New seeps and wet areas have developed at several locations throughout the COU where wetlands are developing naturally. The *Rocky Flats, Colorado, Site Wetland Mitigation Monitoring and Management Plan* (DOE 2006b) provides guidance for monitoring mitigation wetlands and reporting. The 2010 results are presented in the *Rocky Flats, Colorado, Site, 2010 Annual Wetland Mitigation Monitoring Report* (DOE 2011c).

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, 2011 (CY 1997–2011) for the routine automated surface-water monitoring locations operational in CY 2011. Radionuclides summarized include Pu, Am,[13] and total U. Additionally, the POE metals (total beryllium [Be], dissolved Cd, total Cr, and dissolved silver [Ag]) and nitrate+nitrite as N are also summarized. Additional analyses are also performed based on the specific monitoring objective. The results and evaluation for these additional analytes are presented in Section 3.1.2.1 through Section 3.1.2.11 by monitoring objective.

The summary values in this section should not be confused with the RFLMA required water-quality evaluations according to 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, WOMPOC, GS01, GS03, GS08, GS11, and GS31; 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 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.

[13] In this report, "plutonium" or "Pu" refers to plutonium-239,240; and "americium" or "Am" refers to americium-241.
[14] Summaries do not include supplemental post-closure grab samples for uranium 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."

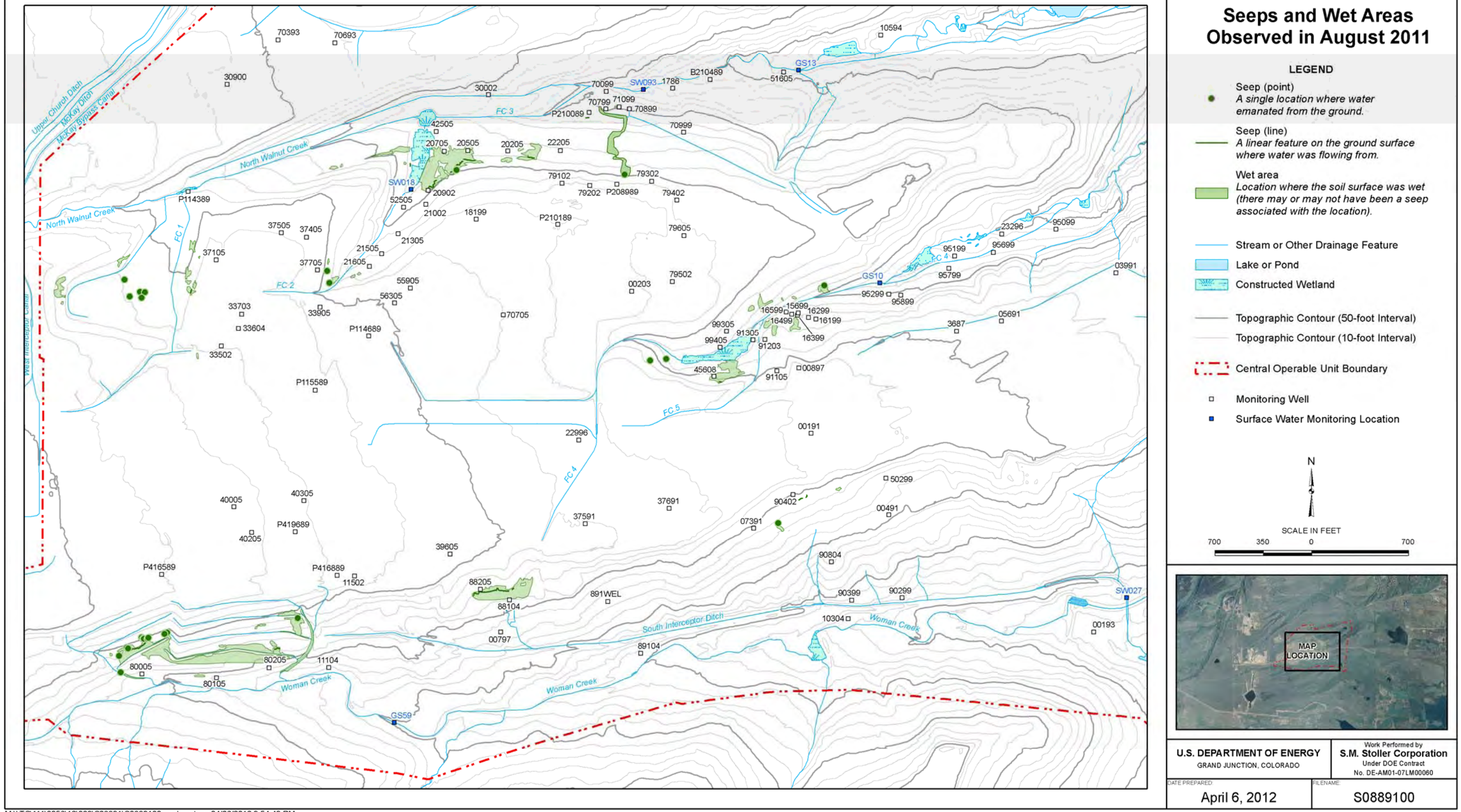

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Figure 157. Seeps and Wet Areas Observed in 2011

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

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 53 and Table 54 show that post-closure median Pu activities for all locations are below the RFLMA standard of 0.15 pCi/L. After closure, significant reductions in 85th percentile and maximum Pu activities are noted, most significantly at POE locations GS10, SW027, and SW093. Figure 158 and Figure 159 show the pre- and post-closure median Pu activities, respectively.

Table 53. Summary Statistics for Pu-239,240 Analytical Results in CY 1997—October 13, 2005

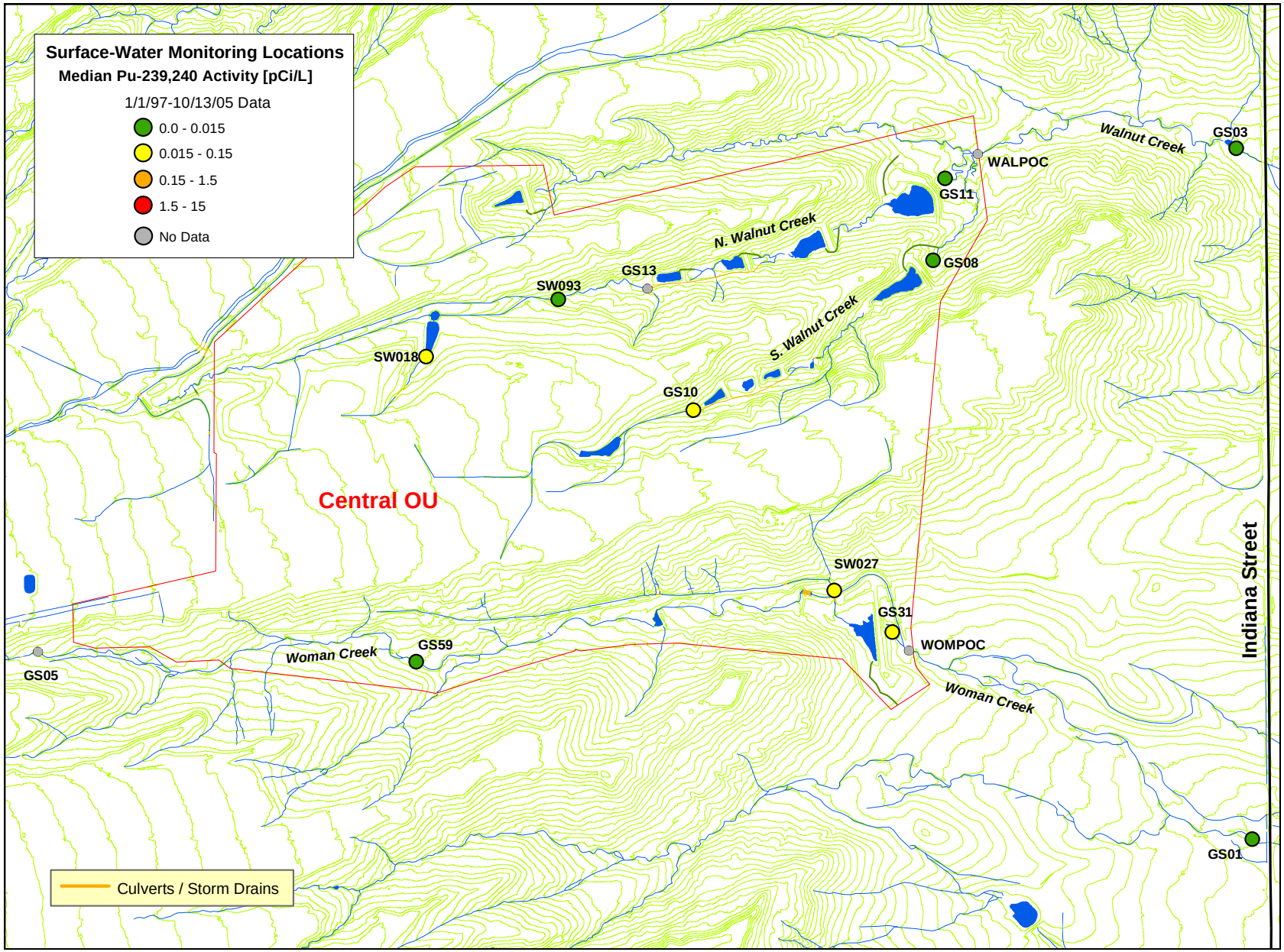
Location	Samples (N)	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	**165**	**0.002**	**0.008**	**0.024**
GS03	**257**	**0.005**	**0.016**	**0.220**
WOMPOC	**NA**	**NA**	**NA**	**NA**
WALPOC	**NA**	**NA**	**NA**	**NA**
GS05	NA	NA	NA	NA
GS08	**118**	**0.004**	**0.013**	**0.864**
GS10	**266**	**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: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = analyte not sampled
Bold = POC or POE

Table 54. Post-Closure Summary Statistics for Pu-239,240 Analytical Results (October 13, 2005−December 31, 2011)

