.28
2015	2.10	2.80	4.94 ^a
Total	3.16	3.71^a	10.7^a

Notes:

^a Partial data

During CY 1997 (through September 30, 1997), flows from Woman Creek were routinely diverted to Mower Ditch for subsequent monitoring at GS02 (discontinued location). Therefore, the load calculated for Woman Creek at Indiana Street (GS01) includes the water that was measured at GS02. The estimated load diverted to GS02 is calculated by multiplying the CY 1997 volume-weighted activities at GS01 by the streamflow volume measured at GS02, and converting for units. This diverted load is then added to the calculated load at GS01 to obtain the total CY 1997 load at GS01. For subsequent water years, the Mower diversion structure was upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch. Monitoring at GS01 was discontinued on October 1, 2015.

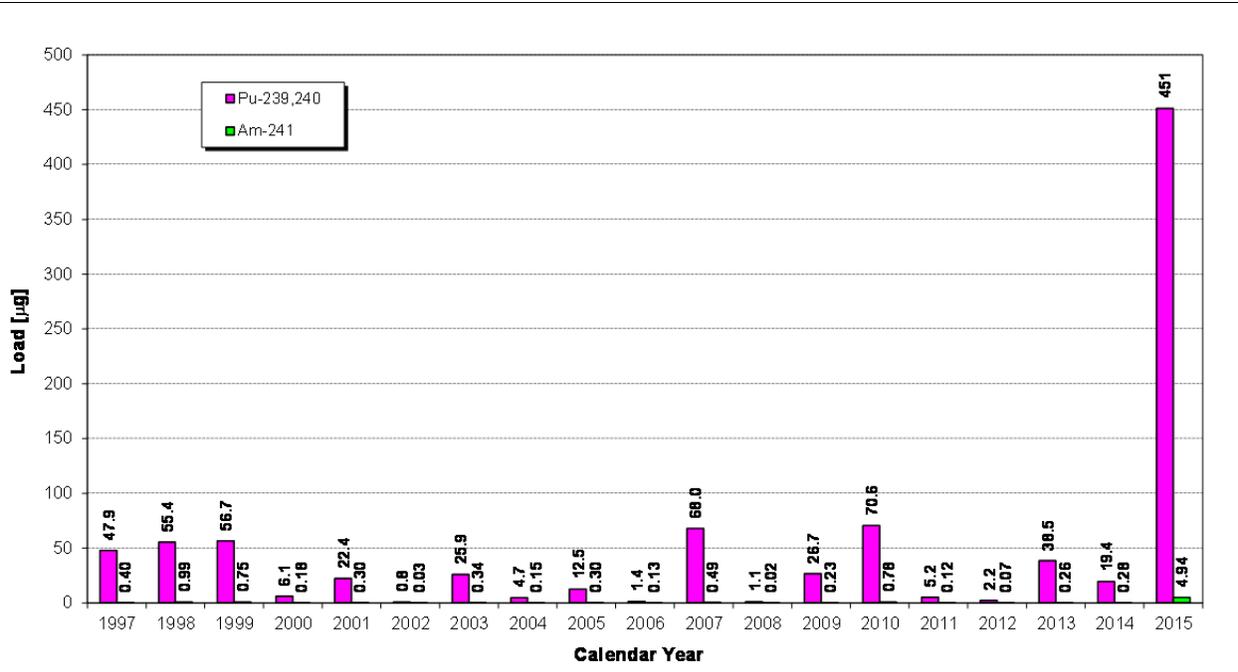
Table 63. Total U Loads at GS01, WOMPOC, and GS31: CY 2003–2015

Calendar Year	Total U (kg)		
	Pond C-2 (GS31)	POC WOMPOC	Woman Creek (GS01)
2003	0.13	NA	0.79
2004	0.09	NA	0.81
2005	0.11	NA	0.92
2006	0.0; No C-2 discharge	NA	0.24
2007	0.0; No C-2 discharge	NA	1.02
2008	0.0; No C-2 discharge	NA	0.17
2009	0.09	NA	0.76
2010	0.06	NA	1.16
2011	0.10	0.27 ^a	0.61
2012	0.05	0.40	0.47
2013	0.16	0.74	0.89
2014	0.07	0.88	1.19
2015	0.33	2.10	2.69 ^a
Total	1.21	4.40 ^a	11.7 ^a

Notes:

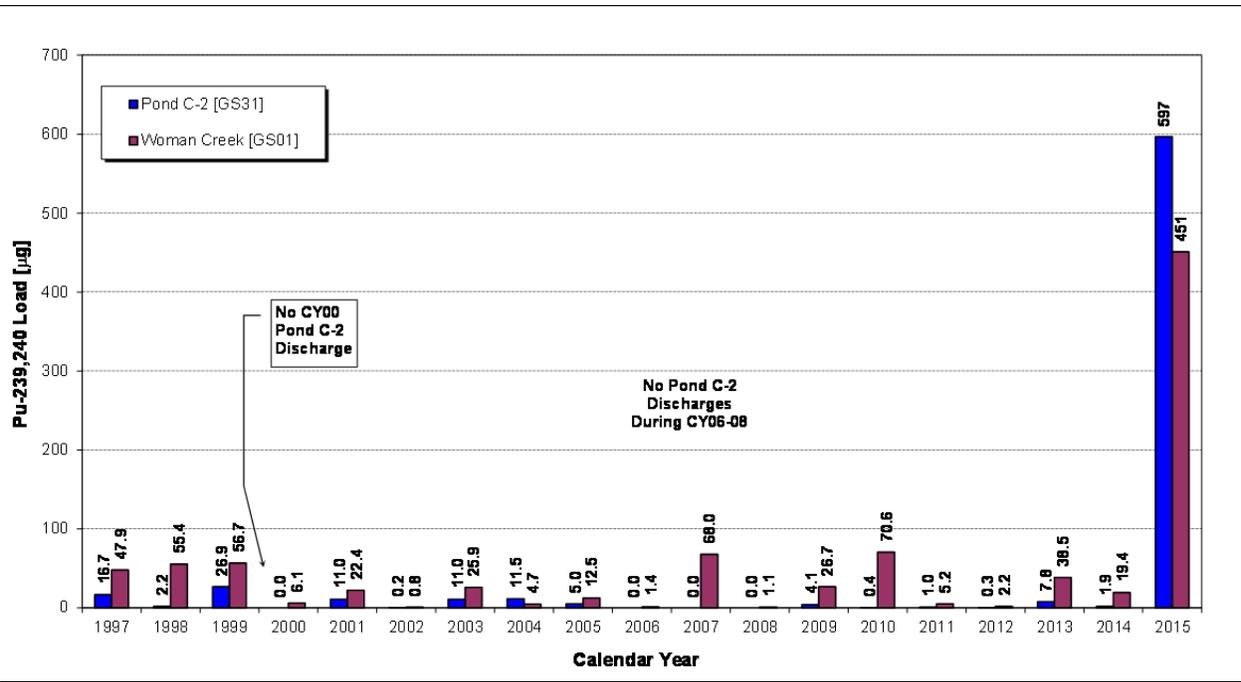
^a Partial data

Monitoring at GS01 was discontinued on October 1, 2015.



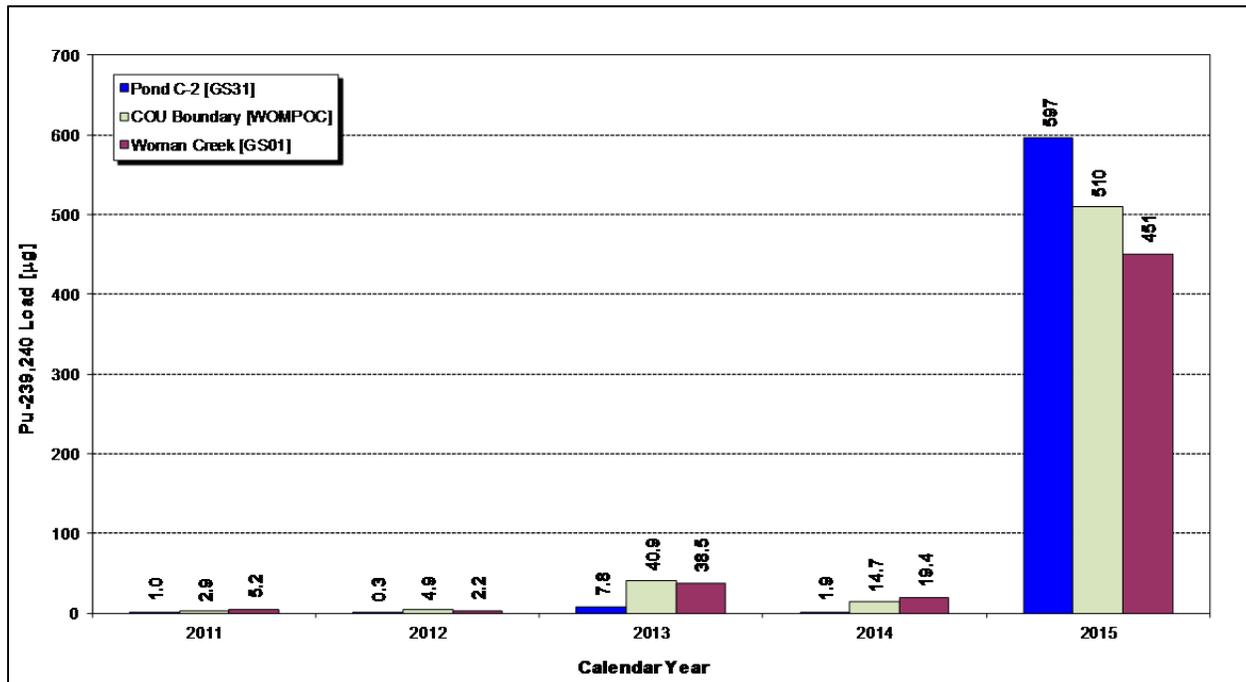
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 157. Annual Pu and Am Loads at GS01: CY 1997–2015



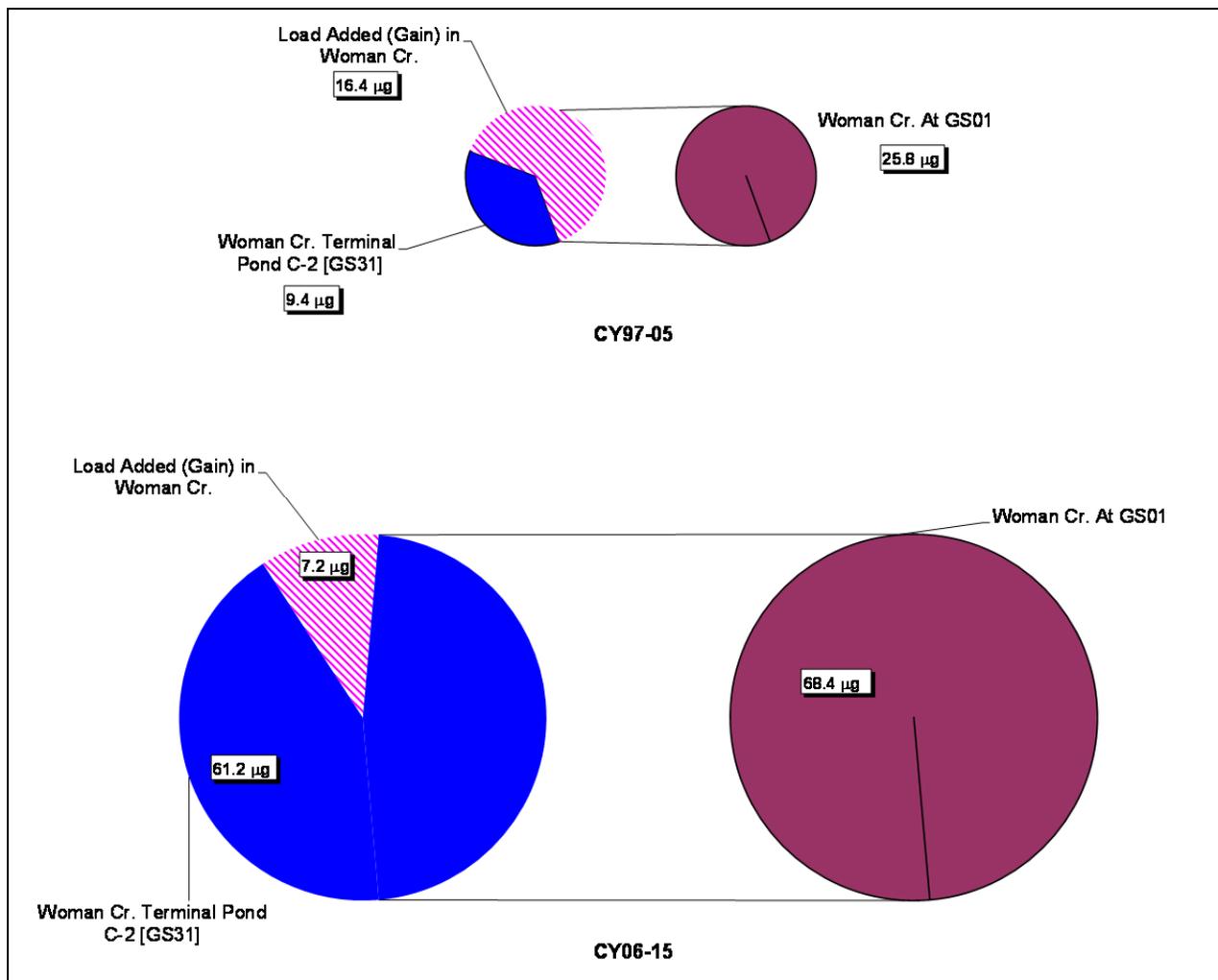
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 158. Annual Pu Loads at GS01 and GS31: CY 1997–2015



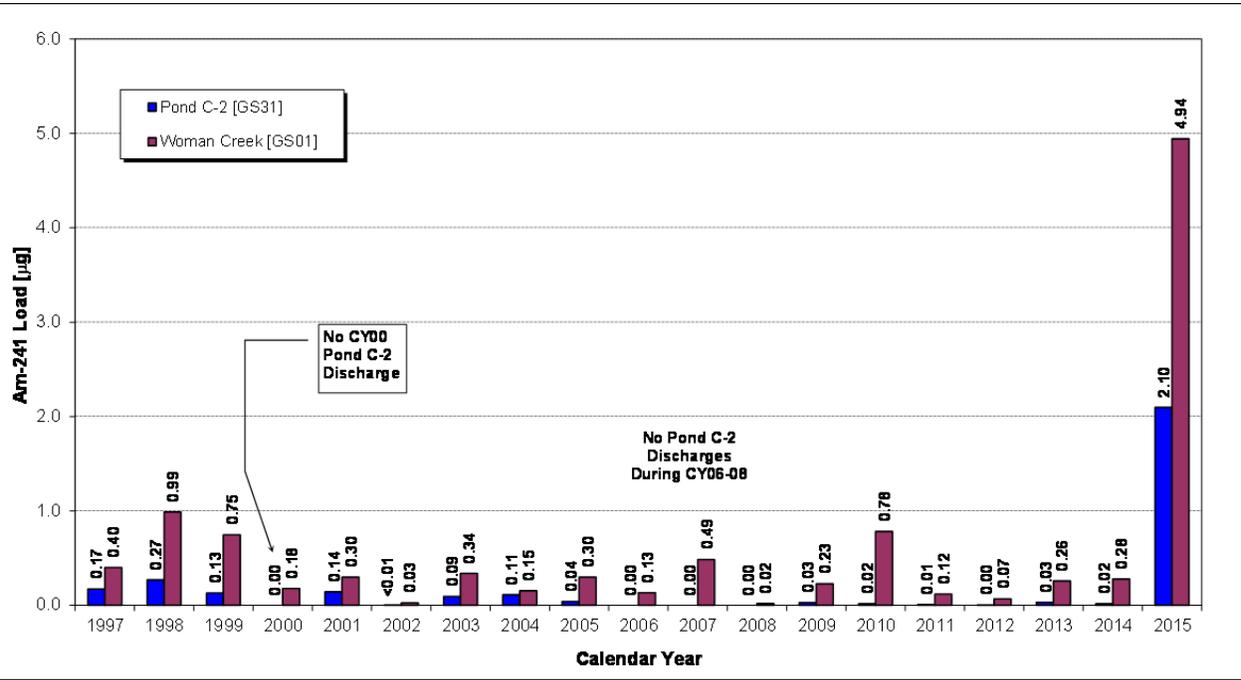
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 159. Annual Pu Loads at GS01, WOMPOC, and GS31: CY 2011–2015



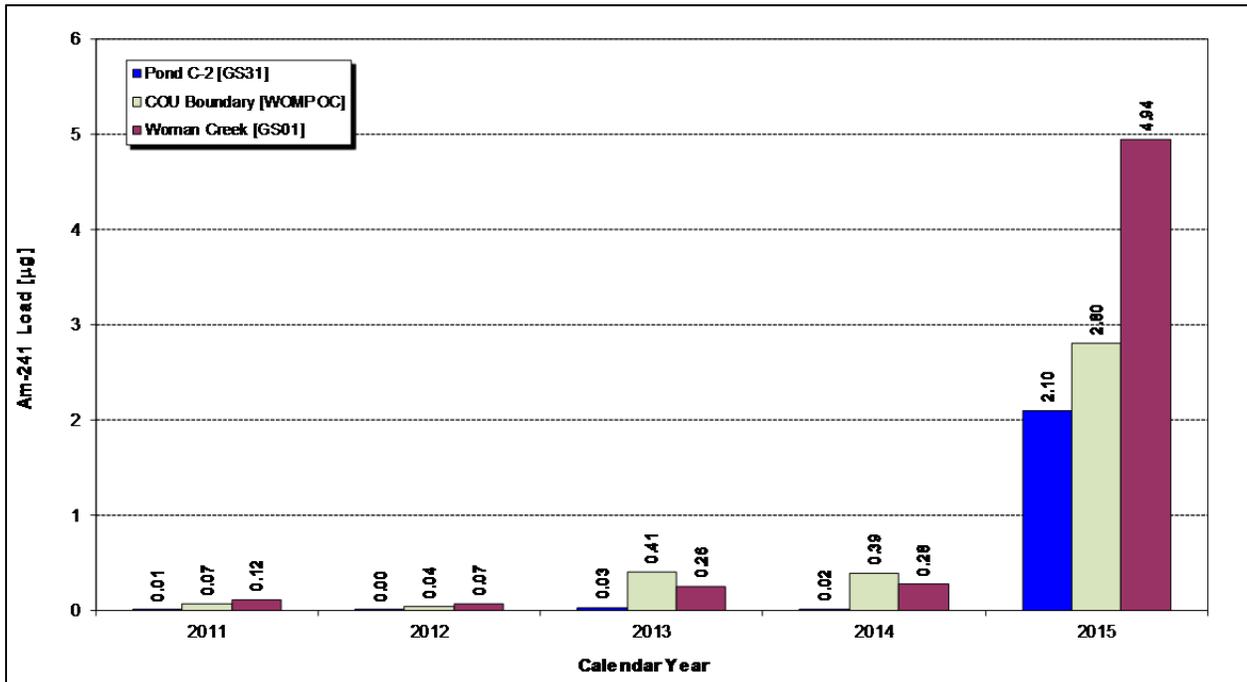
Notes: Pie chart diameters are relative to total load.
 Monitoring at GS01 was discontinued on October 1, 2015.

Figure 160. Relative Average Annual Pu Load Totals at GS01 and GS31



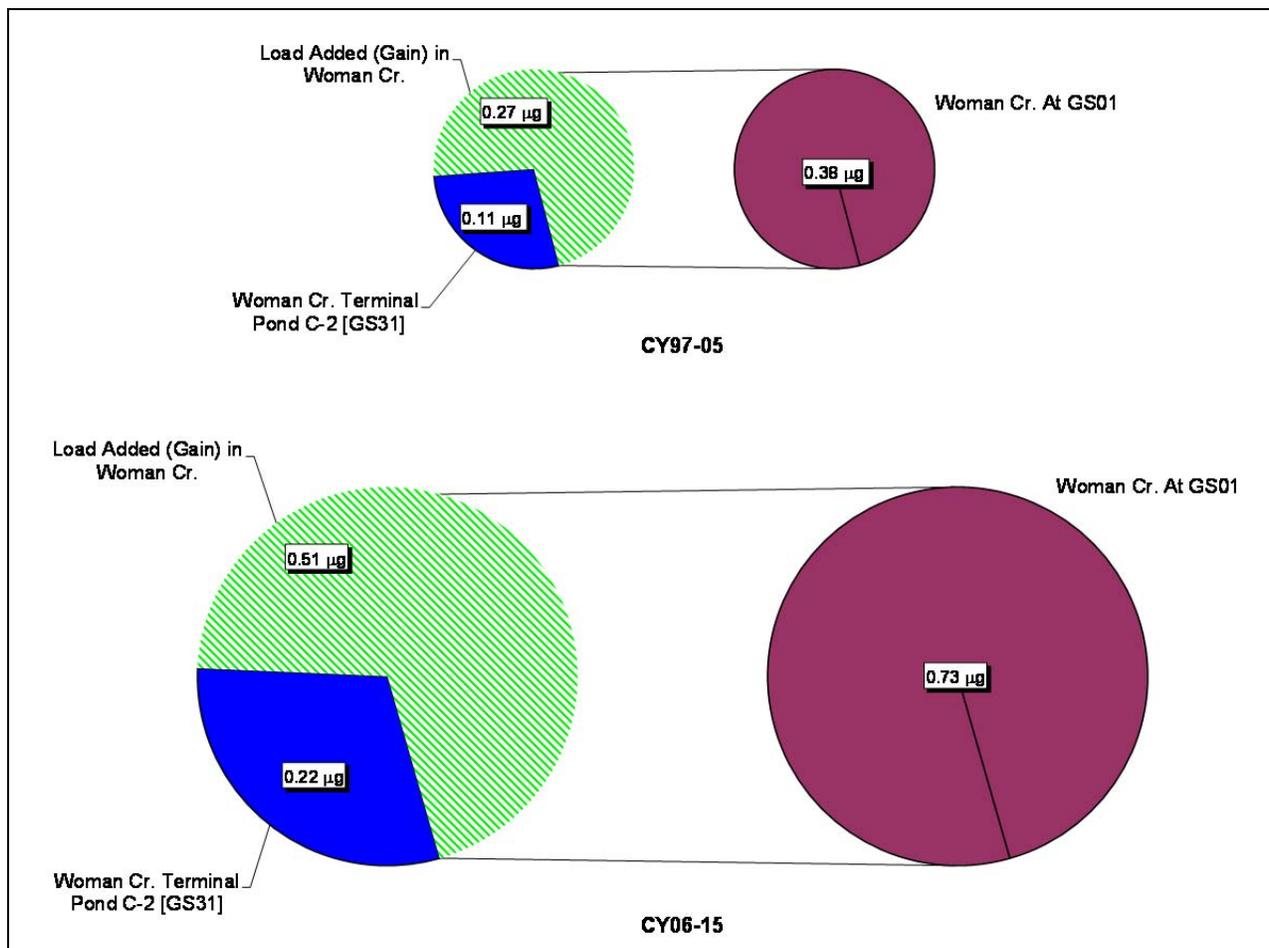
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 161. Annual Am Loads at GS01 and GS31: CY 1997–2015



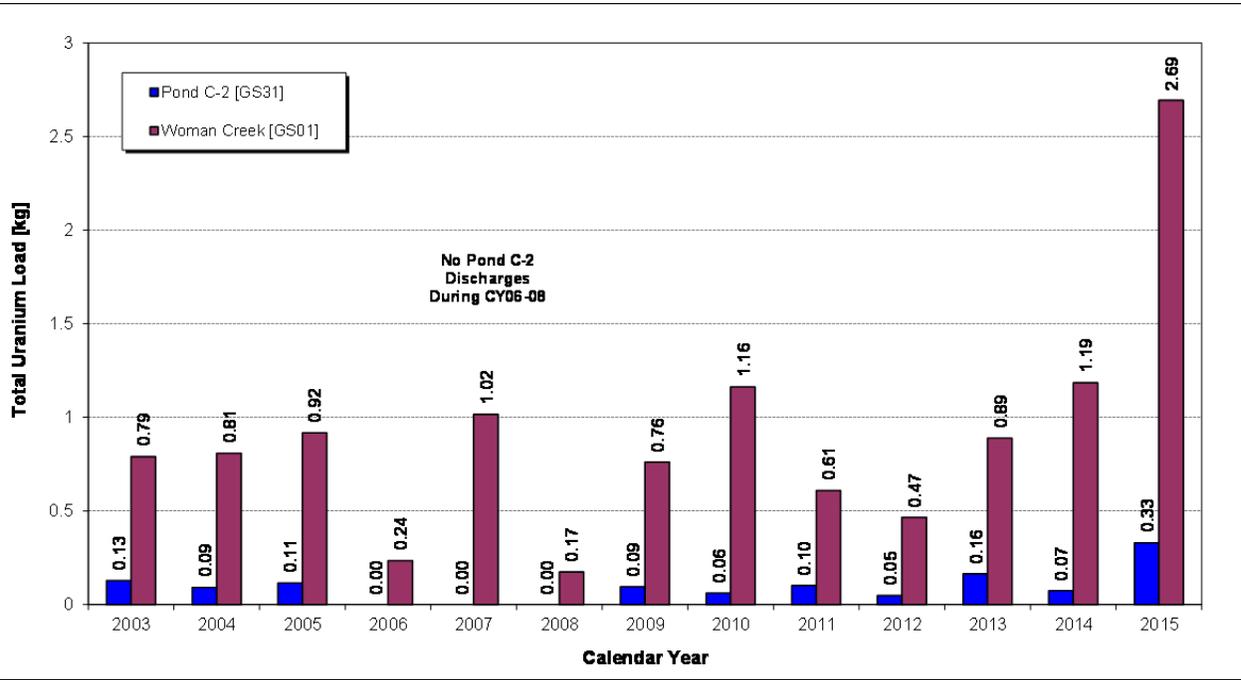
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 162. Annual Am Loads at GS01, WOMPOC, and GS31: CY 2011–2015



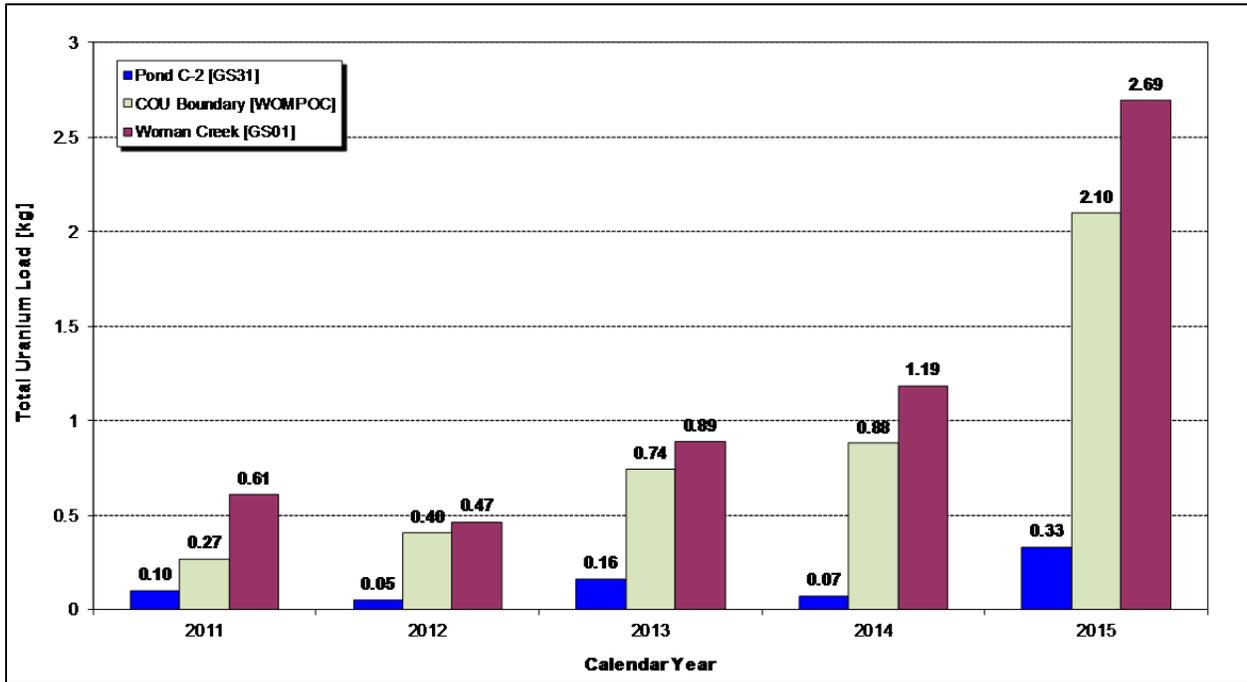
Notes: Pie chart diameters are relative to total load.
Monitoring at GS01 was discontinued on October 1, 2015.

Figure 163. Relative Average Annual Am Load Totals at GS01 and GS31



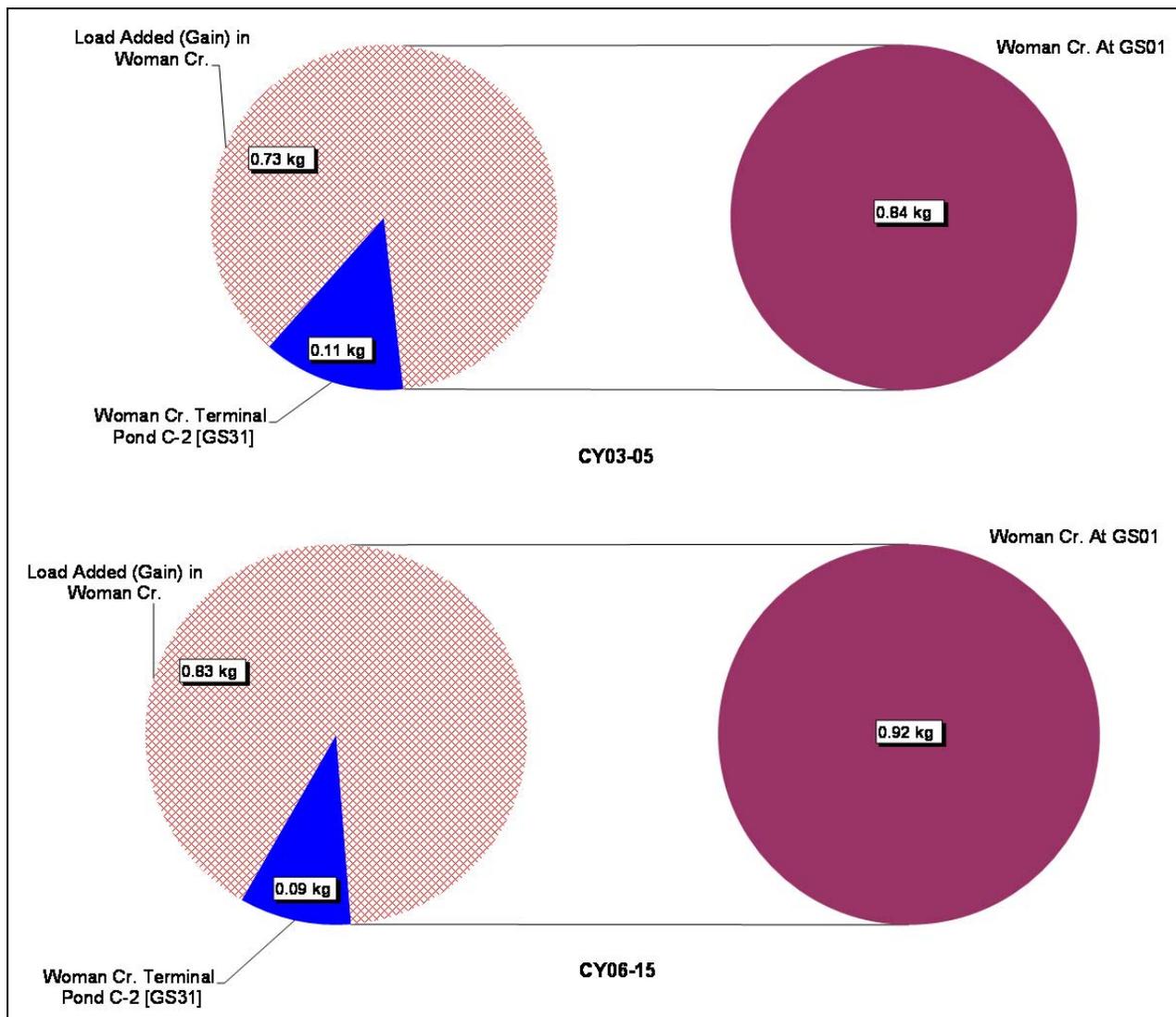
Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 164. Annual Total U Loads at GS01 and GS31: CY 2003–2015



Notes: Monitoring at GS01 was discontinued on October 1, 2015.

Figure 165. Annual Total U Loads at GS01, WOMPOC, and GS31: CY 2011–2015



Notes: Pie chart diameters are relative to total load. Monitoring at GS01 was discontinued on October 1, 2015.

Figure 166. Relative Average Annual Total U Load Totals at GS01 and GS31

A- and B-Series Ponds

This section summarizes the calculated Pu, Am, and U loads for the A- and B-Series Ponds. The data are presented in Table 64, Table 65, and Table 66, and are depicted on Figure 167 through Figure 174. Since water transfers occurred between ponds pre-closure, the load analysis is performed for both pond series combined. The influent load sources are GS10, the former WWTP (South Walnut; WWTP removed in November 2004), and SW093 (North Walnut). The effluent loads are GS08 (Pond B-5 outlet) and GS11 (Pond A-4 outlet). The following points are noted:

- Table 64 shows GS10 with the highest influent Pu load for CY 1997–2015. Although load increases associated with the recent reportable conditions are noted for 2011–2013, annual average post-closure Pu loads at GS10 have been reduced 82 percent.