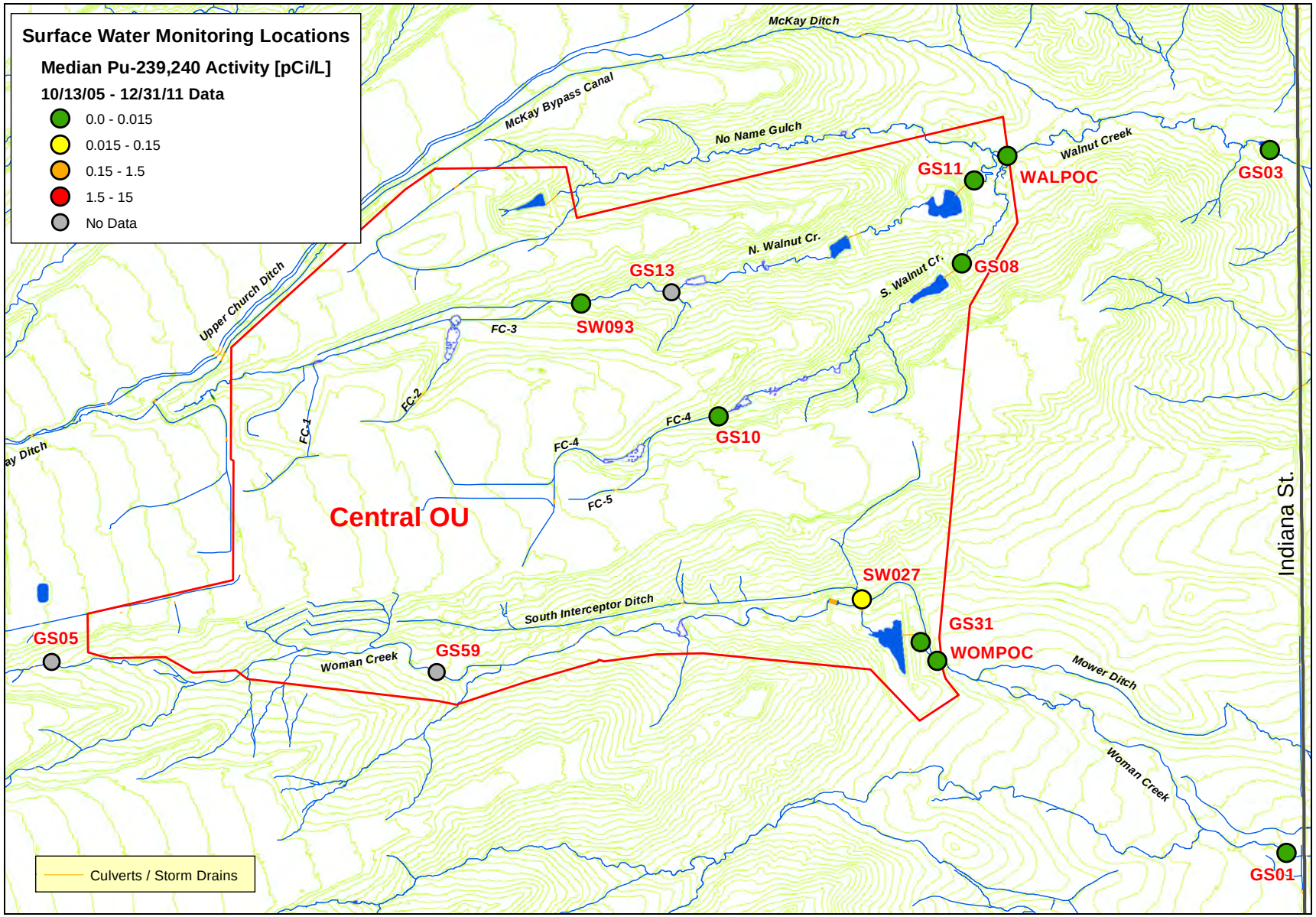
Location	Samples (N)	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	**96**	**0.002**	**0.008**	**0.025**
GS03	**68**	**0.003**	**0.007**	**0.036**
WOMPOC	**5**	**0.004**	**0.007**	**0.012**
WALPOC	**6**	**0.001**	**0.006**	**0.009**
GS05	NA	NA	NA	NA
GS08	**36**	**0.003**	**0.008**	**0.017**
GS10	**104**	**0.009**	**0.031**	**.658**
GS11	**38**	**0.003**	**0.008**	**0.046**
GS13	NA	NA	NA	NA
GS31	**14**	**0.003**	**0.013**	**0.023**
GS59	NA	NA	NA	NA
SW027	**9**	**0.092**	**0.260**	**0.300**
SW093	**99**	**0.006**	**0.024**	**0.861**

Notes: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = analyte not sampled
Bold = POC or POE



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

Figure 158. Median Pu-239,240 Activities for CY 1997—October 13, 2005



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

Figure 159. Post-Closure Median Pu-239,240 Activities

Table 55 and Table 56 show that post-closure median Am activities for all locations are below the RFLMA standard of 0.15 pCi/L. After closure, significant reductions in 85th percentile and maximum Am activities are noted, most significantly at POE locations GS10, SW027, and SW093. Figure 160 and Figure 161 show median Am activities for pre- and post-closure, respectively.

Table 55. Summary Statistics for Am-241 Analytical Results in CY 1997—October 13, 2005

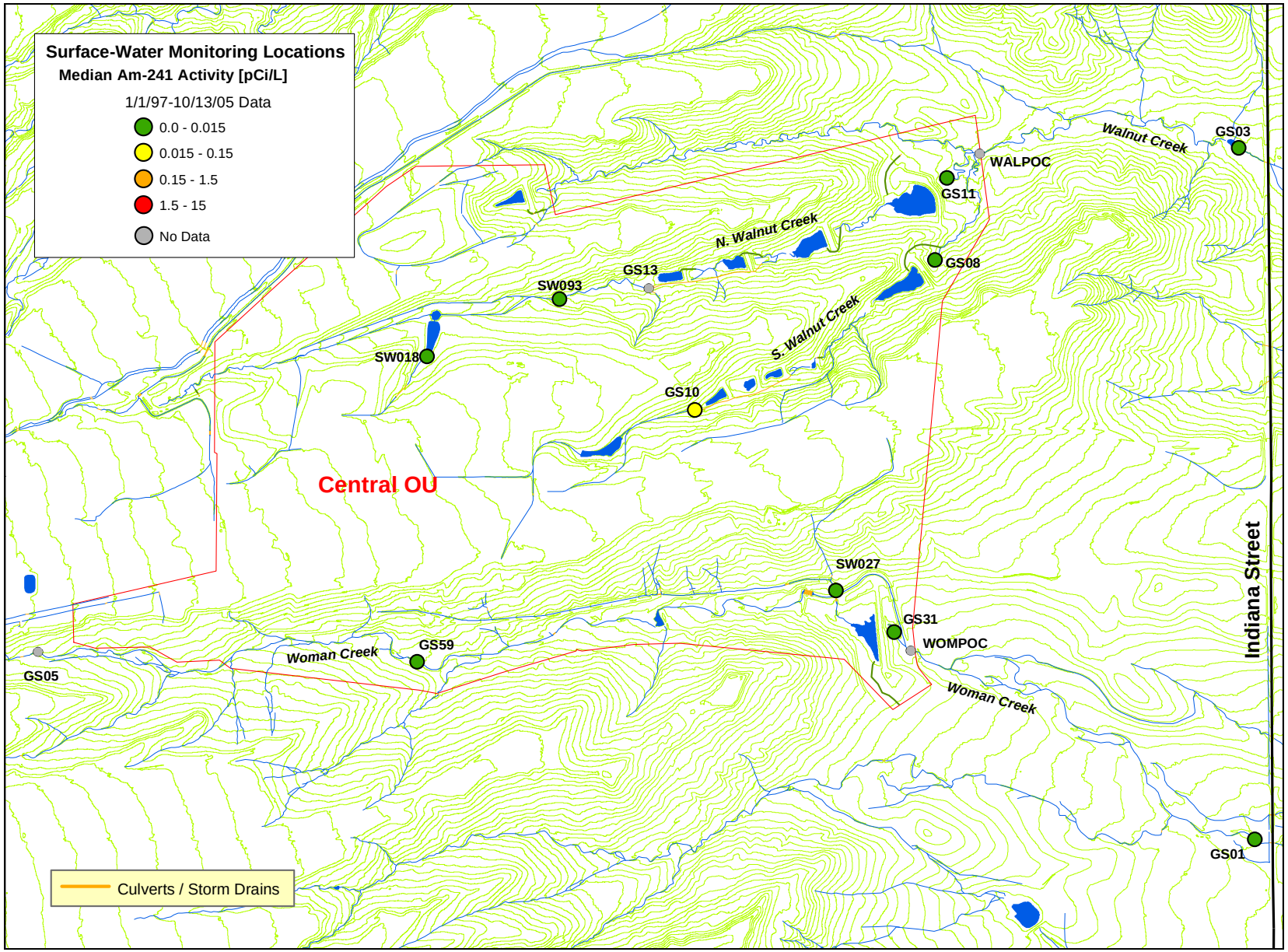
Location	Samples (N)	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	**164**	**0.001**	**0.008**	**0.054**
GS03	**258**	**0.006**	**0.018**	**0.066**
WOMPOC	**NA**	**NA**	**NA**	**NA**
WALPOC	**NA**	**NA**	**NA**	**NA**
GS05	NA	NA	NA	NA
GS08	**118**	**0.006**	**0.015**	**0.275**
GS10	**259**	**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: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = Analyte not sampled
Bold = POC or POE

Table 56. Post-Closure Summary Statistics for Am-241 Analytical Results (October 13, 2005–December 31, 2011)

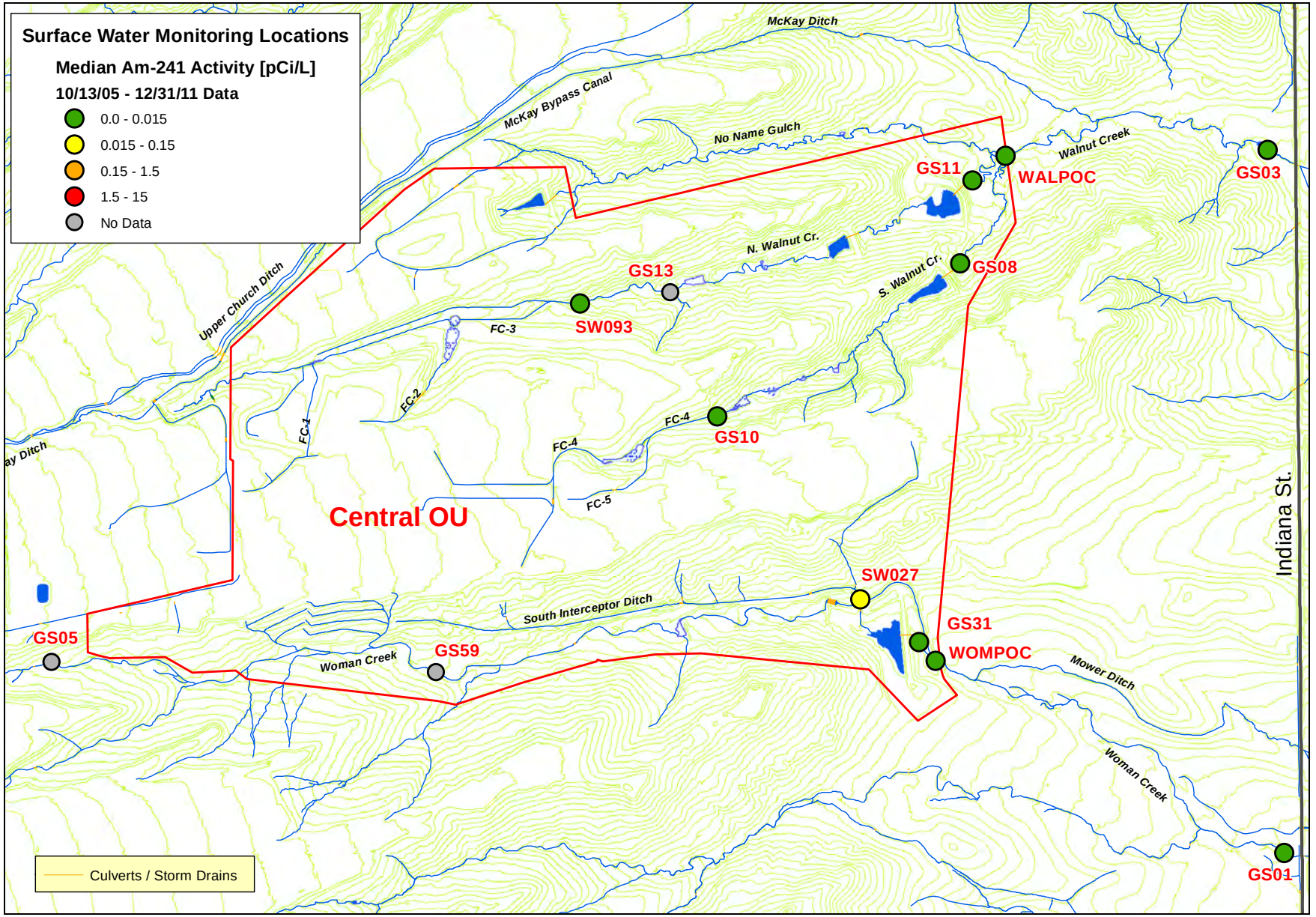
Location	Samples (N)	Median (pCi/L)	85th Percentile (pCi/L)	Maximum (pCi/L)
GS01	**96**	**0.001**	**0.007**	**0.057**
GS03	**68**	**0.002**	**0.007**	**0.027**
WOMPOC	**5**	**0.004**	**0.006**	**0.006**
WALPOC	**6**	**0.004**	**0.006**	**0.008**
GS05	NA	NA	NA	NA
GS08	**36**	**0.002**	**0.005**	**0.012**
GS10	**105**	**0.008**	**0.039**	**3.49**
GS11	**38**	**0.003**	**0.005**	**0.027**
GS13	NA	NA	NA	NA
GS31	**14**	**0.002**	**0.007**	**0.008**
GS59	NA	NA	NA	NA
SW027	**9**	**0.016**	**0.048**	**0.053**
SW093	**99**	**0.005**	**0.018**	**0.357**