- A significant increase in Pu loads to the ponds is noted during CY 2004 due to increased solids transport resulting from active building demolition and soil disturbance (Figure 167). With the implementation of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006–2015. However, the CY 2011–2013 and CY 2015 loads have been affected by recent increases in Pu activity at GS10 and the high flow rates during CY 2015, respectively. Post-closure influent and effluent loads have been reduced by 87 percent and 63 percent, respectively.
- Table 65 shows GS10 with the highest influent Am load for CY 1997–2015. Although load increases associated with the recent reportable conditions are noted for 2011–2013, average annual post-closure Am loads at GS10 have been reduced 76 percent.
- A measurable increase in Am loads to the ponds is noted during CY 2004. This increase was partly due to increased solids transport resulting from active building demolition and soil disturbance (Figure 169). Increased Am loads at SW093 were primarily due to contributions from B771 decontamination and decommissioning during the July 2004–November 2004 period. The pathway causing these increased loads was eliminated in December 2004. With the implementation of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006–2015. However, the CY 2011–2013 loads were measurably affected by recent increases in Am activity at GS10. Post-closure influent and effluent loads have been reduced by 84 percent and 65 percent, respectively.
- Pre-closure (Figure 171), GS10 shows the highest average annual influent total U concentration, while SW093 shows the highest average annual influent total U load (due to larger flow volumes at SW093). Post-closure (Figure 172), GS10 shows both the highest average annual influent concentration and load. Although total influent U concentration has increased significantly, corresponding reductions in streamflow volume have actually resulted in essentially no change in load.
- Pre-closure (Figure 171), GS11 shows the highest effluent average annual total U concentration and load. Again, although U activity has increased at both GS08 and GS11, corresponding reductions in discharge volume have resulted in essentially no change in load.

Table 64. Pu Load Summary for the A- and B-Series Ponds: CY 1997–2015

Calendar Year	Pu-239,240 (µg)				
	Influent (WWTP)	Influent (GS10)	Influent (SW093)	Effluent (GS08)	Effluent (GS11)
1997	11.2	576.0	164.2	8.8	59.2
1998	13.4	328.6	69.1	22.4	20.0
1999	19.4	307.9	127.8	261.4	23.8
2000	17.4	326.2	87.4	244.6	28.4
2001	11.3	141.4	44.4	32.3	4.7
2002	8.3	59.3	9.6	7.8	0.1
2003	3.8	207.2	140.1	111.5	7.3
2004	2.1	523.3	1,330.9	27.1	2.2
2005	0.0; WWTP removed	247.1	29.2	17.9	2.2
2006	0.0; WWTP removed	2.3	2.5	0.0; No B-5 discharge	0.0; No A-4 discharge
2007	0.0; WWTP removed	14.2	17.0	1.9	7.8
2008	0.0; WWTP removed	3.5	13.2	0.0; No B-5 discharge	0.0; No A-4 discharge
2009	0.0; WWTP removed	15.2	23.0	3.0	2.3
2010	0.0; WWTP removed	13.1	16.4	5.4	6.4
2011	0.0; WWTP removed	106.7	4.3	1.8	1.0
2012	0.0; WWTP removed	69.0	1.2	1.1	2.1 ^a
2013	0.0; WWTP removed	257.0	4.3	6.3	37.3
2014	0.0; WWTP removed	9.5	5.3	7.0	2.2
2015	0.0; WWTP removed	56.6	43.8	117	157
Total	86.9	3,264	2,134	878	364

Table 65. Am Load Summary for the A- and B-Series Ponds: CY 1997–2015

Calendar Year	Am-241 (µg)				
	Influent (WWTP)	Influent (GS10)	Influent (SW093)	Effluent (GS08)	Effluent (GS11)
1997	0.64	12.20	2.24	0.25	0.70
1998	0.32	4.69	1.30	0.35	1.25
1999	0.11	12.55	1.73	1.81	0.20
2000	0.29	14.57	0.98	3.14	0.02
2001	0.32	2.75	0.65	0.46	0.11
2002	0.20	1.76	0.52	0.25	0.04
2003	0.52	4.44	2.05	0.54	0.18
2004	0.25	4.68	28.48	0.58	0.14
2005	0.00; WWTP removed	3.98	0.82	0.97	0.43
2006	0.00; WWTP removed	0.04	0.02	0.00; No B-5 discharge	0.00; No A-4 discharge
2007	0.00; WWTP removed	0.14	0.28	0.03	0.02
2008	0.00; WWTP removed	0.09	0.15	0.00; No B-5 discharge	0.00; No A-4 discharge
2009	0.00; WWTP removed	0.15	0.21	0.02	0.09
2010	0.00; WWTP removed	0.15	0.35	0.11	0.14
2011	0.00; WWTP removed	3.42	0.07	0.02	0.05
2012	0.00; WWTP removed	2.13	0.04	0.01	0.06
2013	0.00; WWTP removed	8.66	0.20	0.20	0.61
2014	0.00; WWTP removed	0.70	0.10	0.10	0.05
2015	0.00; WWTP removed	0.80	0.51	1.36	1.56
Total	2.65	77.9	40.7	10.2	5.65

Table 66. Total U Load Summary for the A- and B-Series Ponds: CY 1997–2015

Calendar Year	Total U (kg)				
	Influent (WWTP)	Influent (GS10)	Influent (SW093)	Effluent (GS08)	Effluent (GS11)
1997	0.26	0.64	0.85	0.25	1.37
1998	0.47	0.63	0.80	0.62	1.30
1999	0.12	0.59	0.71	0.81	0.63
2000	0.10	0.38	0.49	0.46	0.39
2001	0.26	0.52	0.65	0.64	0.56
2002	0.06	0.28	0.45	0.26	0.13
2003	0.16	0.50	0.57	0.61	0.86
2004	0.14	0.43	0.58	0.39	0.32
2005	0.00; WWTP removed	0.88	0.53	1.39	0.16
2006	0.00; WWTP removed	0.23	0.17	0.00; No B-5 discharge	0.00; No A-4 discharge
2007	0.00; WWTP removed	0.83	0.54	0.48	0.41
2008	0.00; WWTP removed	0.28	0.15	0.00; No B-5 discharge	0.00; No A-4 discharge
2009	0.00; WWTP removed	0.76	0.57	0.32	0.41
2010	0.00; WWTP removed	1.16	1.05	0.75	1.20
2011	0.00; WWTP removed	0.76	0.40	0.31	0.43
2012	0.00; WWTP removed	0.68	0.29	0.13	0.38
2013	0.00; WWTP removed	0.93	0.77	0.41	0.97
2014	0.00; WWTP removed	0.58	0.51	0.40	0.90
2015	0.00; WWTP removed	1.80	1.96	1.72	2.79
Total	1.57	12.7	12.0	9.95	13.2

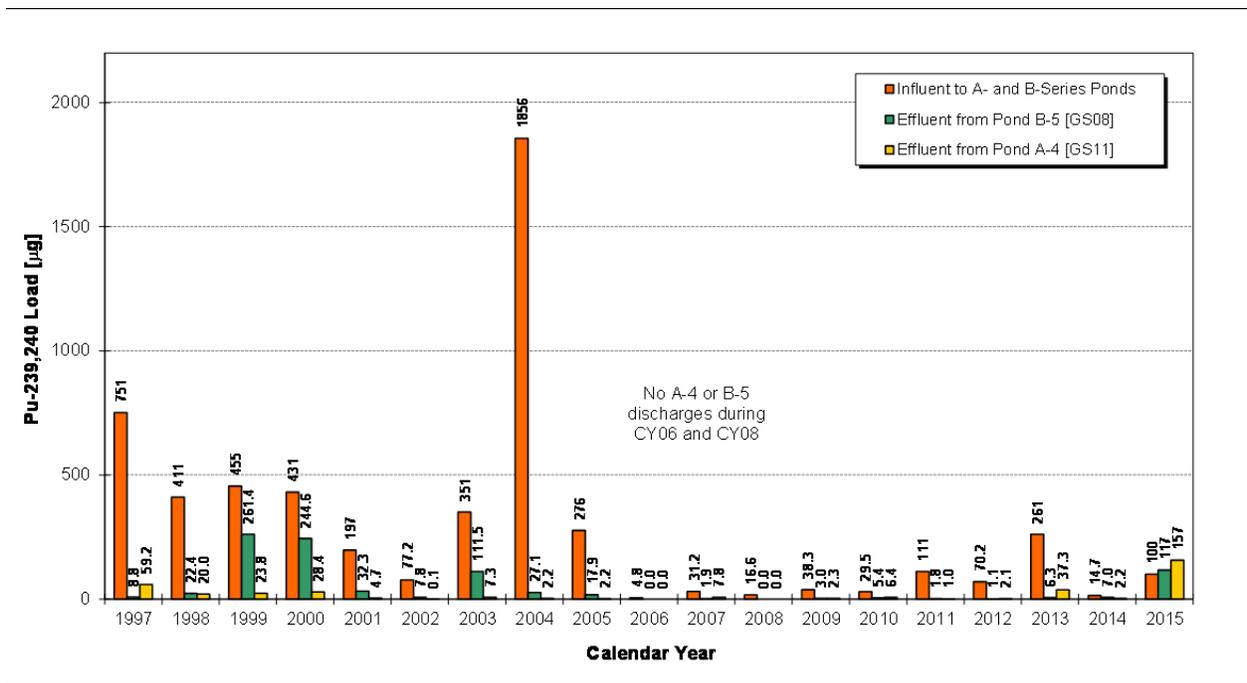
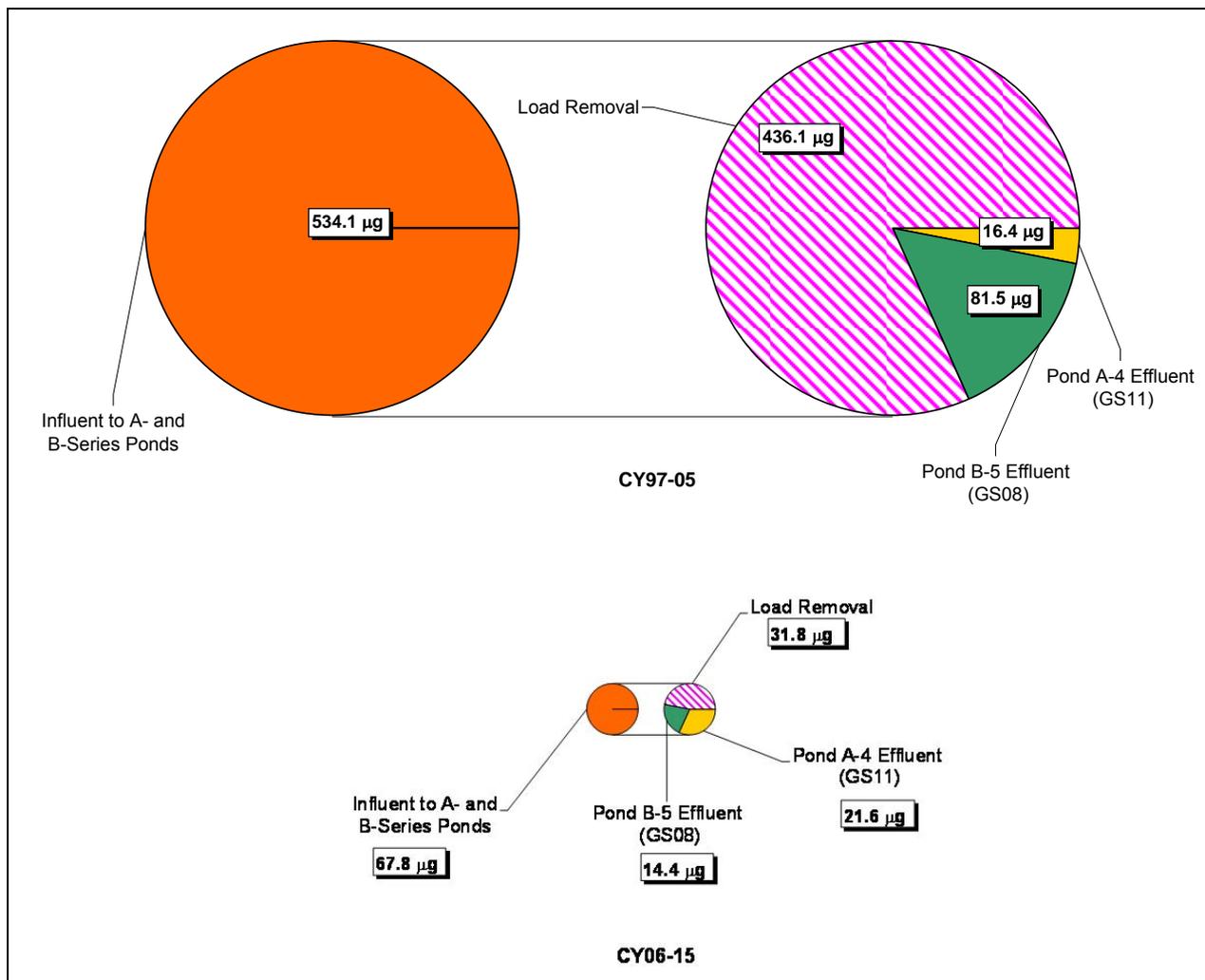


Figure 167. Annual Pu Loads for the A- and B-Series Ponds: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 168. Relative Average Annual Pu Load Totals for the A- and B-Series Ponds

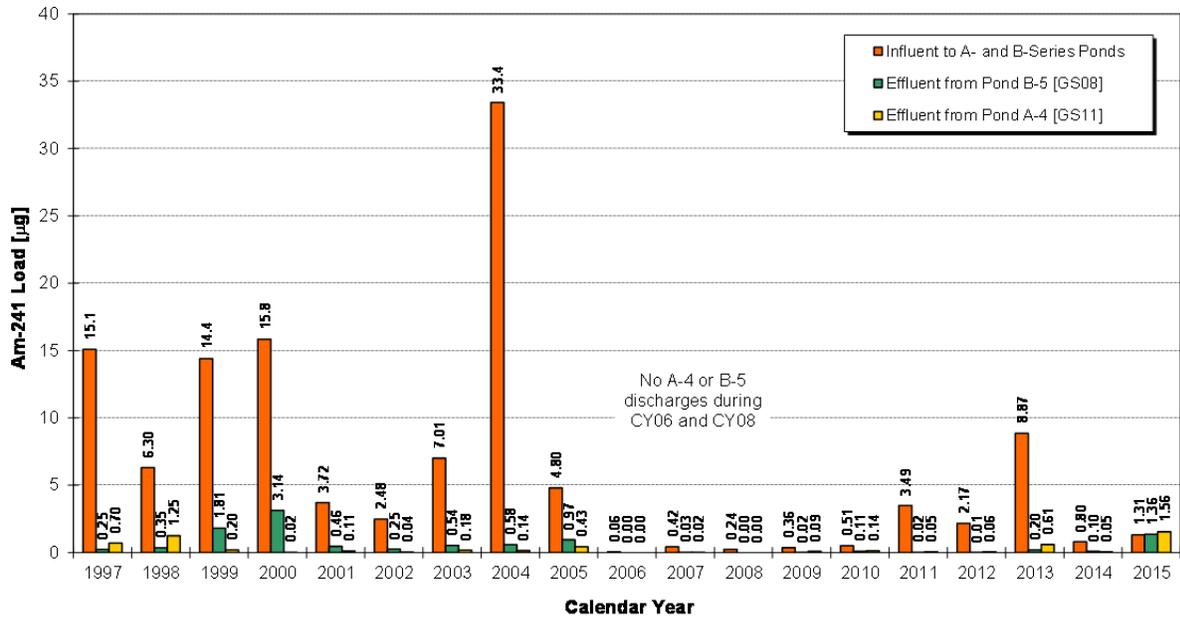
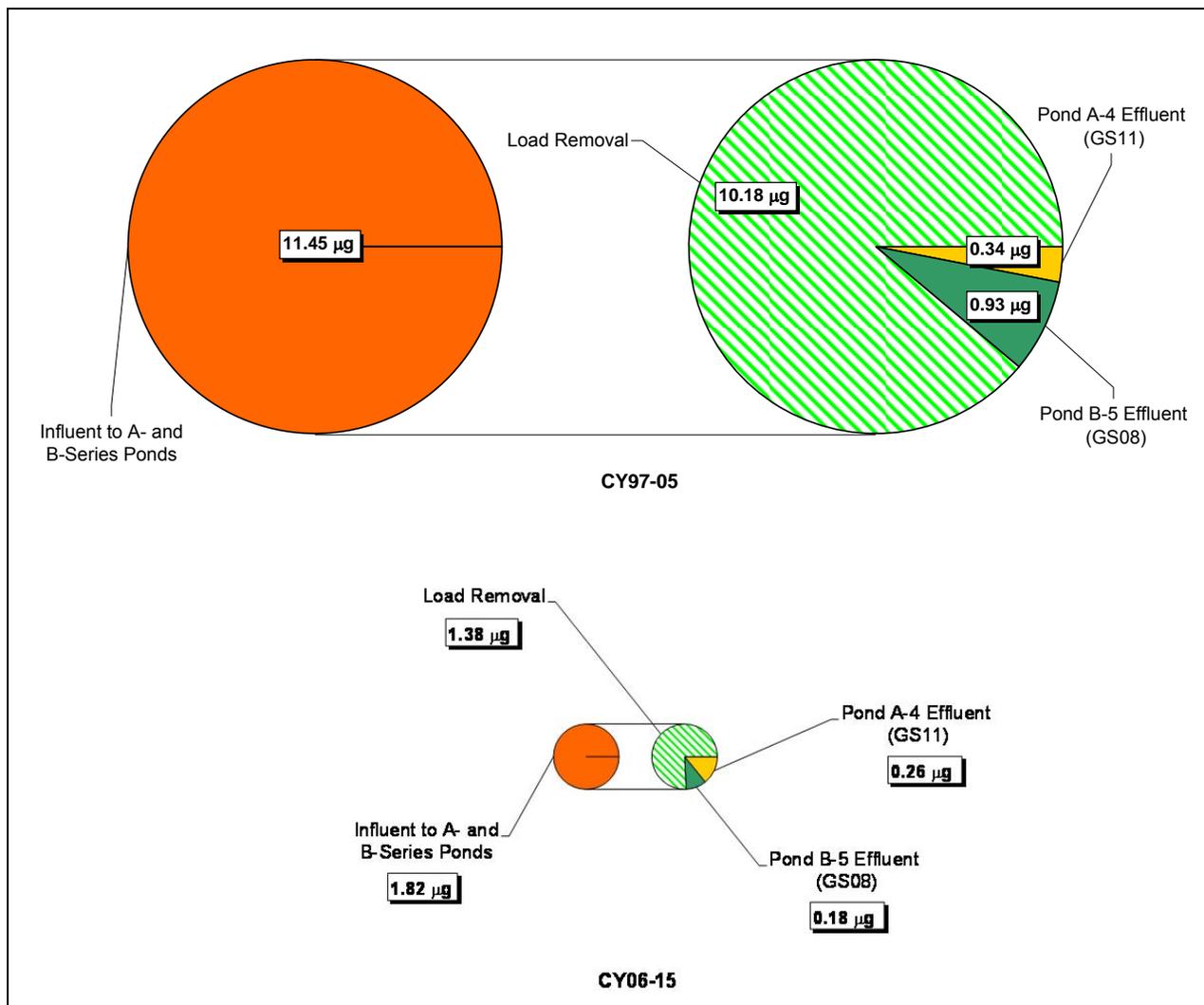
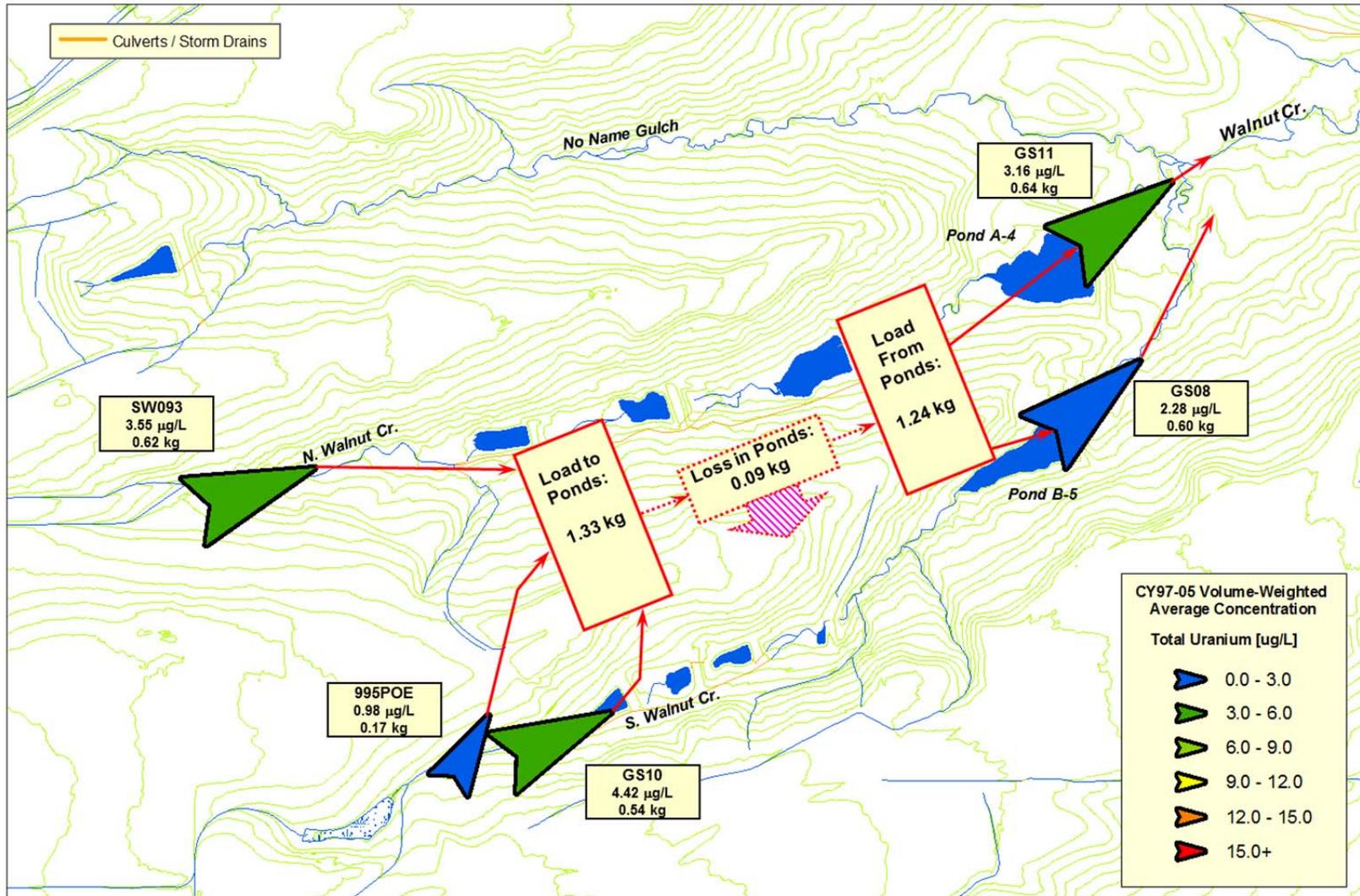


Figure 169. Annual Am Loads for the A- and B-Series Ponds: CY 1997–2015



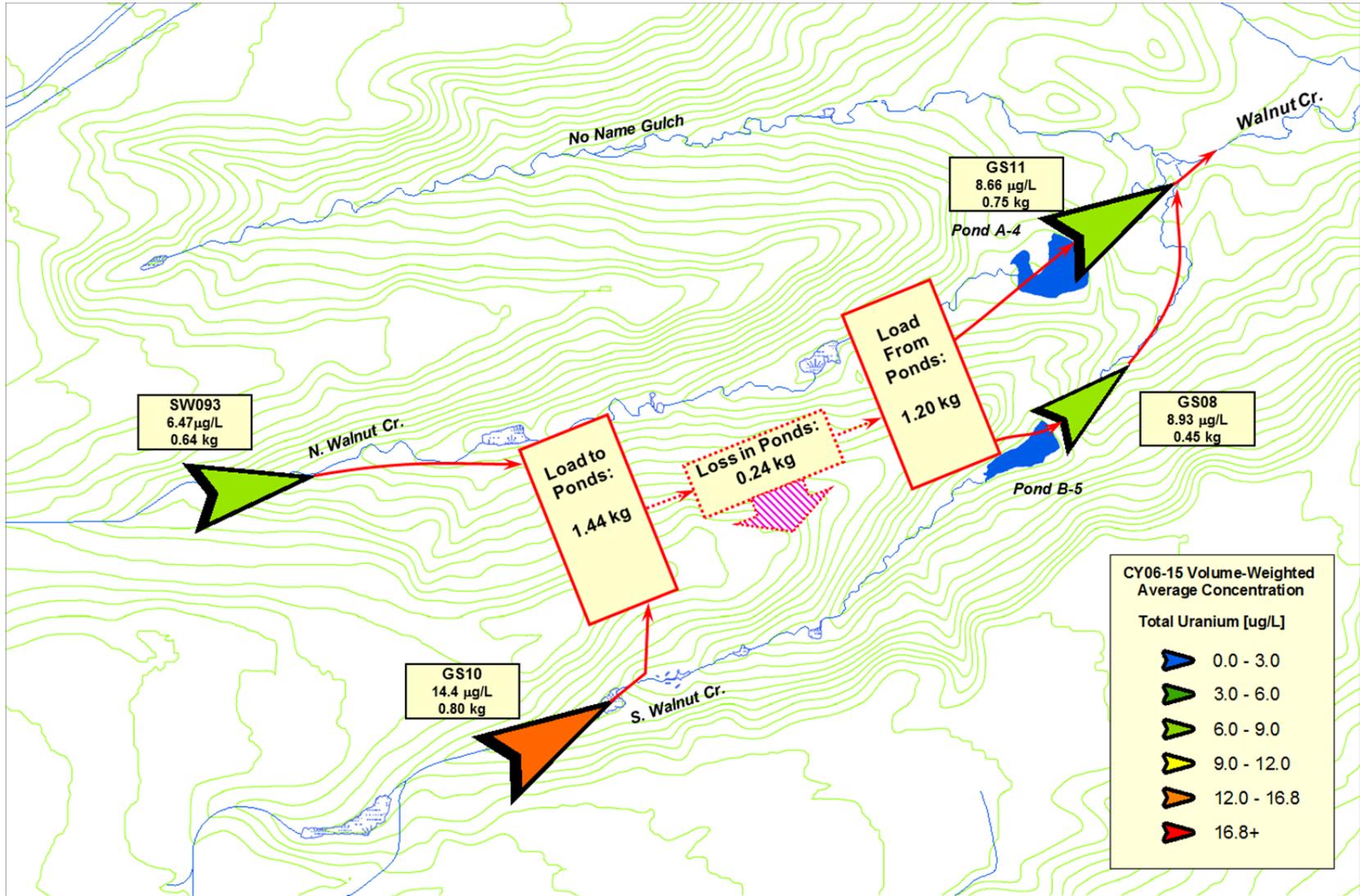
Notes: Pie chart diameters are relative to total load.

Figure 170. Relative Average Annual Am Load Totals for the A- and B-Series Ponds



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to concentration ranges in the legend.

Figure 171. Relative Average Annual Total U Loading Schematic for the A- and B-Series Ponds: CY 1997–2005



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to concentration ranges in the legend.

Figure 172. Relative Average Annual Total U Loading Schematic for the A- and B-Series Ponds: CY 2006–2015

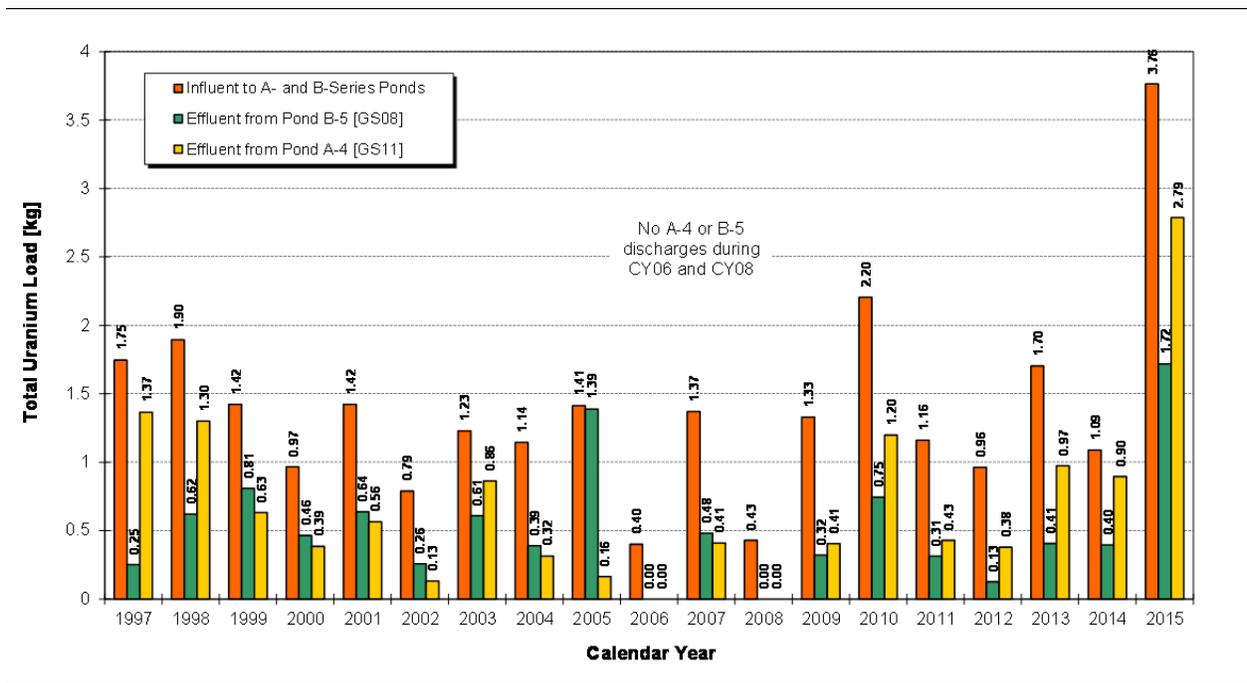
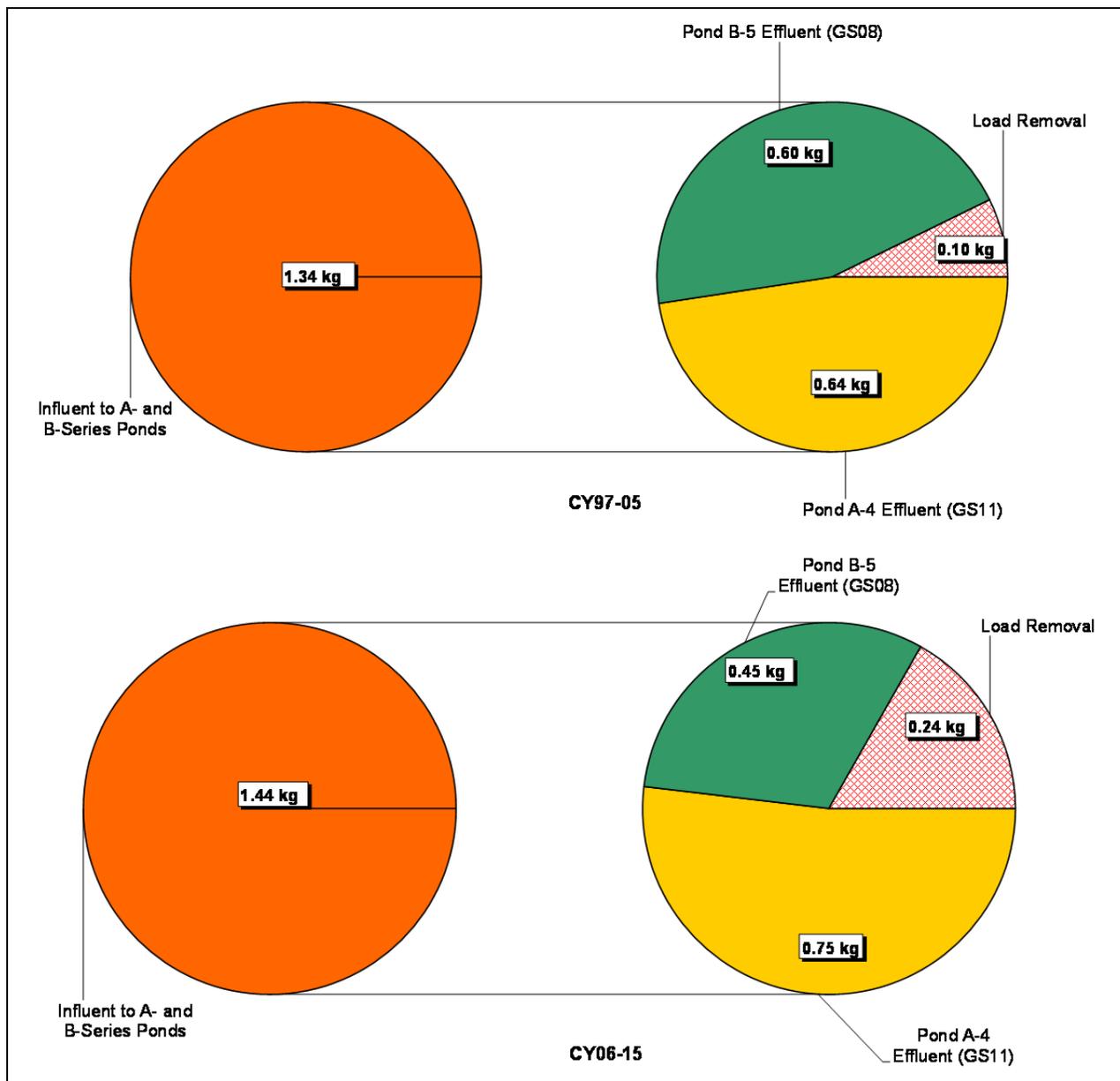


Figure 173. Annual Total U Loads for the A- and B-Series Ponds: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 174. Relative Average Annual Total U Load Totals for the A- and B-Series Ponds

Pond C-2

This section summarizes the calculated Pu, Am, and U loads for Pond C-2. Data are presented in Table 67, Table 68, and Table 69, and depicted on Figure 175 through Figure 182. The influent load source is SW027 (SID at Pond C-2 inlet). The effluent loads are calculated at GS31 (Pond C-2 outlet). The following points are noted:

- Annual Pu and Am loads vary significantly year to year (Figure 175 and Figure 177). A significant increase in both Pu and Am loads influent to Pond C-2 is noted during CY 2004 due to increased solids transport from extensive soil disturbance in the drainage associated with the 903 Pad-Lip accelerated actions. With the implementation of remedial actions,

erosion controls, revegetation, and soil stabilization, a measurable reduction is noted for CY 2005–2014. However, the sustained wet weather in 2015 resulted in significant increases in influent load from the SID to Pond C-2. At the same time, with Pond C-2 being operated in a flow-through mode, significant effluent load increases are also noted.