Notes: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = Analyte not sampled
Bold = POC or POE



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

Figure 160. Median Am-241 Activities for CY 1997—October 13, 2005



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

Figure 161. Post-Closure Median Am-241 Activities

Table 57 and Table 58 show that post-closure median total U concentrations for all locations do not exceed the RFLMA standard of 16.8 µg/L. Recent data from GS10, GS13, and SW093 show total U levels in excess of 16.8 µg/L. U activities at GS13 are likely to be affected by the former Solar Ponds. Recent observations also indicate that SW093 is periodically influenced by surface seepage from the SPPTS hillside area. In addition, the measurements at GS10 and SW093 are influenced by contributions of naturally occurring U in groundwater and hydrologic changes post-closure. These U concentrations can also be seen in samples collected at downstream locations GS11, GS08, WALPOC, and GS03. Figure 162 and Figure 163 show median total U activities for pre- and post-closure, respectively.

Table 57. Summary Statistics for Total U Analytical Results in CY 1997—October 13, 2005

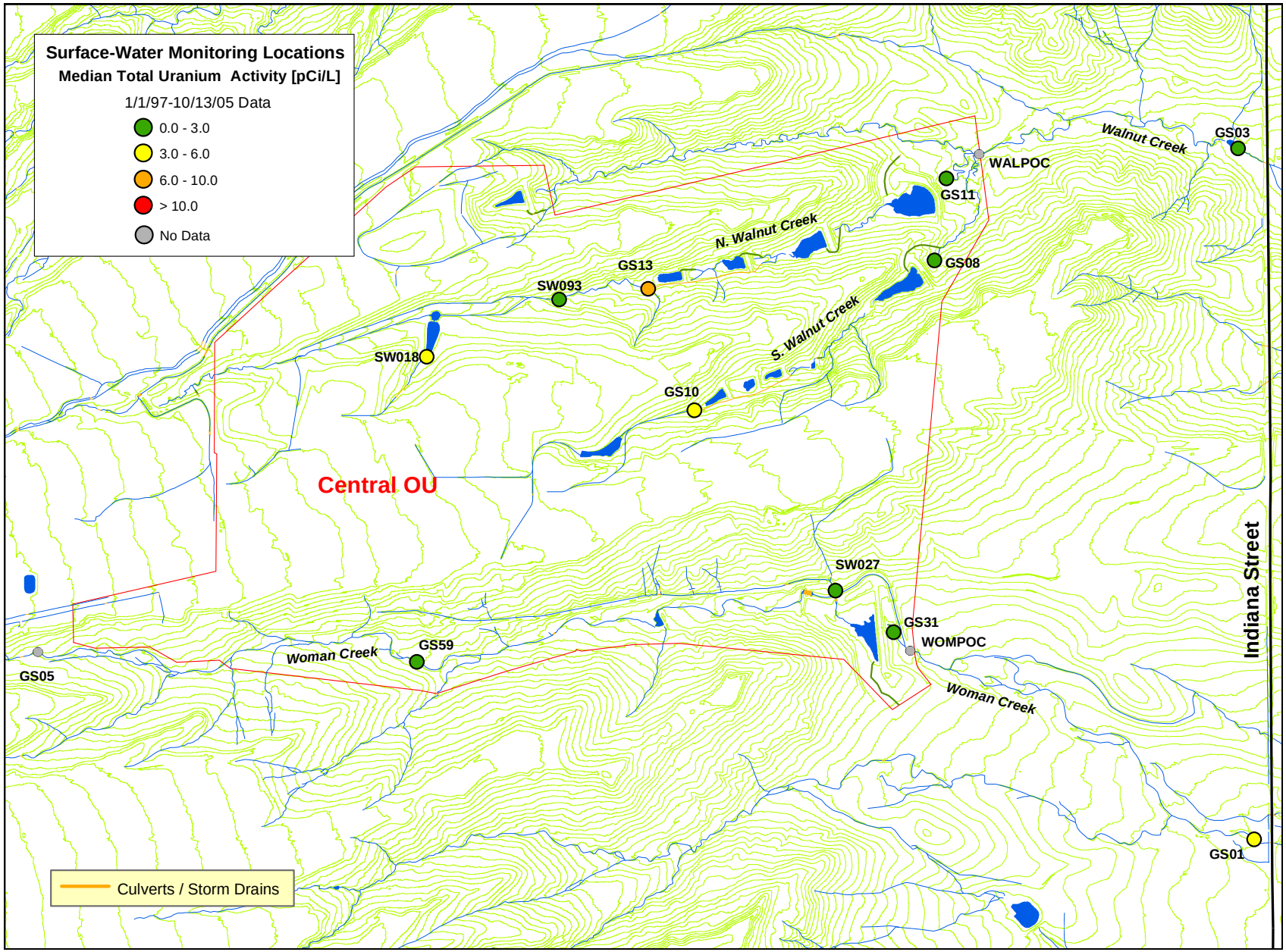
Location	Samples (N)	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
GS01	**53**	**4.29**	**6.51**	**11.9**
GS03	**78**	**2.37**	**4.48**	**7.64**
WOMPOC	**NA**	**NA**	**NA**	**NA**
WALPOC	**NA**	**NA**	**NA**	**NA**
GS05	NA	NA	NA	NA
GS08	**118**	**1.83**	**3.09**	**9.88**
GS10	**266**	**4.48**	**7.15**	**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: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = Analyte not sampled
Bold type = POC or POE

Table 58. Post-Closure Summary Statistics for Total U Analytical Results (October 13, 2005−December 31, 2011)

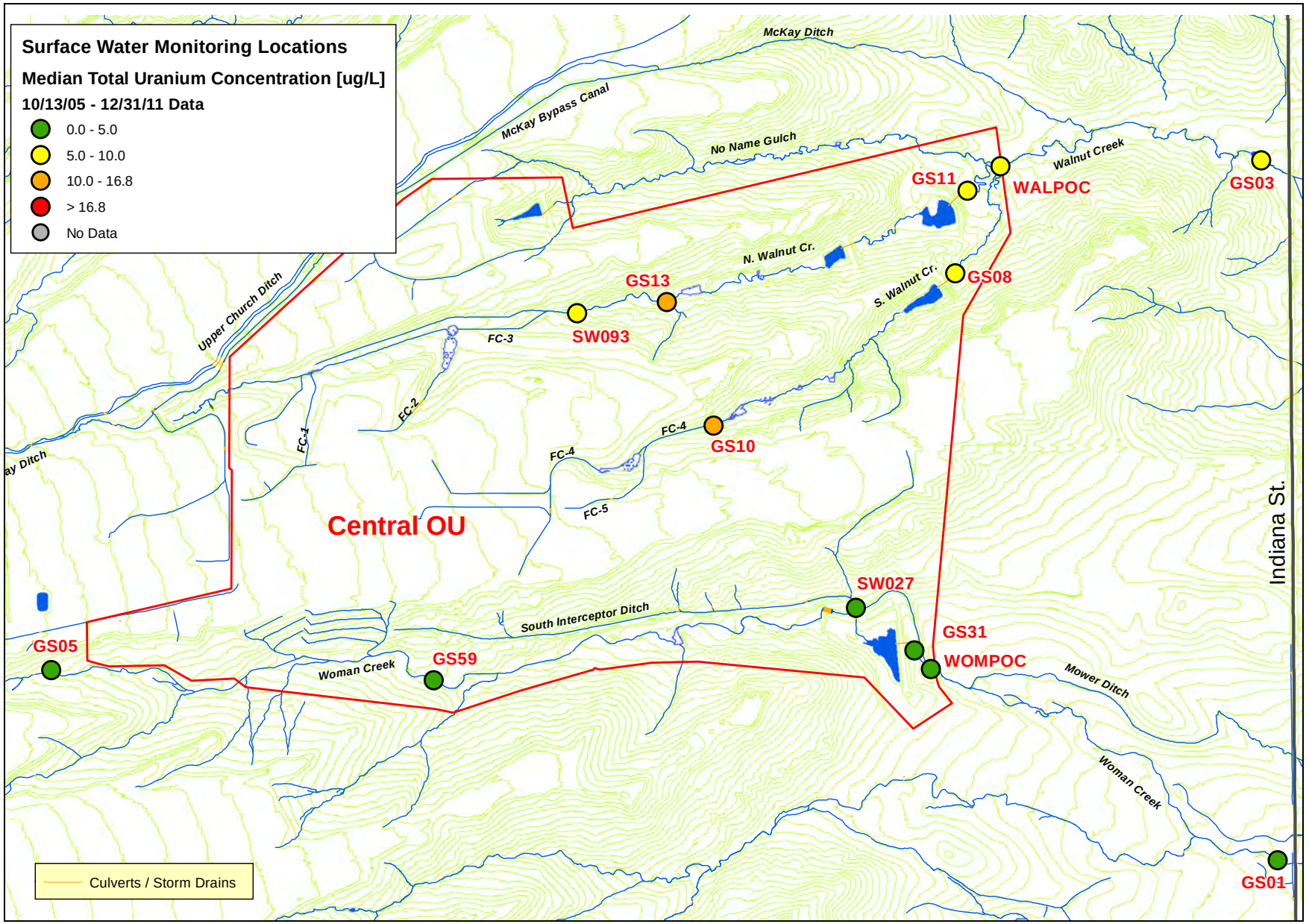
Location	Samples (N)	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
GS01	**96**	**4.03**	**6.65**	**9.09**
GS03	**68**	**5.83**	**8.49**	**10.2**
WOMPOC	**5**	**4.41**	**6.67**	**6.98**
WALPOC	**6**	**7.25**	**10.8**	**12.7**
GS05	51	0.71	1.44	4.67
GS08	**36**	**8.25**	**12.7**	**15.1**
GS10	**105**	**16.5**	**24.3**	**89.2**
GS11	**38**	**6.67**	**9.70**	**13.5**
GS13	87	16.8	44.2	63.6
GS31	**14**	**4.97**	**7.73**	**8.22**
GS59	49	1.40	2.24	9.30
SW027	**9**	**3.36**	**6.08**	**7.07**
SW093	**99**	**7.62**	**11.6**	**23.4**