- Annual total U loads also vary significantly year to year (Figure 181). Post-closure influent and effluent U loads have been reduced by 60 percent and 24 percent, respectively.
- There is a measurable average annual U load gain in Pond C-2 (Figure 179 and Figure 180). This is likely due to seepage with naturally occurring U entering Pond C-2 from the Woman Creek Diversion Canal and therefore not being accounted for at SW027.

Table 67. Pu Load Summary for Terminal Pond C-2: CY 1997–2015

Calendar Year	Pu-239,240 (µg)	
	Influent (SW027)	Effluent (GS31)
1997	17.4	16.7
1998	87.7	2.2
1999	34.3	26.9
2000	67.2	0.0; No C-2 discharge
2001	10.7	11.0
2002	0.3	0.2
2003	45.1	11.0
2004	820.8	11.5
2005	18.6	5.0
2006	0.0; No flow	0.0; No C-2 discharge
2007	16.5	0.0; No C-2 discharge
2008	0.0; No flow	0.0; No C-2 discharge
2009	6.9	4.1
2010	32.4	0.4
2011	<0.01	1.0
2012	0.0; No flow	0.3
2013	6.0	7.8
2014	0.7	1.9
2015	1,020	597
Total	2,185	697

Table 68. Am Load Summary for Terminal Pond C-2: CY 1997–2015

Calendar Year	Am-241 (µg)	
	Influent (SW027)	Effluent (GS31)
1997	0.08	0.17
1998	0.25	0.27
1999	0.20	0.13
2000	0.24	0.00; No C-2 discharge
2001	0.05	0.14
2002	0.00	<0.01
2003	0.12	0.09
2004	3.09	0.11
2005	0.05	0.04
2006	0.00; No flow	0.00; No C-2 discharge
2007	0.15	0.00; No C-2 discharge
2008	0.00; No flow	0.00; No C-2 discharge
2009	0.02	0.03
2010	0.12	0.02
2011	0.00	0.01
2012	0.00; No flow	<0.005
2013	0.01	0.03
2014	<0.01	0.02
2015	4.45	2.10
Total	8.86	3.16

Table 69. Total U Load Summary for Terminal Pond C-2: CY 1997–2015

Calendar Year	Total U (kg)	
	Influent (SW027)	Effluent (GS31)
1997	0.08	0.23
1998	0.24	0.22
1999	0.12	0.19
2000	0.02	0.00; No C-2 discharge
2001	0.07	0.07
2002	~0.0	~0.0
2003	0.11	0.13
2004	0.04	0.09
2005	0.03	0.12
2006	0.00; No flow	0.00; No C-2 discharge
2007	0.04	0.00; No C-2 discharge
2008	0.00; No flow	0.00; No C-2 discharge
2009	0.02	0.10
2010	0.07	0.06
2011	~0.0	0.10
2012	0.00; No flow	0.05
2013	0.01	0.16
2014	~0.0	0.07
2015	0.19	0.33
Total	1.04	1.91

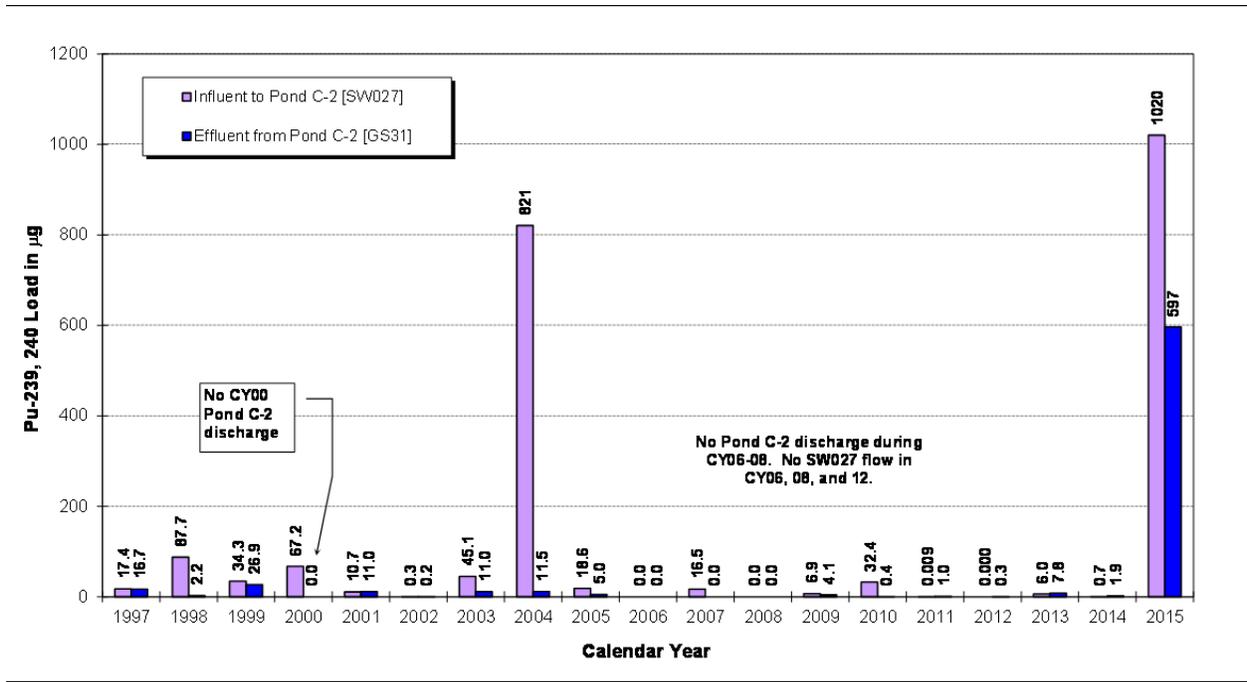
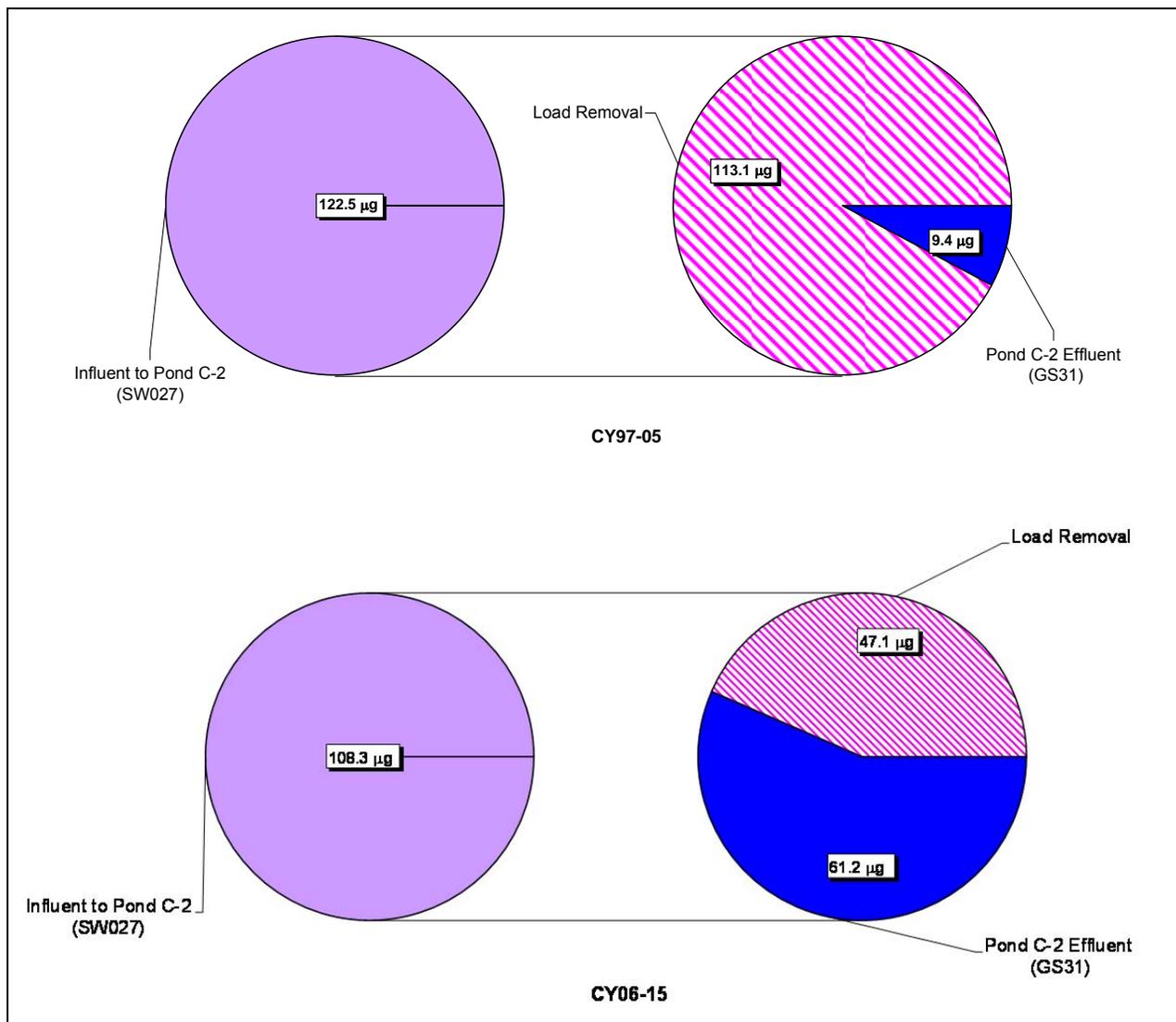


Figure 175. Annual Pu Loads for Pond C-2: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 176. Relative Average Annual Pu Load Totals for Pond C-2

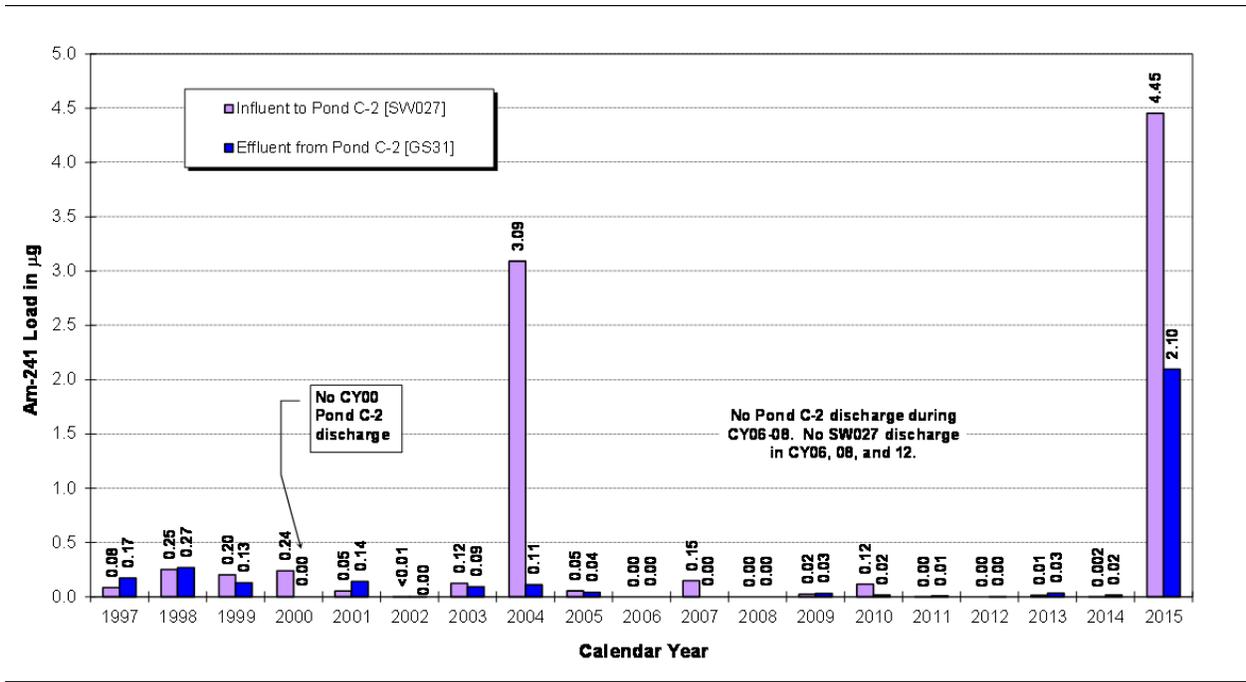
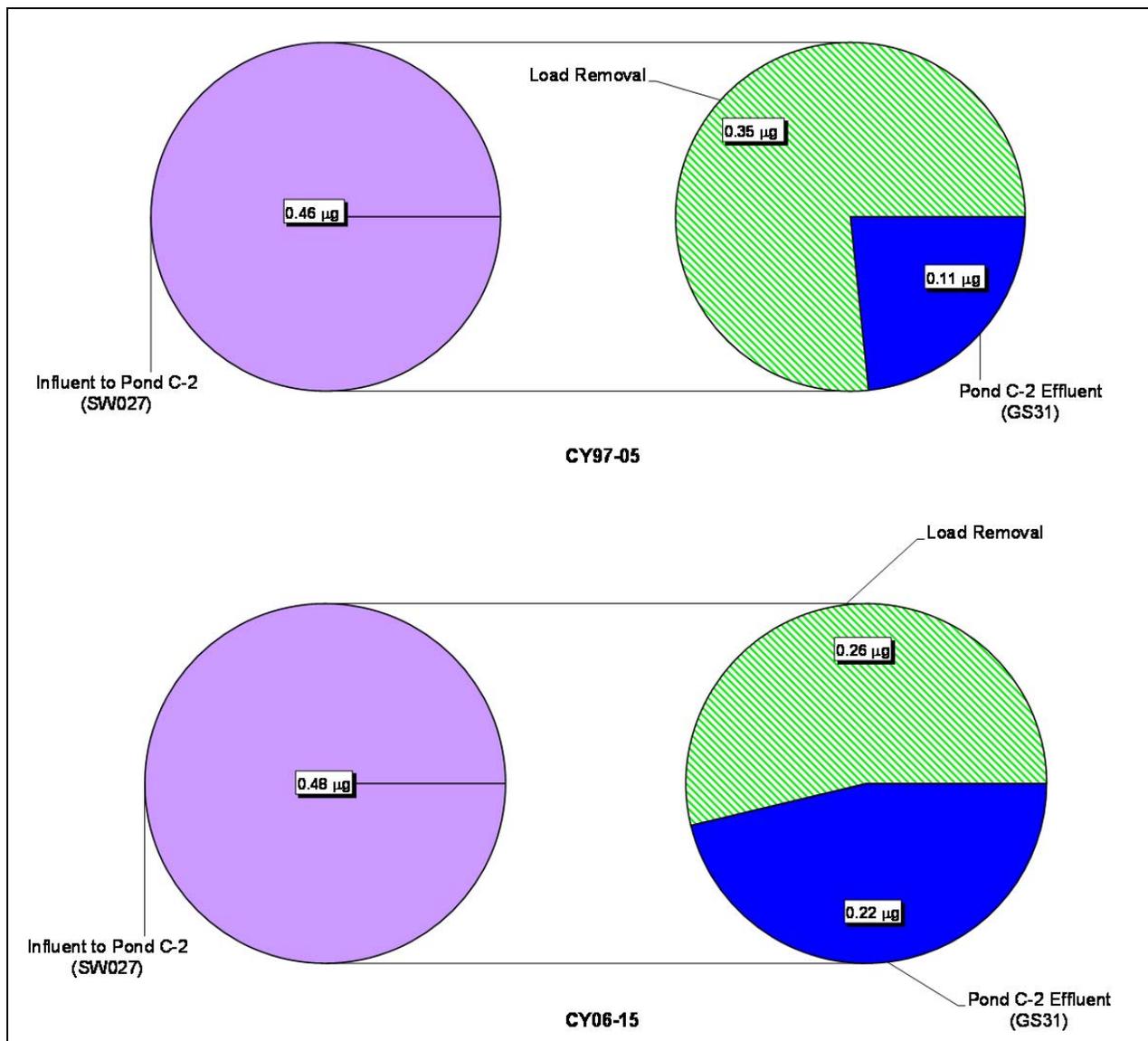
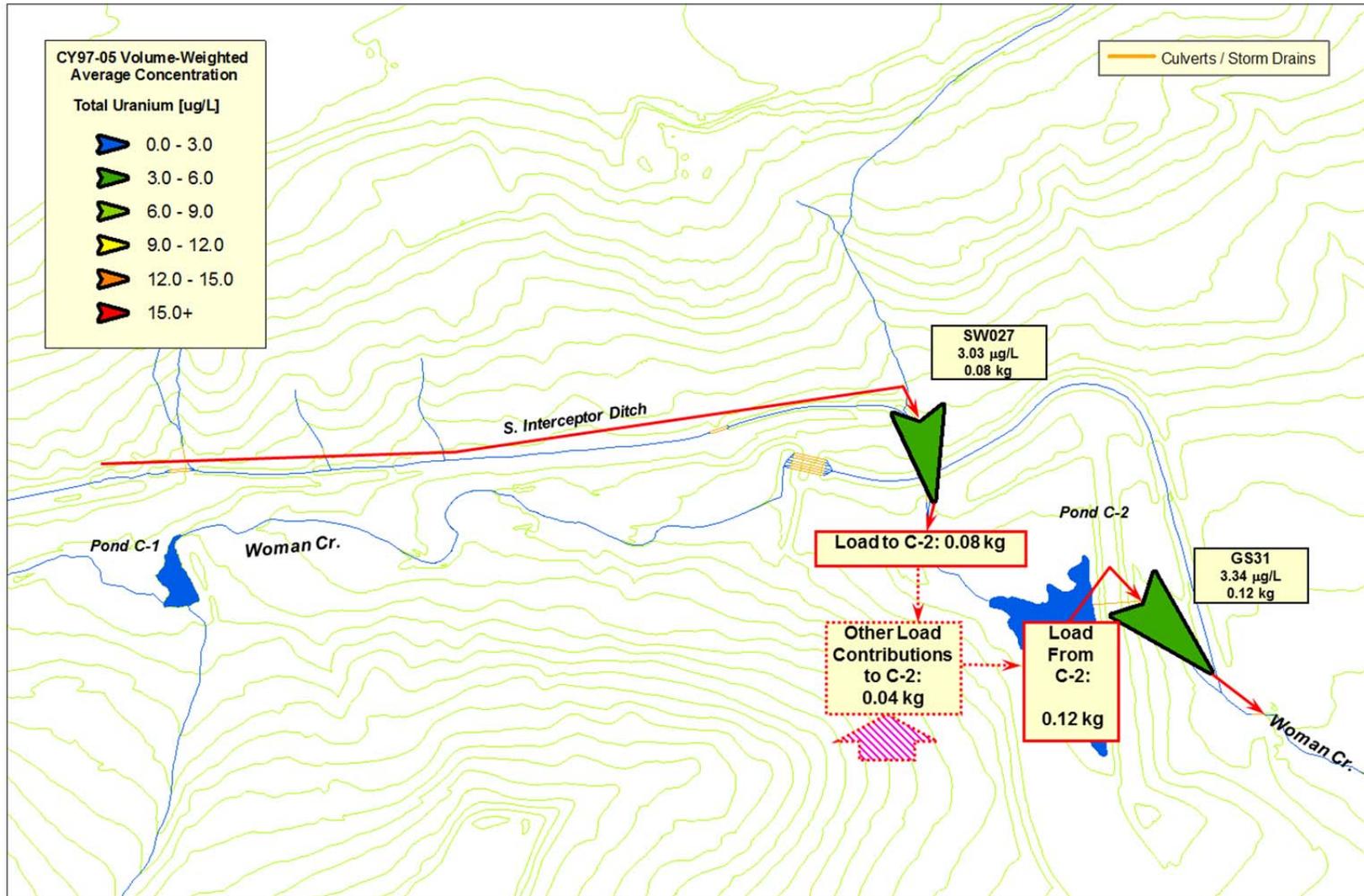


Figure 177. Annual Am Loads for Pond C-2: CY 1997–2015



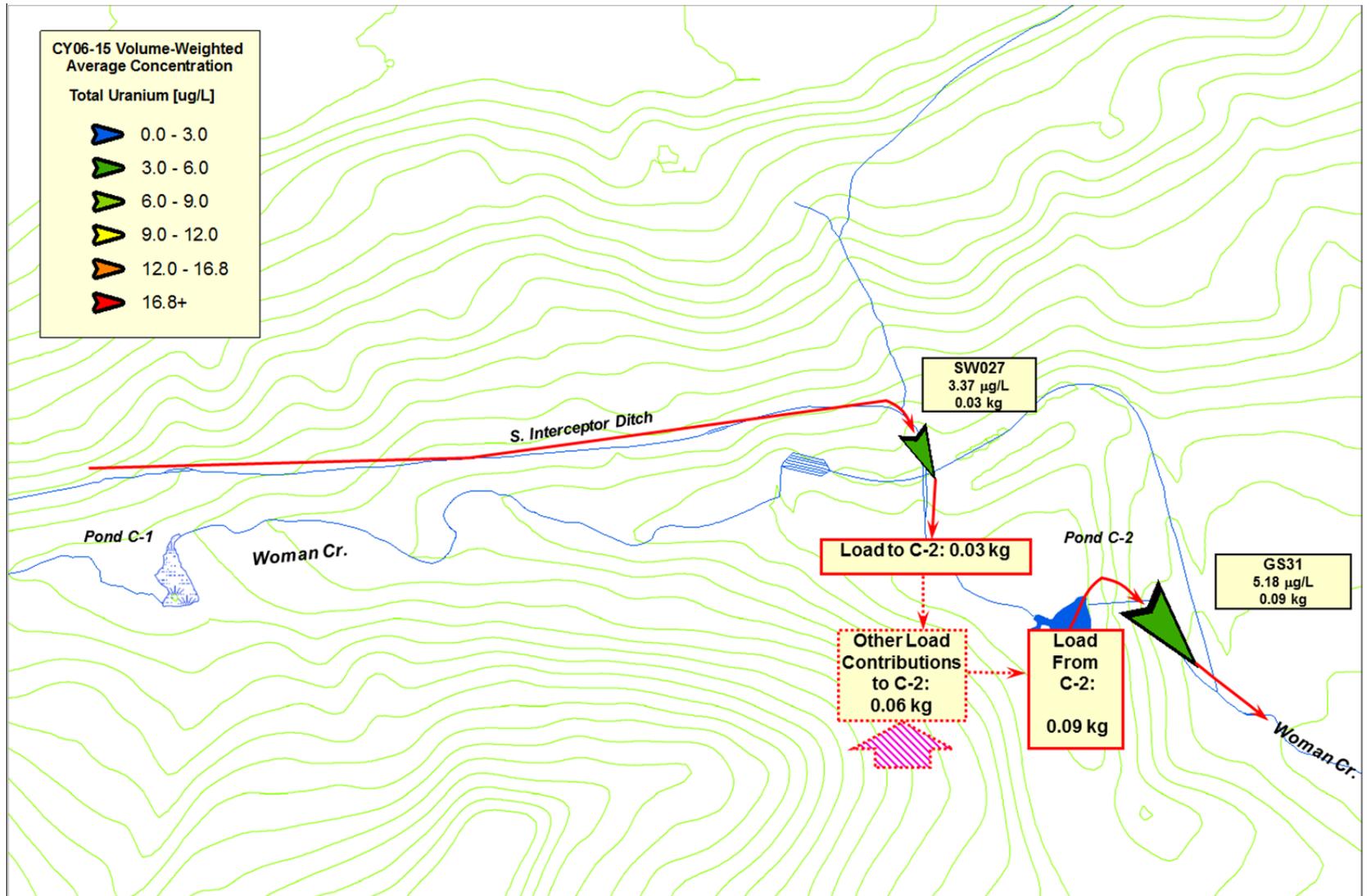
Notes: Pie chart diameters are relative to total load.

Figure 178. Relative Average Annual Am Load Totals for Pond C-2



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to concentration ranges in the legend.

Figure 179. Relative Average Annual U Loading Schematic for Pond C-2: CY 1997–2005



Notes: Location symbols are sized proportional to the calculated average annual load and colored according to concentration ranges in the legend.

Figure 180. Relative Average Annual U Loading Schematic for Pond C-2: CY 2006–2015

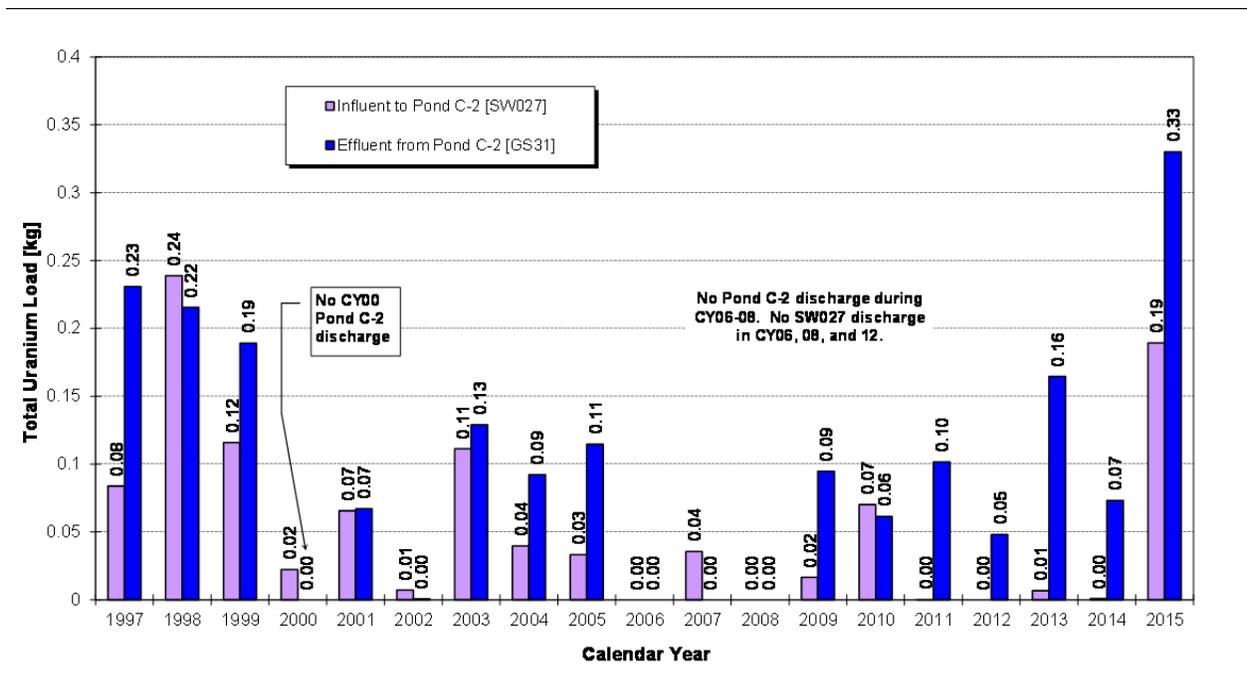
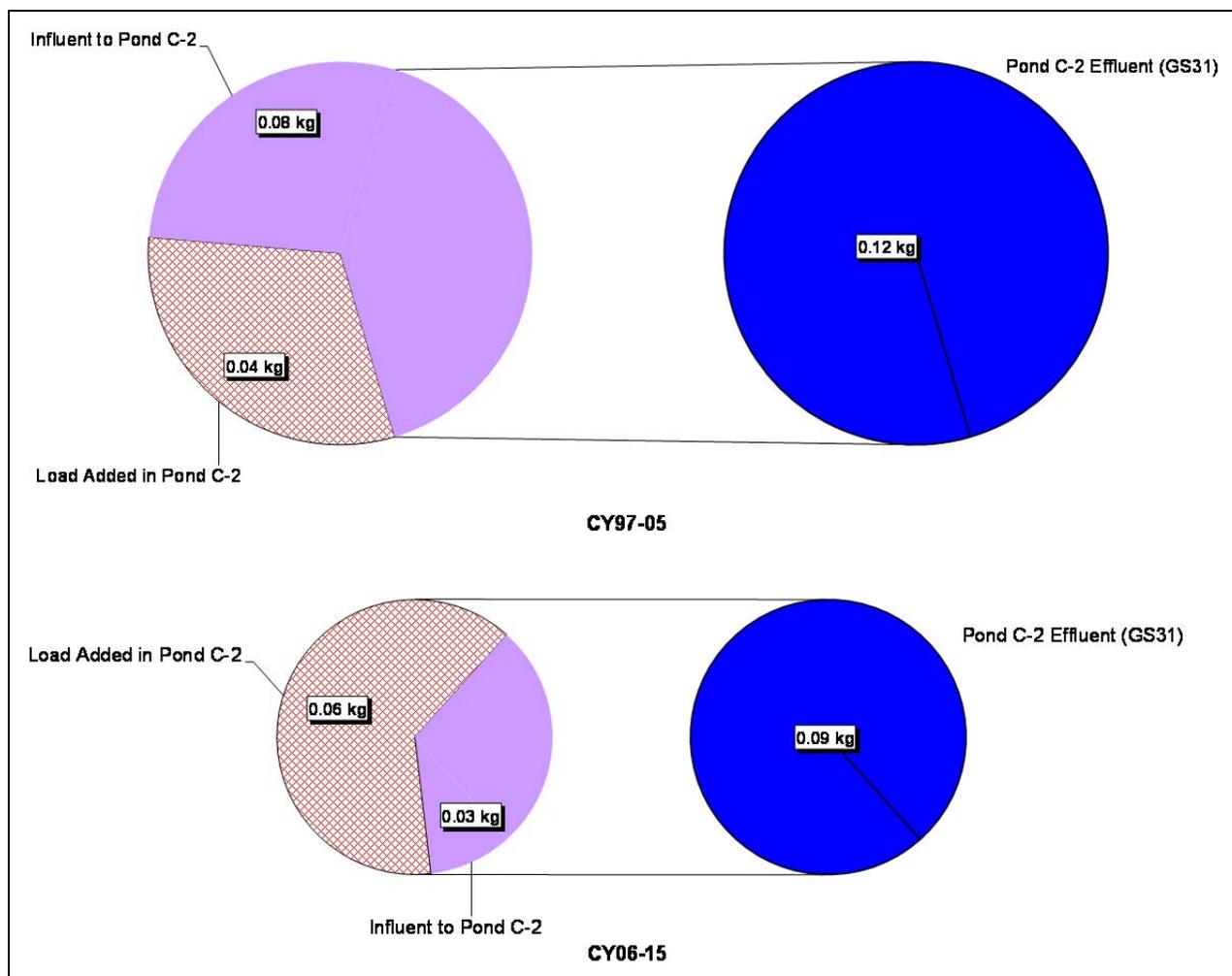


Figure 181. Annual Total U Loads for Pond C-2: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 182. Relative Average Annual Total U Load Totals for Pond C-2

RFLMA Points of Evaluation

This section summarizes the calculated Pu, Am, and U loads for the three major former IA drainages: North Walnut Creek (SW093), South Walnut Creek (GS10 and the former WWTP), and the SID (SW027). Data are presented in Table 70 and Table 71 and are depicted on Figure 183 through Figure 192. The following points are noted:

- Total Pu load varies year to year and shows a significant increase in CY 2004 mostly due to extensive soil disturbance (Figure 183). With the completion of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006–2014. Although the CY 2011–2013 and CY 2015 loads were affected by recent increases in Pu activity at GS10 and the wet spring of 2015, respectively, average annual post-closure Pu loads have been reduced by 73 percent.
- Total Am load also varies year to year and shows a measurable increase in CY 2004 due to soil disturbance and contributions from closure actions in the B771 area (Figure 185). With the completion of remedial actions, erosion controls, revegetation, and soil stabilization, a reduction is noted for CY 2006–2014. Data from SW093 in CY 2005 (Figure 190) also

clearly show that the B771 pathway elimination was successful. Although the CY 2011–2013 and CY 2015 loads were affected by recent increases in Am activity at GS10 and the wet spring of 2015, respectively, average annual post-closure Am loads have still been reduced by 81 percent.

- South Walnut Creek accounts for a majority (47 percent) of the Pu load from the former IA (Figure 184) pre-closure. Of the South Walnut Creek Pu load, GS10 accounted for 97 percent, and the former WWTP accounted for the remaining 3 percent. Post-closure, the SID is the largest contributor (62 percent) of Pu load.
- South Walnut Creek accounts for a majority (60 percent) of the Am load from the former IA (Figure 186) pre-closure. Of the South Walnut Creek Am load, GS10 accounted for 96 percent, and the former WWTP accounted for the remaining 4 percent. Post-closure, South Walnut Creek remains the largest contributor (71 percent) of the Am loads.
- Annual total U loads are more consistent year to year (Figure 191), with a notable increase in CY 2015 due to the high flow volumes. The load reductions in CY 2006 and 2008 are due to flow volume reduction (dry years) and not a decrease in U concentration. Similarly, the load increases in CY 2010, 2013, and 2015 are due to large flow volumes and not a significant increase in U concentration. Post-closure average annual U loads are essentially unchanged from average annual pre-closure loads.
- Pre-closure total U loads are fairly evenly divided (44 percent to 50 percent) between North and South Walnut creeks (Figure 192). Post-closure, there is a slight shift toward South Walnut Creek (54 percent of the total).