Notes: WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.
NA = Analyte not sampled
Bold = POC or POE



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

Figure 162. Median Total U Activities for CY 1997—October 13, 2005



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

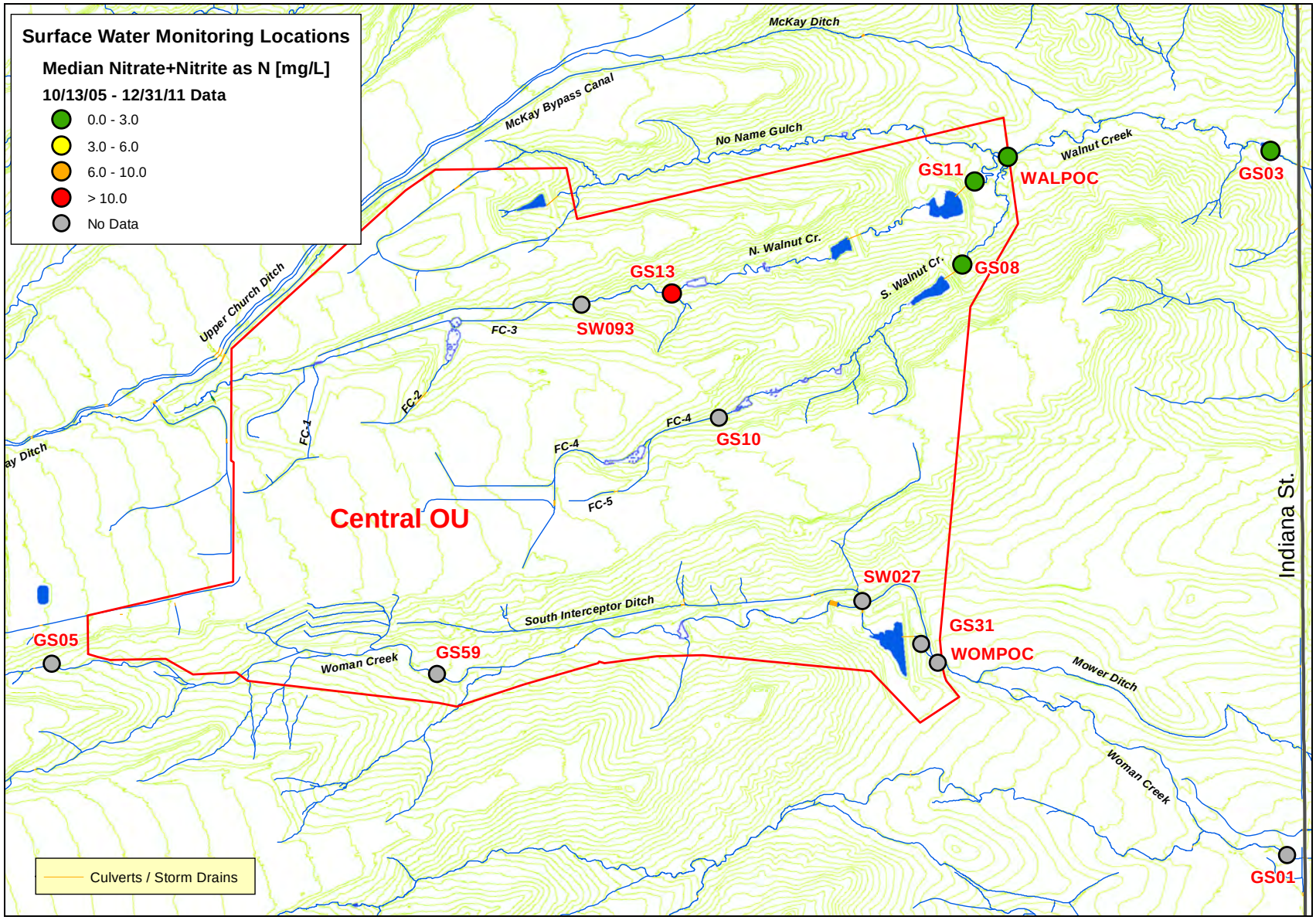
Figure 163. Post-Closure Median Total U Activities

Table 59 and Figure 164 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 59. Post-Closure Summary Statistics for Nitrate+Nitrite as Nitrogen Analytical Results (October 13, 2005−December 31, 2011)

Location	Samples (N)	Median (mg/L)	85th Percentile (mg/L)	Maximum (mg/L)
GS03	**44**	**0.24**	**3.43**	**6.70**
WALPOC	**6**	**0.02**	**0.07**	**0.21**
GS08	**29**	**0.11**	**0.24**	**0.73**
GS11	**38**	**0.98**	**5.66**	**8.20**
GS13	75	26.0	64.0	100

Notes: WALPOC began operation on September 9, 2011.
Bold = POC or POE



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

Figure 164. Post-Closure Median Nitrate+Nitrite as Nitrogen Concentrations

Table 60 and Table 61 list the average Pu/Am activity ratios for locations where samples are analyzed for Pu and Am. A ratio greater than one indicates Pu activity in excess of Am activity. Conversely, a ratio less than one 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. Figure 165 and Figure 166 present pre- and post-closure average Am/Pu ratios, respectively.

Table 60. Average Pu/Am Ratios for Analytical Results in CY 1997—October 13, 2005

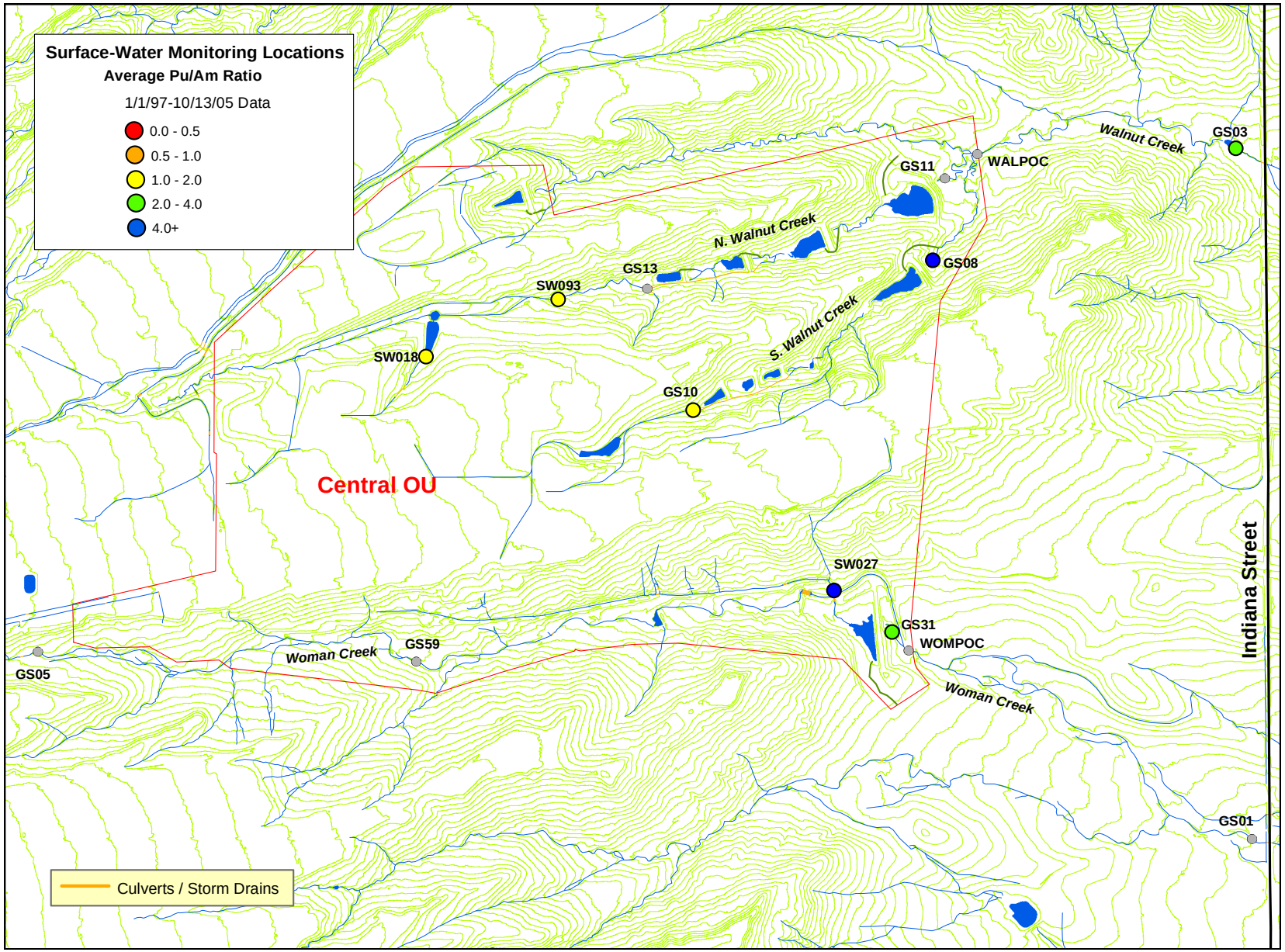
Location	Samples (N)[a]	Average Pu/Am Ratio
GS01	**1**	**1.5**
GS03	**14**	**2.1**
WOMPOC	**NA**	**NA**
WALPOC	**NA**	**NA**
GS05	NA	NA
GS08	**5**	**8.9**
GS10	**196**	**1.3**
GS11	*****	*****
GS13	NA	NA
GS31	**4**	**3.9**
GS59	*	*
SW027	**26**	**4.9**
SW093	**95**	**1.8**

[a] Number of samples in which both Pu and Am activities were greater than 0.015 pCi/L
* No results greater than 0.015 pCi/L
Bold = POC or POE
NA = Analyte not sampled
WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.