Table 70. Former IA Drainage Pu and Am Loads: CY 1997–2015

Calendar Year	Pu-239,240 (µg)				Am-241 (µg)			
	North Walnut Creek (SW093)	South Walnut Creek (GS10)	South Walnut Creek (WWTP)	SID (SW027)	North Walnut Creek (SW093)	South Walnut Creek (GS10)	South Walnut Creek (WWTP)	SID (SW027)
1997	164.2	576.0	11.2	17.4	2.24	12.20	0.64	0.08
1998	69.1	328.6	13.4	87.7	1.30	4.69	0.32	0.25
1999	127.8	307.9	19.4	34.3	1.73	12.55	0.11	0.20
2000	87.4	326.2	17.4	67.2	0.98	14.57	0.29	0.24
2001	44.4	141.4	11.3	10.7	0.65	2.75	0.32	0.05
2002	9.6	59.3	8.3	0.3	0.52	1.76	0.20	0.00
2003	140.1	207.2	3.8	45.1	2.05	4.44	0.52	0.12
2004	1,330.9	523.3	2.1	820.8	28.48	4.68	0.25	3.09
2005	29.2	247.1	0.0; WWTP removed	18.6	0.82	3.98	0.00; WWTP removed	0.05
2006	2.5	2.3	0.0; WWTP removed	0.0; No flow	0.02	0.04	0.00; WWTP removed	0.00; No flow
2007	17.0	14.2	0.0; WWTP removed	16.5	0.28	0.14	0.00; WWTP removed	0.15
2008	13.2	3.5	0.0; WWTP removed	0.0; No flow	0.15	0.09	0.00; WWTP removed	0.00; No flow
2009	23.0	15.2	0.0; WWTP removed	6.9	0.21	0.15	0.00; WWTP removed	0.02
2010	16.4	13.1	0.0; WWTP removed	32.4	0.35	0.15	0.00; WWTP removed	0.12
2011	4.3	106.7	0.0; WWTP removed	<0.01	0.07	3.42	0.00; WWTP removed	0.00
2012	1.2	69.0	0.0; WWTP removed	0.0; No flow	0.04	2.13	0.00; WWTP removed	0.0; No flow
2013	4.3	257.0	0.0; WWTP removed	6.0	0.20	8.66	0.00; WWTP removed	0.01
2014	5.3	9.5	0.0; WWTP removed	0.7	0.10	0.70	0.00; WWTP removed	~0.0 ^a
2015	43.8	56.6	0.0; WWTP removed	1,020	0.51	0.80	0.00; WWTP removed	4.45
Total	2,134	3,264	86.9	2,185	40.7	77.9	2.65	8.86

Notes:

^a Estimated

Table 71. Former IA Total U Loads: CY 1997–2015

Calendar Year	Total U (kg)			
	North Walnut Creek (SW093)	South Walnut Creek (GS10)	South Walnut Creek (WWTP)	SID (SW027)
1997	0.85	0.64	0.26	0.08
1998	0.80	0.63	0.47	0.24
1999	0.71	0.59	0.12	0.12
2000	0.49	0.38	0.10	0.02
2001	0.65	0.52	0.26	0.07
2002	0.45	0.28	0.06	<0.01
2003	0.57	0.50	0.16	0.11
2004	0.57	0.43	0.14	0.04
2005	0.53	0.88	0.00; WWTP removed	0.03
2006	0.17	0.23	0.00; WWTP removed	0.00; No flow
2007	0.54	0.83	0.00; WWTP removed	0.04
2008	0.15	0.28	0.00; WWTP removed	0.00; No flow
2009	0.57	0.76	0.00; WWTP removed	0.02
2010	1.05	1.16	0.00; WWTP removed	0.07
2011	0.40	0.76	0.00; WWTP removed	~0.0
2012	0.29	0.68	0.00; WWTP removed	0.00; No flow
2013	0.77	0.93	0.00; WWTP removed	0.07
2014	0.51	0.58	0.00; WWTP removed	~0.0 ^a
2015	1.96	1.80	0.00; WWTP removed	0.19
Total	12.0	12.8	1.57	1.04

Notes:

^a Estimated

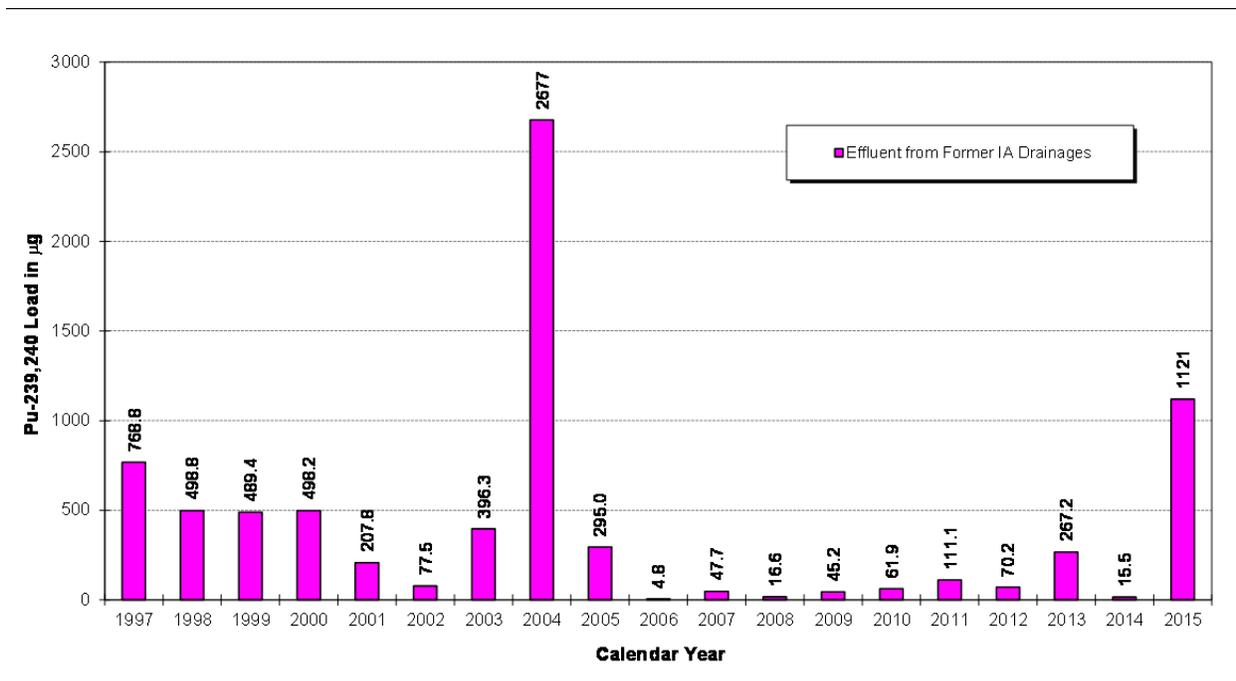
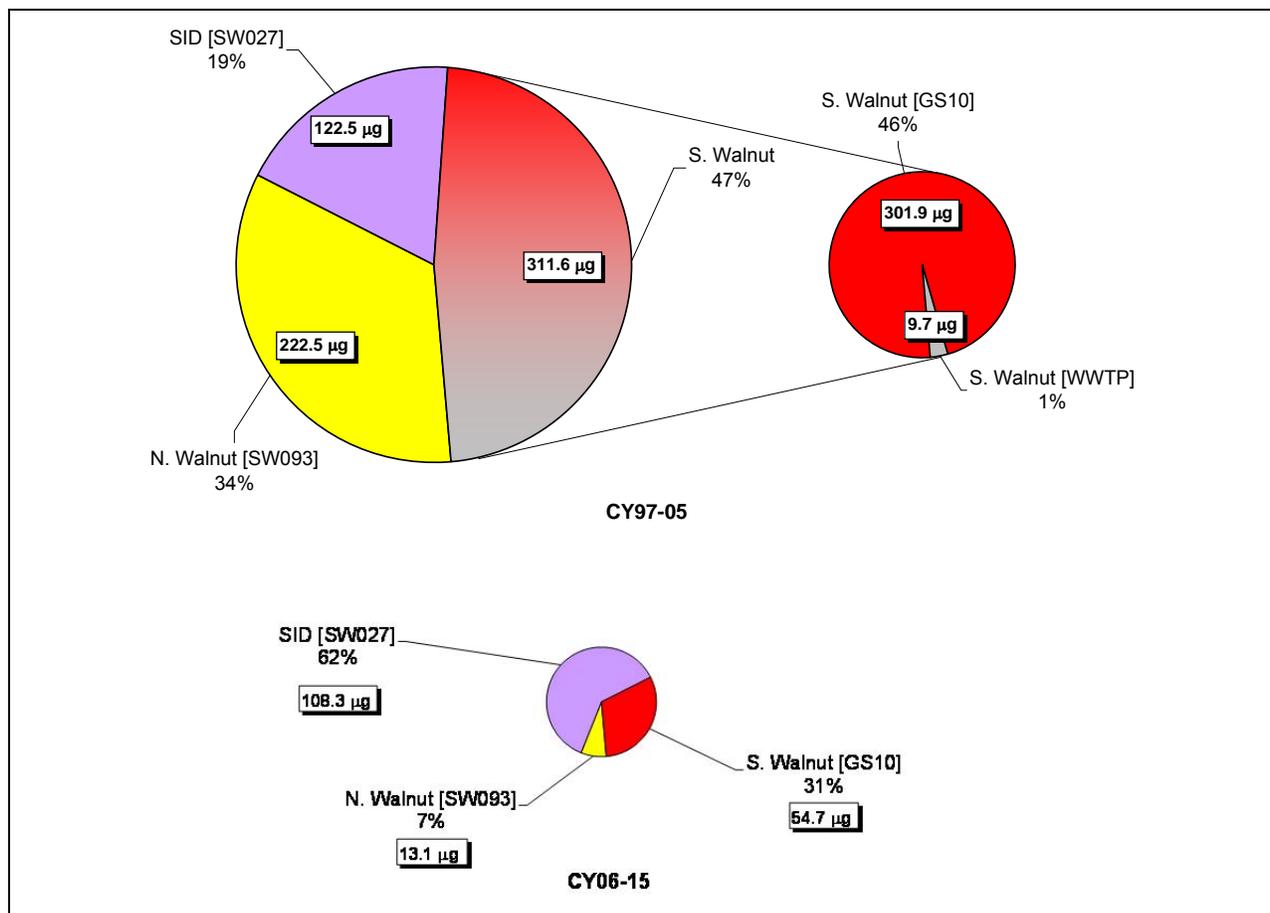


Figure 183. Combined Annual Pu Loads from Former IA Drainages: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 184. Relative Average Annual Pu Load Totals from Former IA Drainages and WWTP

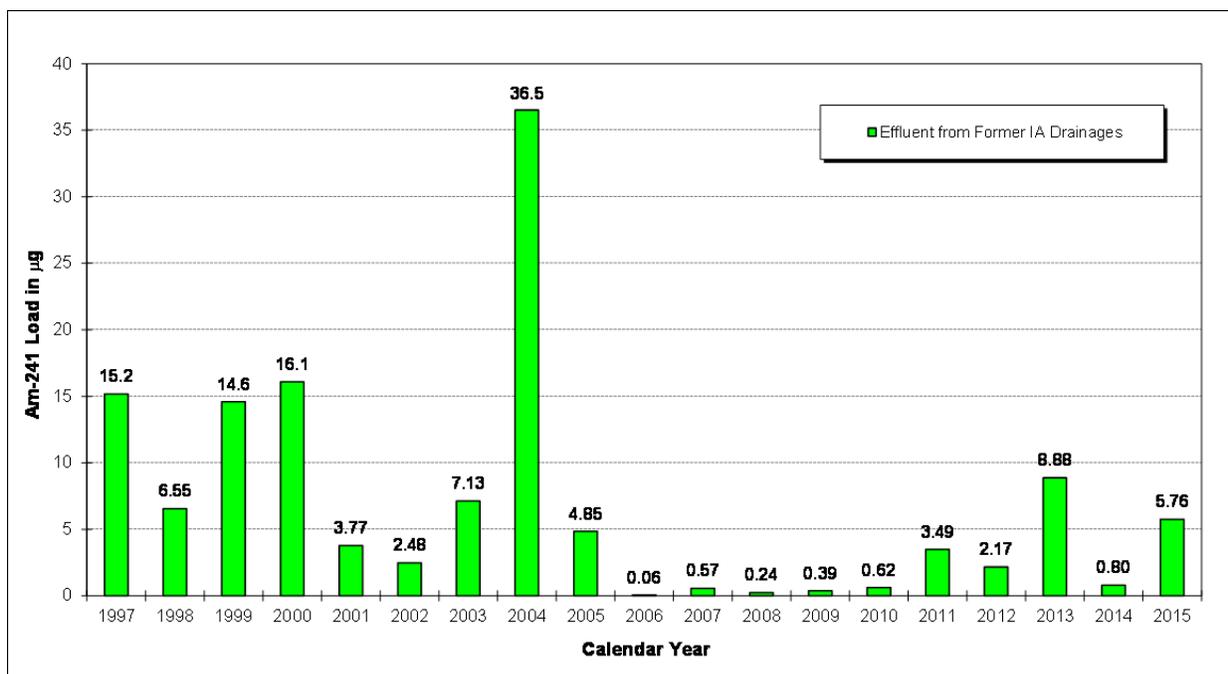
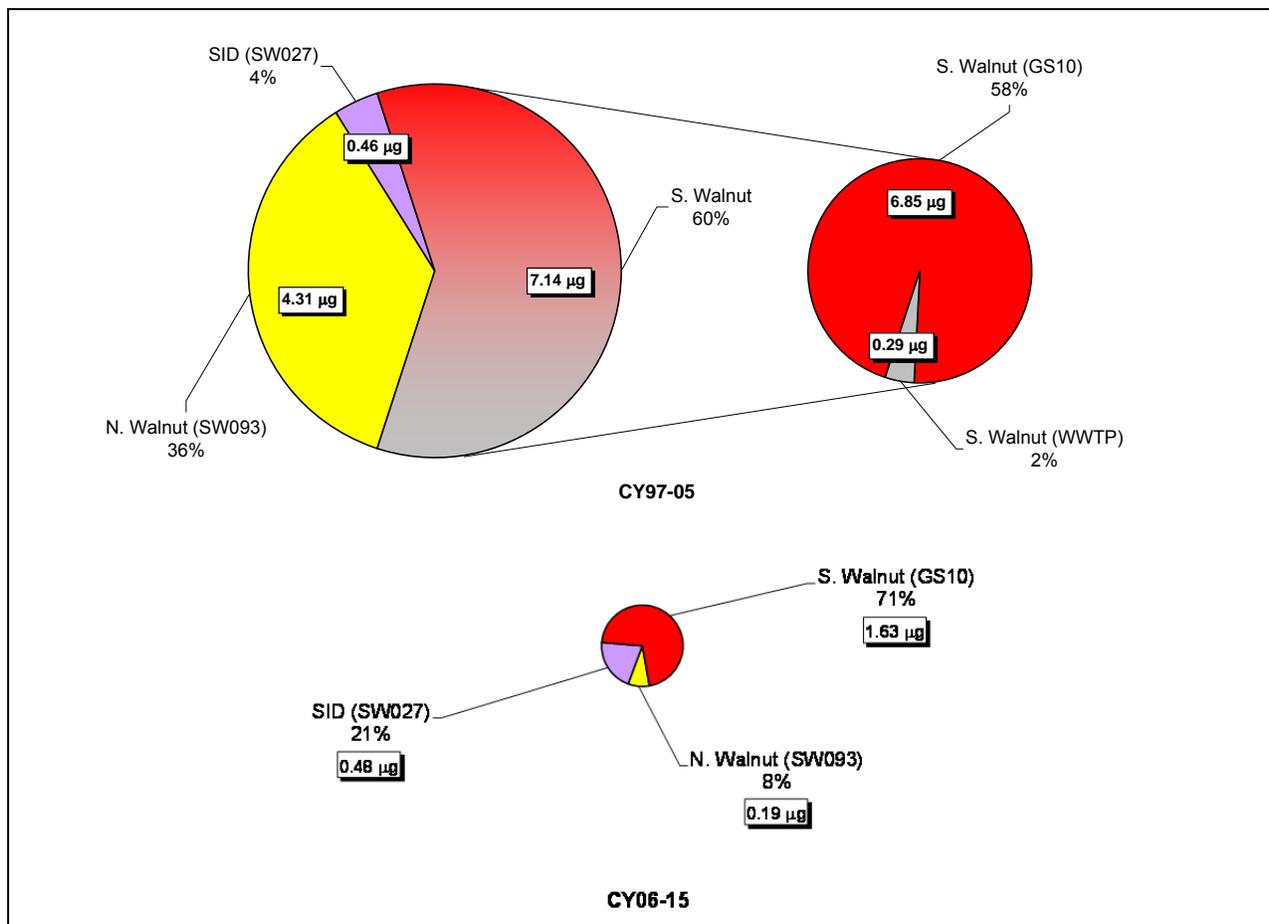


Figure 185. Annual Am Loads from Former IA Drainages and WWTP: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 186. Relative Average Annual Am Load Totals from Former IA Drainages and WWTP