Table 61. Post-Closure Average Pu/Am Ratios for Analytical Results (October 13, 2005−December 31, 2011)

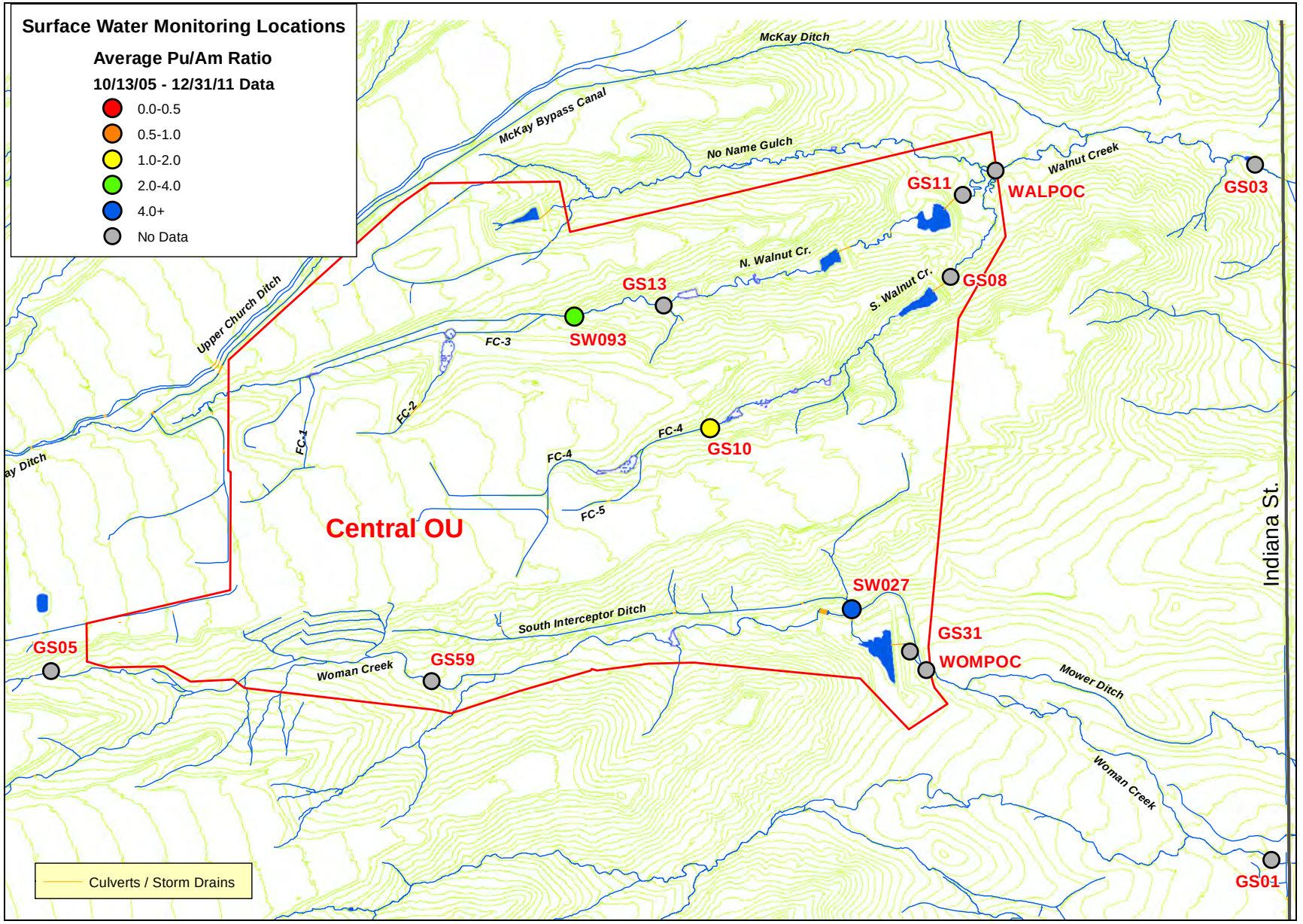
Location	Samples (N)[a]	Average Pu/Am Ratio
GS01	*****	*****
GS03	*****	*****
WOMPOC	*****	*****
WALPOC	*****	*****
GS05	NA	NA
GS08	*****	*****
GS10	**25**	**1.0**
GS11	*****	*****
GS13	NA	NA
GS31	*****	*****
GS59	NA	NA
SW027	**5**	**5.2**
SW093	**12**	**2.1**

[a] Number of samples in which both Pu and Am activities were greater than 0.015 pCi/L
* No results greater than 0.015 pCi/L
Bold = POC or POE
NA = Analyte not sampled
WOMPOC and WALPOC began operation on September 28, 2011, and September 9, 2011, respectively.



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

Figure 165. Average Pu/Am Ratios for CY 1997—October 13, 2005



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

Figure 166. 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 62, Table 63, Table 64, Table 65, Table 66, and Table 67 present summary statistics for the POE metals. All three POEs generally show reduced metals concentrations post-closure.

Table 62. Summary Statistics for POE Metals Results from GS10 in CY 1997—October 13, 2005

Analyte	Samples (N)	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 63. Post-Closure Summary Statistics for POE Metals Results from GS10 (October 13, 2005–December 31, 2011)

Analyte	Samples (N)	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	105	100.0%	0.50	0.50	0.50
Dissolved Cd	105	92.4%	0.06	0.06	0.34
Total Cr	105	76.2%	0.50	1.40	7.10
Dissolved Ag	105	99.0%	0.10	0.10	0.20

Table 64. Summary Statistics for POE Metals Results from SW027 in CY 1997—October 13, 2005

Analyte	Samples (N)	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

[16] Arithmetic averaging of metal pairs is performed only when the relative percentage 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 65. Post-Closure Summary Statistics for POE Metals Results from SW027 (October 13, 2005–December 31, 2011)

Analyte	Samples (N)	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	9	100.0%	0.50	0.50	0.50
Dissolved Cd	8	100.0%	0.06	0.06	0.06
Total Cr	9	55.6%	1.00	1.77	2.15
Dissolved Ag	8	100.0%	0.10	0.10	0.10

Table 66. Summary Statistics for POE Metals Results from SW093 in CY 1997—October 13, 2005

Analyte	Samples (N)	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 67. Post-Closure Summary Statistics for POE Metals Results from SW093 (October 13, 2005–December 31, 2010)

Analyte	Samples (N)	Nondetect	Median (µg/L)	85th Percentile (µg/L)	Maximum (µg/L)
Total Be	99	100.0%	0.50	0.50	0.50
Dissolved Cd	99	92.9%	0.06	0.06	0.24
Total Cr	99	64.6%	1.00	1.90	25.7
Dissolved Ag	99	100.0%	0.10	0.10	0.10

3.1.4.2 Surface-Water Loading Analysis

This section provides a summary of radionuclide loads (Am, Pu, and total U) for RFLMA POEs and POCs. 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; these locations do continue to operate under the AMP. Therefore, WALPOC and WOMPOC are not included this year, and GS08, GS11, and GS31 are included. As additional data are collected at WALPOC and WOMPOC, these locations will be included in future reports. The locations included in this section 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.

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 success and continued performance of the remedy.

To calculate load, the activity for each composite sample (pCi/L) is multiplied by the corresponding stream discharge (liters [L]) during the composite sample period, to yield the load (picocuries [pCi]). The total pCi value is then converted to micrograms (μg) using the conversion factors in Table 68.[17] A detailed description of the method for load estimation is given in Appendix B.[18]

Table 68. Activity to Mass Conversion Factors for Pu, Am, and U Isotopes

Analyte	Mass/Activity (g/Ci)
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

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

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), Appendix B, October 7, 2000.[19]

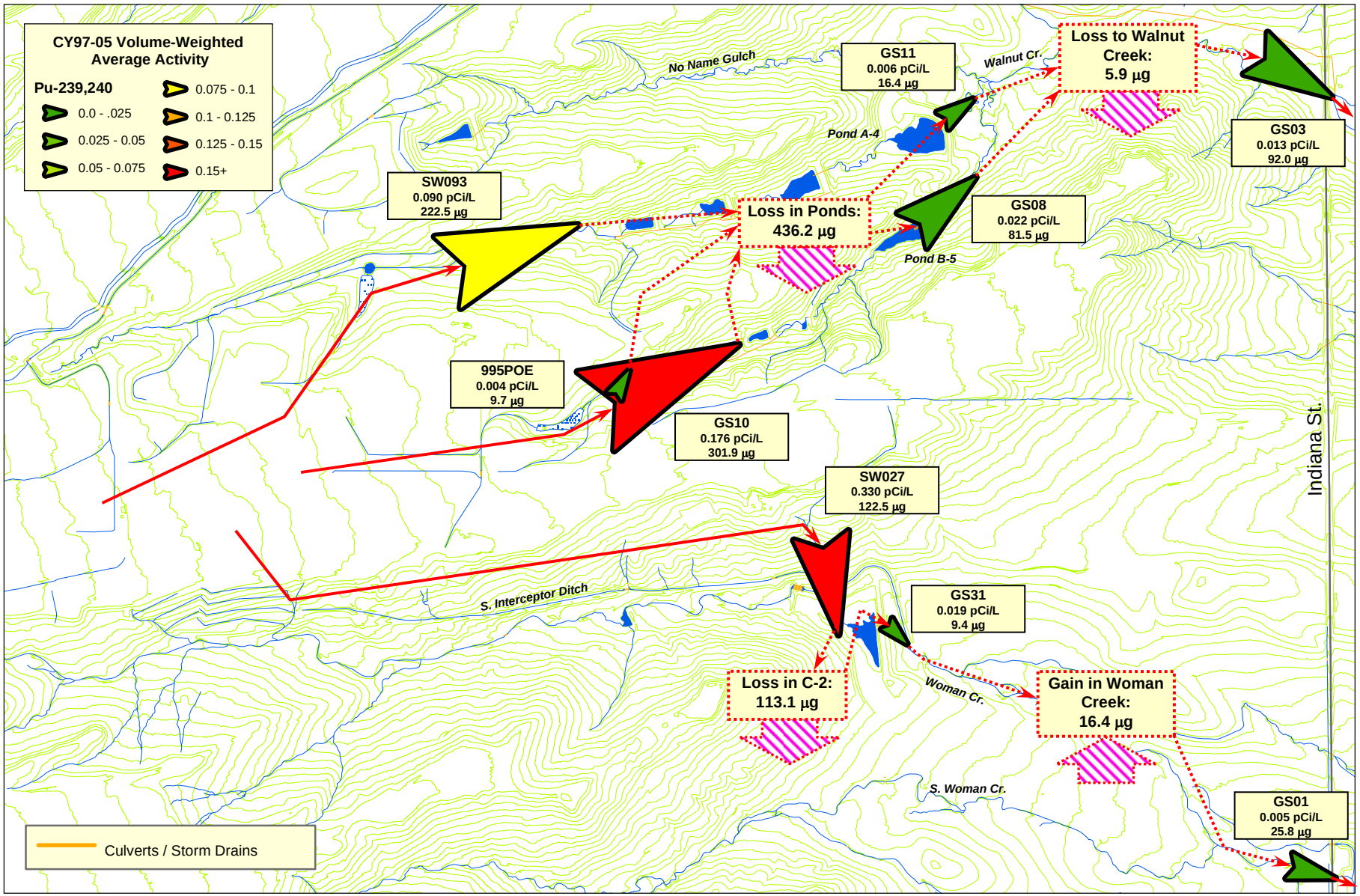
Site and Refuge Area

This section summarizes the calculated overall Pu and Am loads for selected locations. Total U data collection began at GS01 and GS03 just prior to CY 2003; therefore, only CY 2003–2011 data are shown for uranium. The following points are noted:

- Figure 167, Figure 168, Figure 169, and Figure 170 show a significant reduction in average annual Pu and Am loads and activities from the COU, the terminal ponds, and Walnut Creek at Indiana Street post-closure. The load reductions are between 82 percent and 98 percent for all Walnut Creek locations affected directly by the former IA. Similarly, activity has been reduced between 32 percent and 91 percent. For lower Woman Creek (GS01), however, post-closure loads are comparable to pre-closure loads. This is likely due to transport of diffuse, low-level contamination in the much larger flow volumes measured at GS01, especially during CY 2007 and CY 2010; GS01 is not significantly affected by the former IA. GS01 post-closure volume-weighted average Pu and Am activities of 0.007 and 0.004 pCi/L, respectively, are significantly below the RFLMA standard of 0.15 pCi/L and within the analytical measurement error for each analyte.
- For both Pu and Am, remedial actions, removal of impervious surfaces (reducing runoff), revegetation, and erosion control efforts have significantly improved water quality.
- Figure 171 and Figure 172 show a measurable increase in average annual total U concentration in Walnut Creek post-closure (63 percent–286 percent increase). This increase

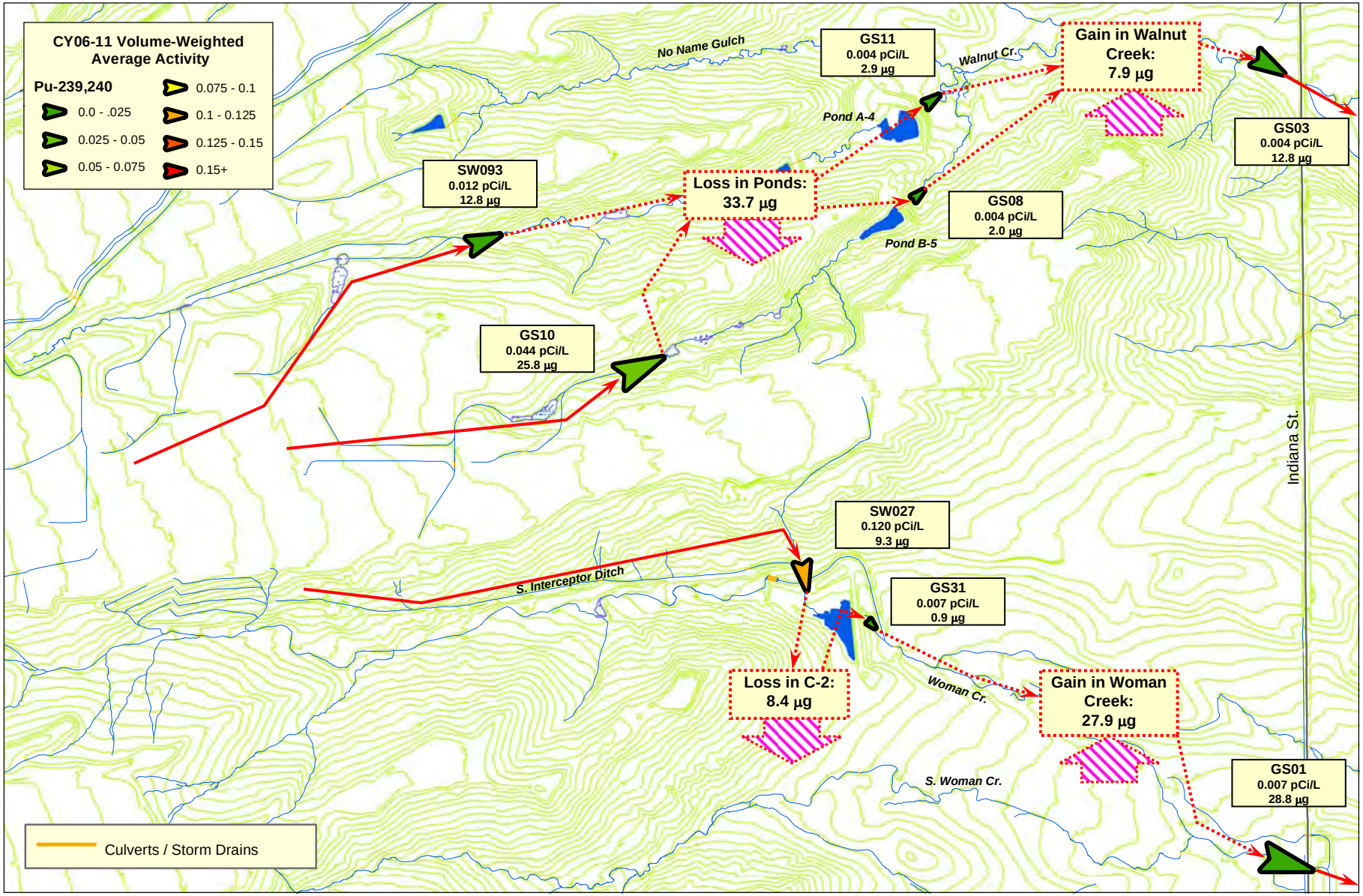
[17] In the following tables and plots, values are rounded for presentation.
[18] Data are generally presented at varying precision for presentation. Accuracy should not be inferred; both analytical and flow measurement error have not been quantified in this report.
[19] The U-234 conversion factor was used to represent U-233,234 due to the small relative abundance of U-233.

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. Conversely, the reduction in overall stream flows has actually resulted in decreased total U loads (23 percent–48 percent reduction) in Walnut Creek at all locations except GS10 (24 percent increase). For lower Woman Creek (GS01), U loads and concentrations have changed to a lesser extent (21 percent and 10 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. The Site continues to collect additional information, evaluate data, and consult outside experts to further describe the geochemistry of uranium at Rocky Flats.



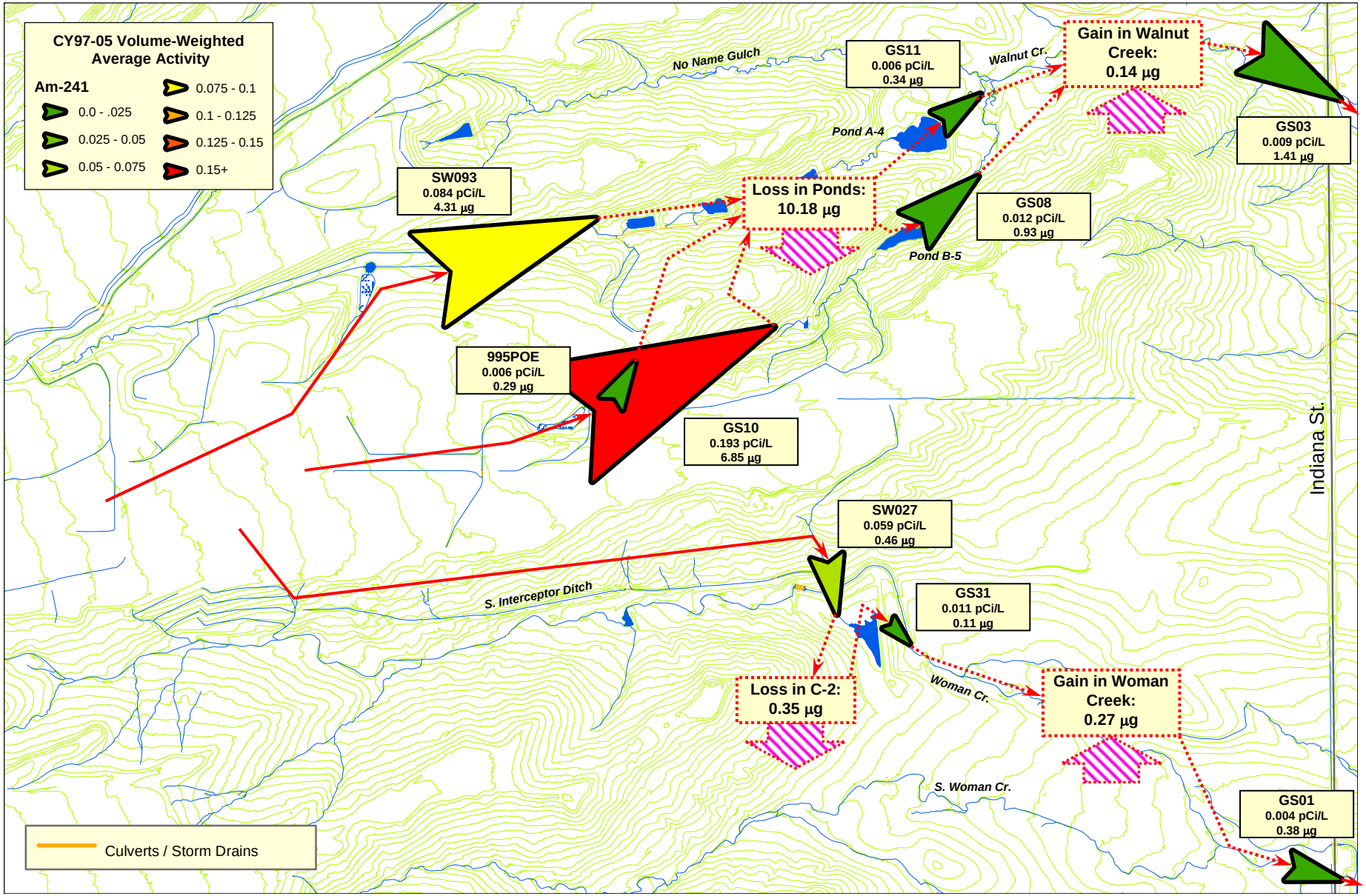
Note: Location symbols are displayed proportional to calculated average annual load and colored according to activity ranges in legend.

Figure 167. Relative Average Annual Pu Loading Schematic: CY 1997−2005



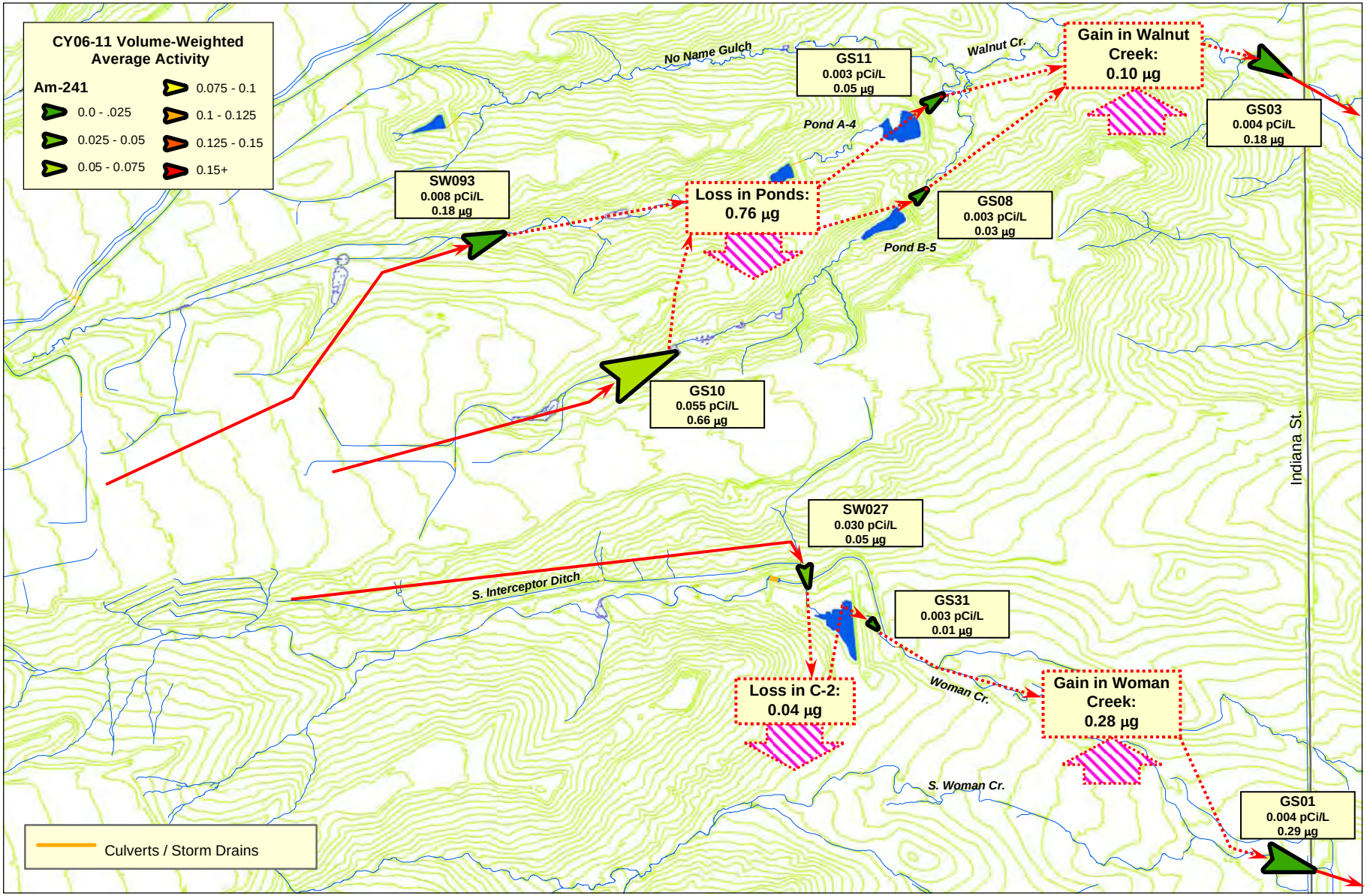
Note: Location symbols are displayed proportional to calculated average annual load and colored according to activity ranges in legend.

Figure 168. Relative Average Annual Pu Loading Schematic: CY 2006−2011



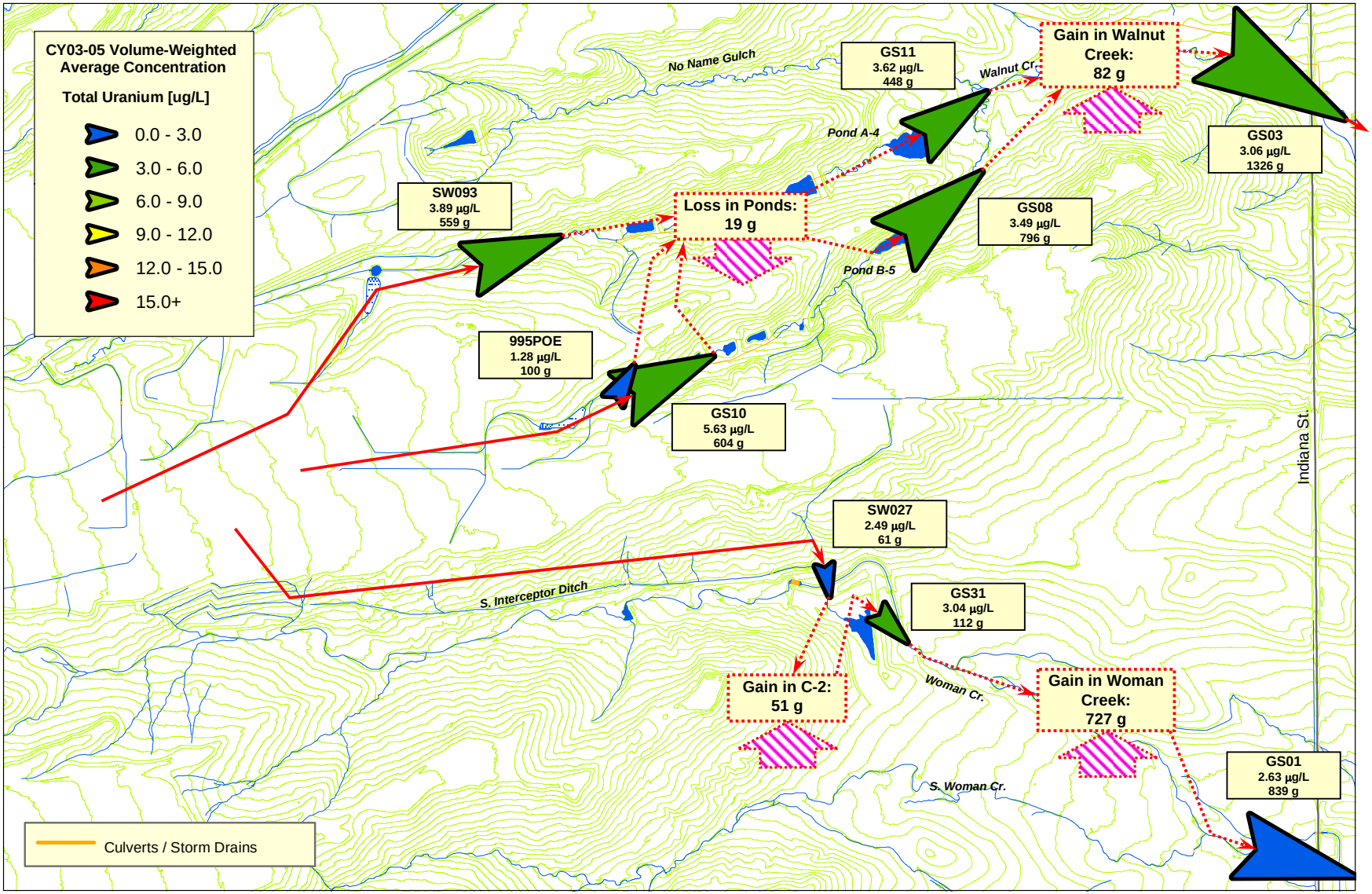
Note: Location symbols are displayed proportional to calculated average annual load and colored according to activity ranges in legend.

Figure 169. Relative Average Annual Am Loading Schematic: CY 1997−2005



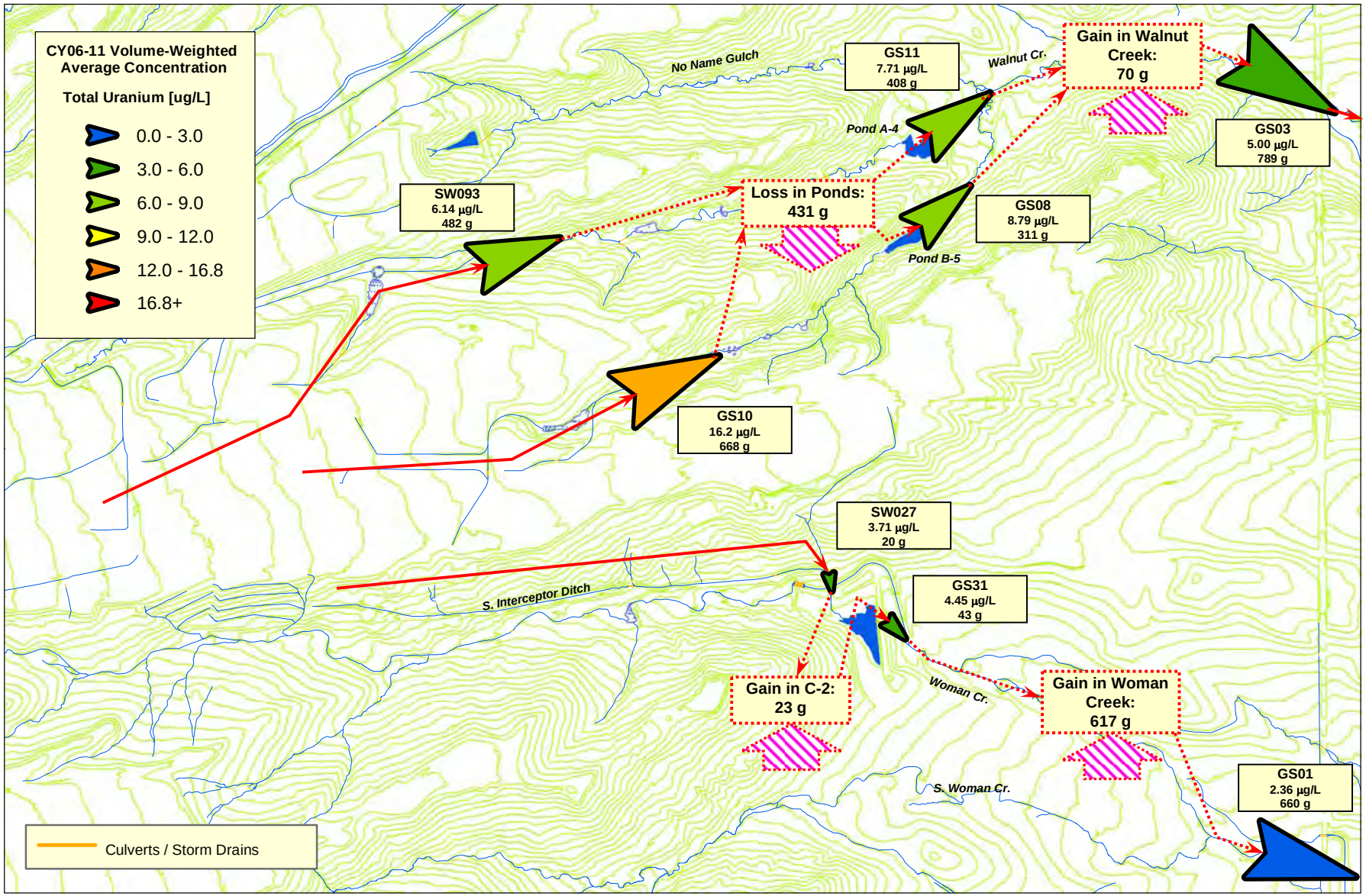
Note: Location symbols are displayed proportional to calculated average annual load and colored according to activity ranges in legend.