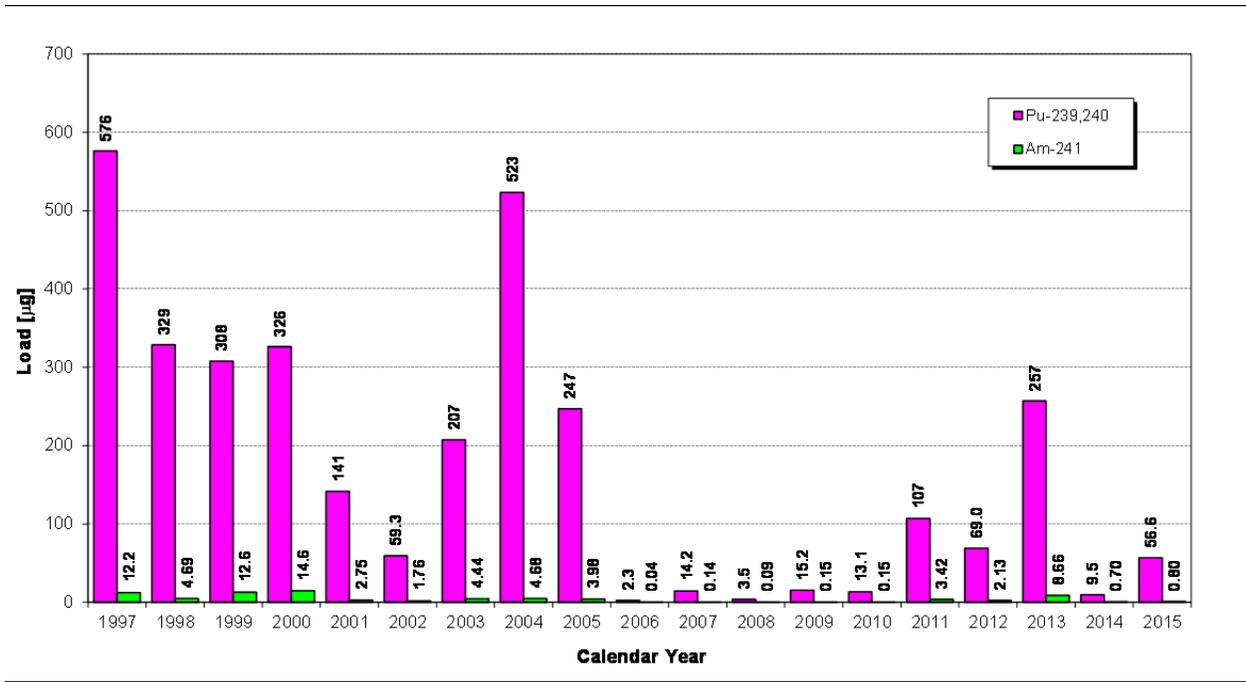


Figure 187. Annual Pu and Am Loads at GS10: CY 1997–2015

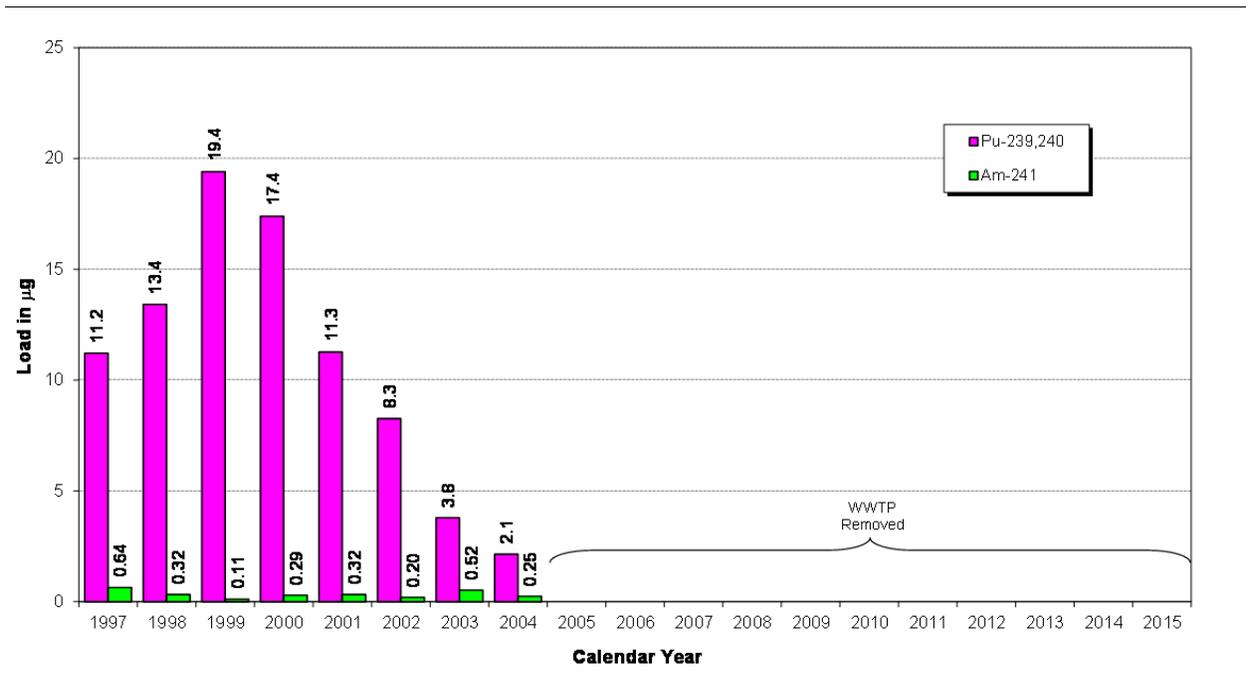


Figure 188. Annual Pu and Am Loads at the WWTP: CY 1997–2015

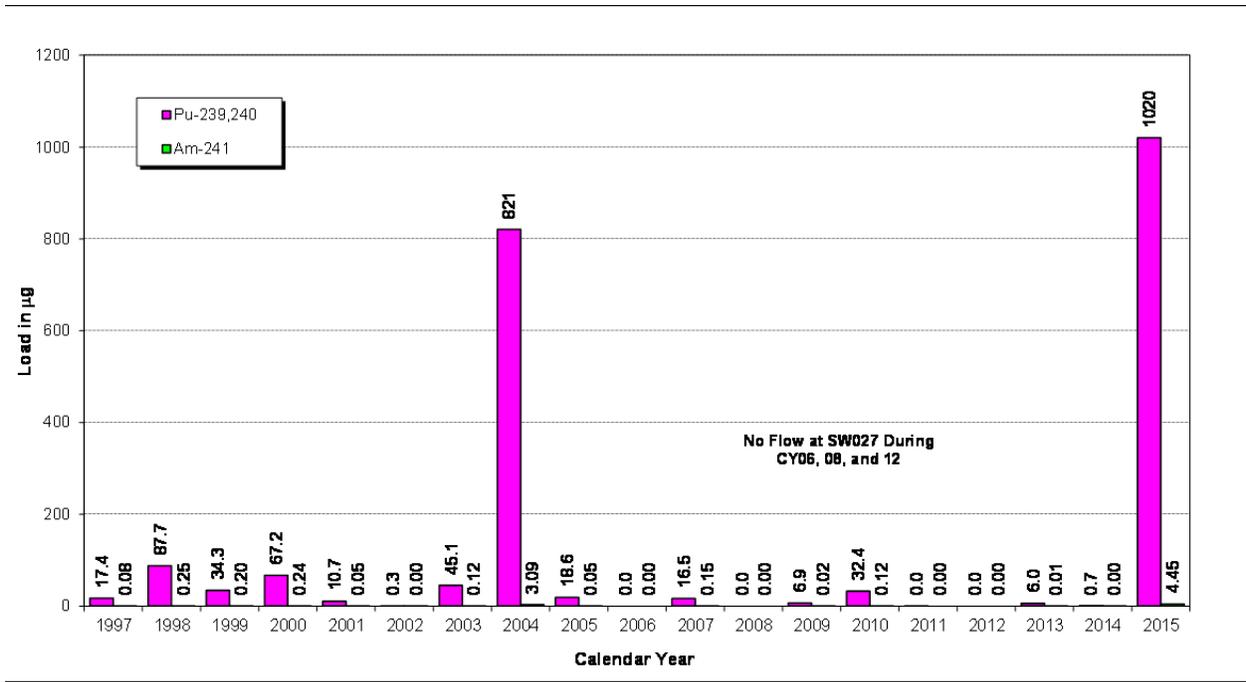


Figure 189. Annual Pu and Am Loads at SW027: CY 1997–2015

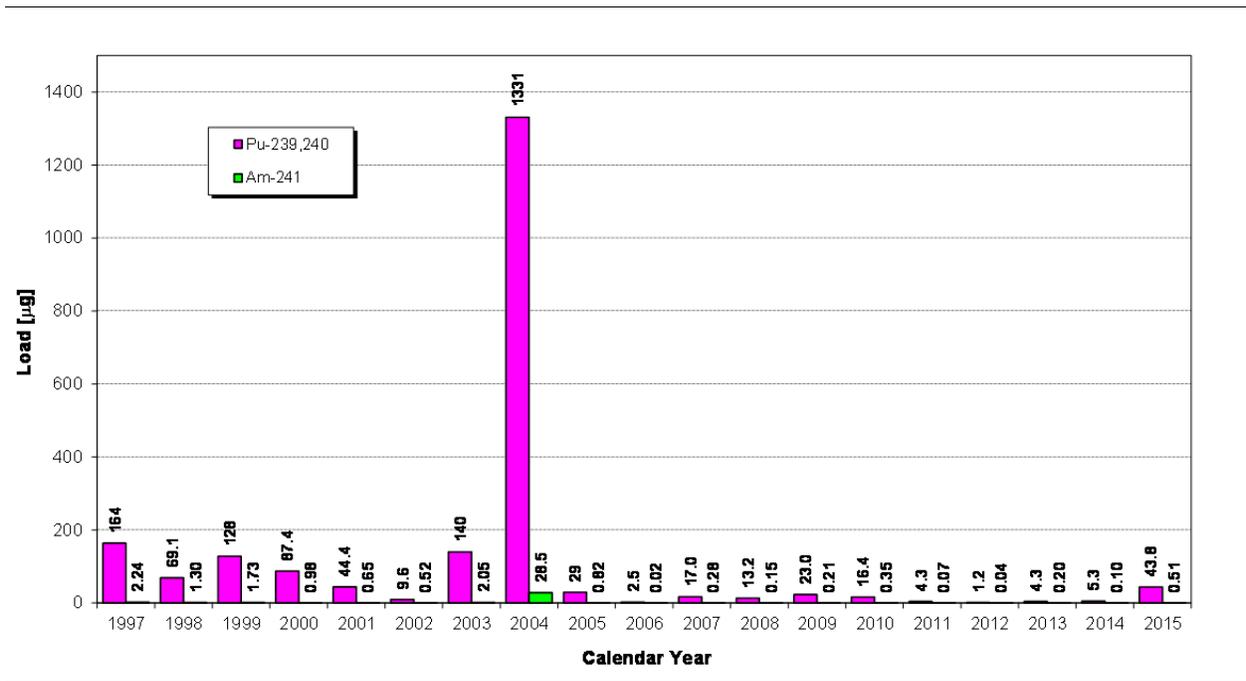


Figure 190. Annual Pu and Am Loads at SW093: CY 1997–2015

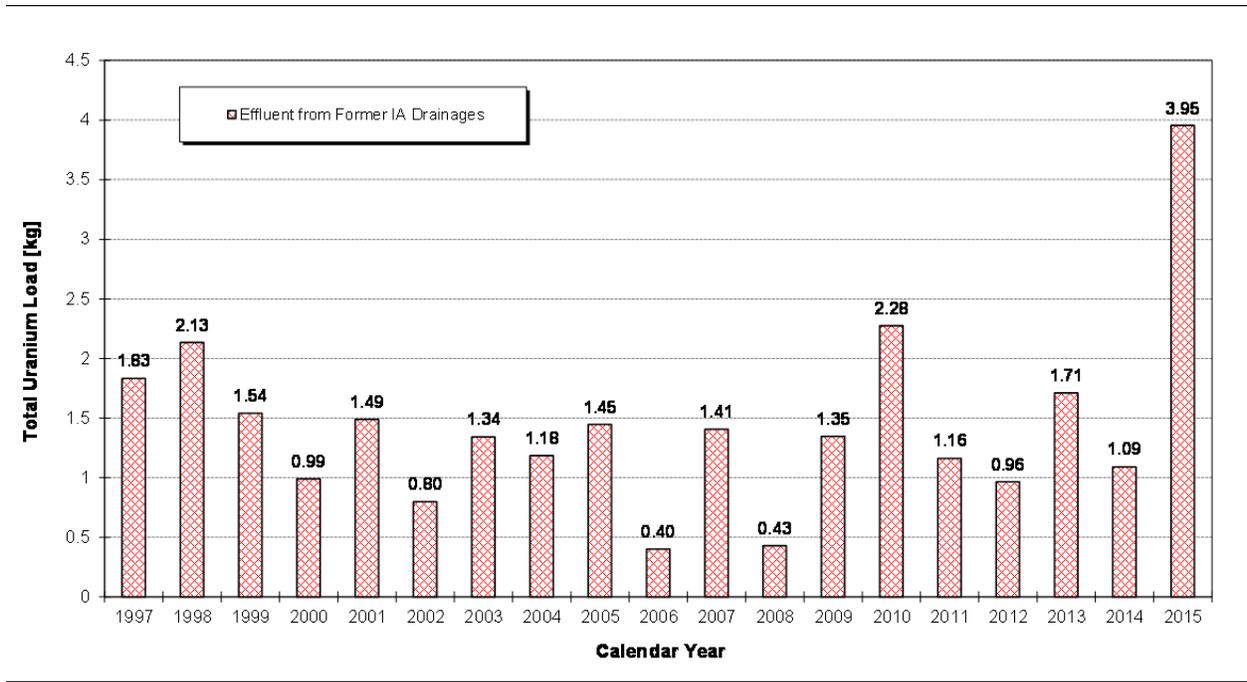
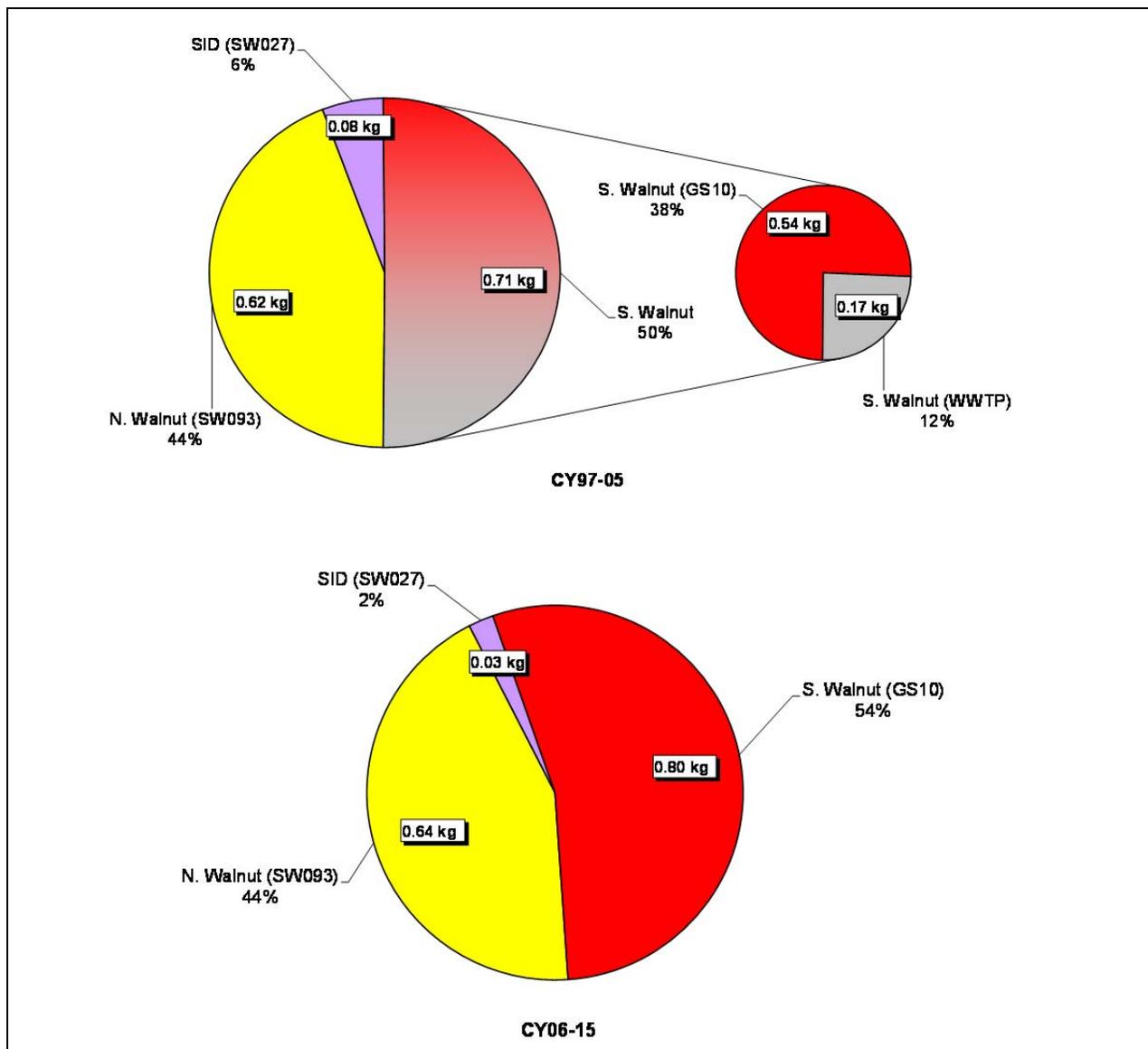


Figure 191. Annual Total U Loads from Former IA Drainages and WWTP: CY 1997–2015



Notes: Pie chart diameters are relative to total load.

Figure 192. Relative Average Annual Total U Loads from Former IA Drainages and WWTP

3.1.5 Groundwater Data Interpretation and Evaluation

This section provides a summary of groundwater monitoring performed in 2015. A discussion of groundwater conditions during 2015, focusing on the most important water-quality aspects in the areas of interest (i.e., the main contaminant plumes), is then presented.

3.1.5.1 RFLMA Groundwater Monitoring Activities of 2015

Routine activities of the groundwater monitoring program in 2015 included sample collection, water-level measurement, groundwater treatment system maintenance, and well maintenance. “Groundwater” monitoring also includes monitoring activities at several surface-water locations, as well as at some locations that may not clearly belong to either category. (Examples of the