Figure 170. Relative Average Annual Am Loading Schematic: CY 2006−2011



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 171. Relative Average Annual Total U Loading Schematic: CY 2003−2005



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 172. Relative Average Annual Total U Loading Schematic: CY 2006−2011

Indiana Street POCs

This section summarizes the calculated Pu and Am loads from Walnut and Woman Creeks at Indiana Street. Figure 173, Figure 174, Figure 175, Figure 176, Figure 177, Figure 178, and Figure 179, as well as Table 69 and Table 70 present the load data. The following points are noted:

- Walnut Creek accounts for nearly 80 percent of both the Pu (Figure 175) and Am (Figure 177) loads at Indiana Street pre-closure. However, post-closure these proportions are essentially reversed as a result of the reduction in runoff and transport due to the effectiveness of remedial actions, revegetation, and erosion control measures.
- Both Pu and Am loads have decreased in recent years as Site closure activities have reduced discharge volumes, reduced sediment transport, and eliminated source terms (Figure 173).
- Figure 174 and Figure 176 show a significant post-closure reduction in both Pu and Am loads in Walnut Creek at Indiana Street (86 percent and 87 percent, respectively).
- The somewhat higher CY 2007 and CY 2010 Pu and Am loads in Woman Creek at Indiana Street (Figure 174 and Figure 176) can be attributed to high-flow volumes at GS01.[20] Post-closure average annual volume-weighted Pu and Am activities at GS01 are 0.007 and 0.004 pCi/L, respectively; these activities are within the analytical measurement error range.
- Walnut Creek accounts for 61 percent of the pre-closure and 54 percent of the post-closure U loads at Indiana Street (Figure 179). Although U concentration has increased in Walnut Creek post-closure, reduced flow volumes have resulted in measurably decreased average annual loads comparable to pre-closure loads.

[20] Measured flow volumes at GS01 in CY 2007 were the highest recorded to date. These volumes are attributed to a combination of large snow events and extensive flood irrigation from Rocky Flats Lake. Volumes in CY 2010 were also well above average due to a large storm event in April 2010.

Table 69. Offsite Pu and Am Loads from Walnut and Woman Creeks: CY 1997–2011

Calendar Year	Pu-239,240 (µg)			Am-241 (µg)		
	Walnut Creek	Woman Creek	Total	Walnut Creek	Woman Creek	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
Total	904.5	405.3	1,309.8	13.74	5.19	18.93

Note: During CY 1997, flows from Woman Creek were routinely diverted to Mower Ditch for subsequent monitoring at GS02. 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 has been upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch.

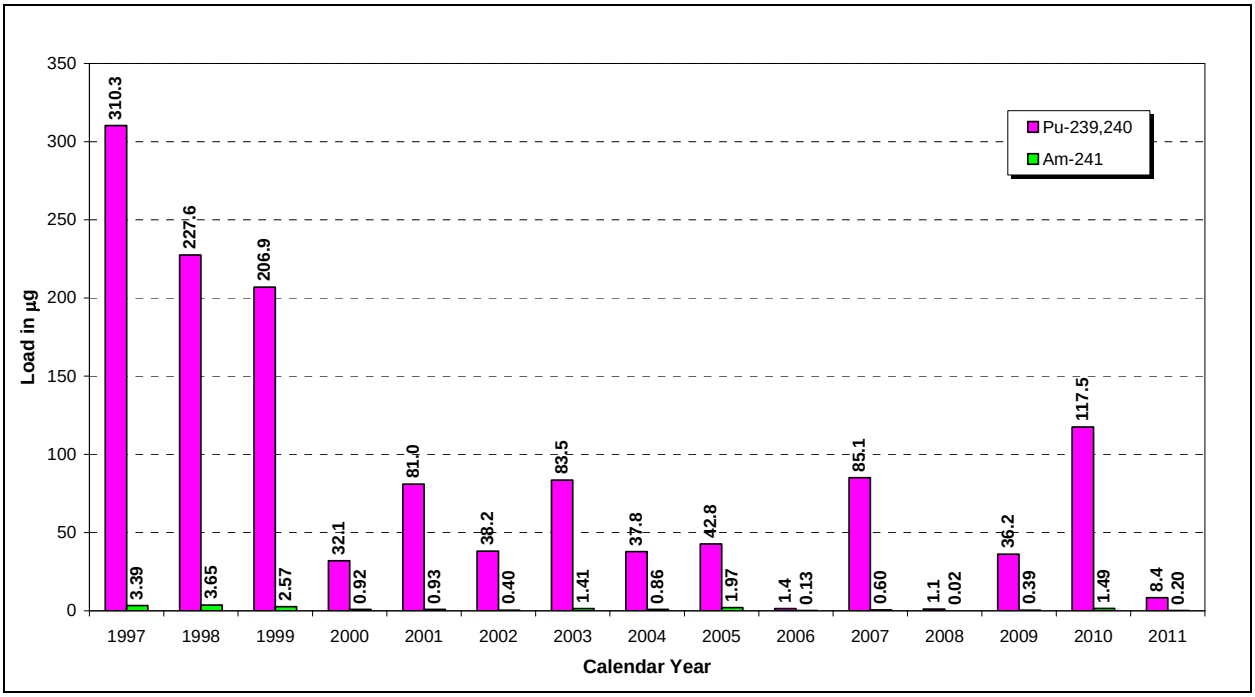


Figure 173. Combined Annual Pu and Am Loads from Walnut and Woman Creeks: CY 1997–2011

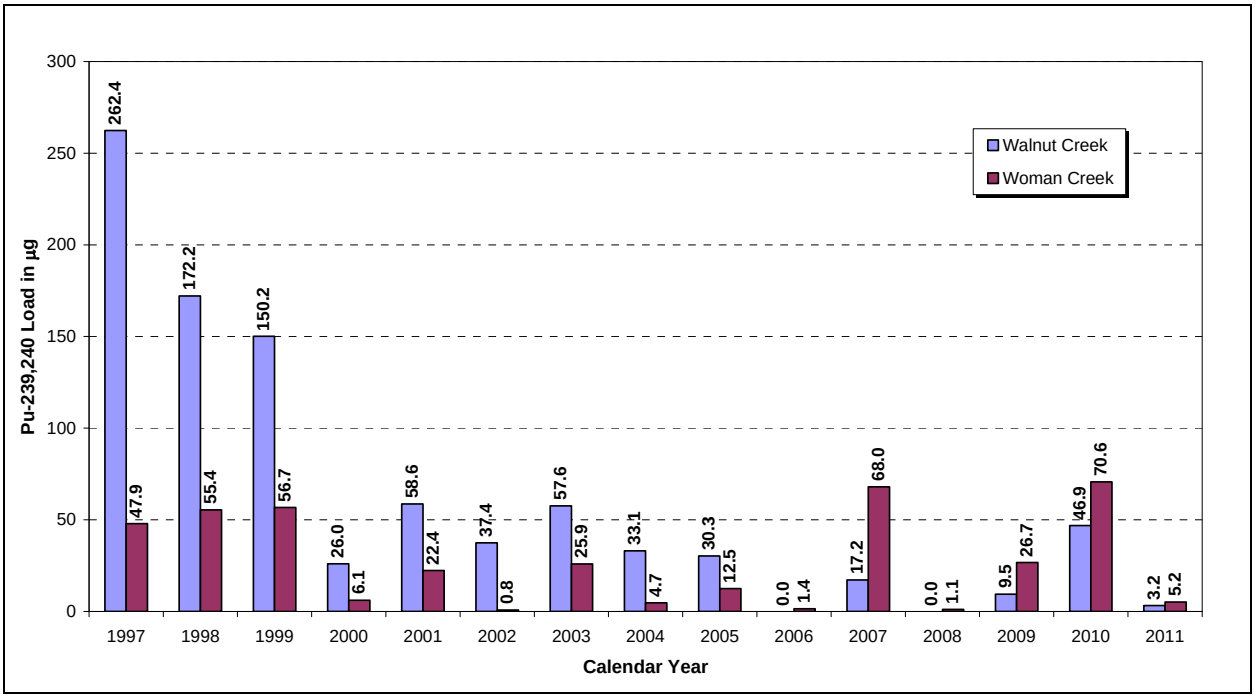
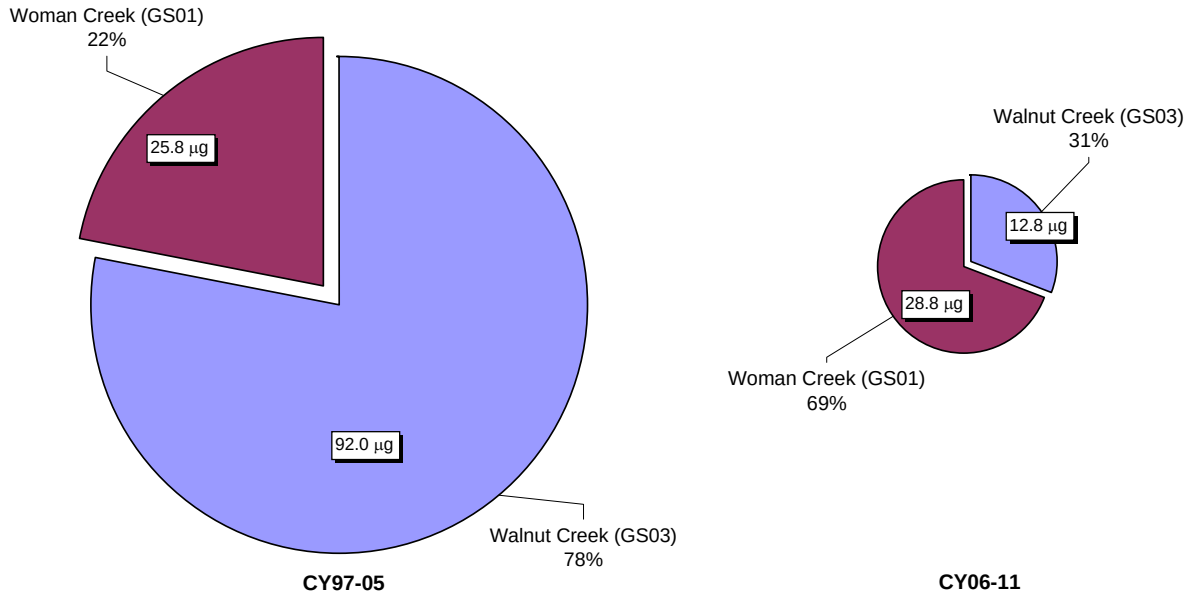


Figure 174. Annual Pu Loads from Walnut and Woman Creeks: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 175. Relative Average Annual Pu Load Totals from Walnut and Woman Creeks

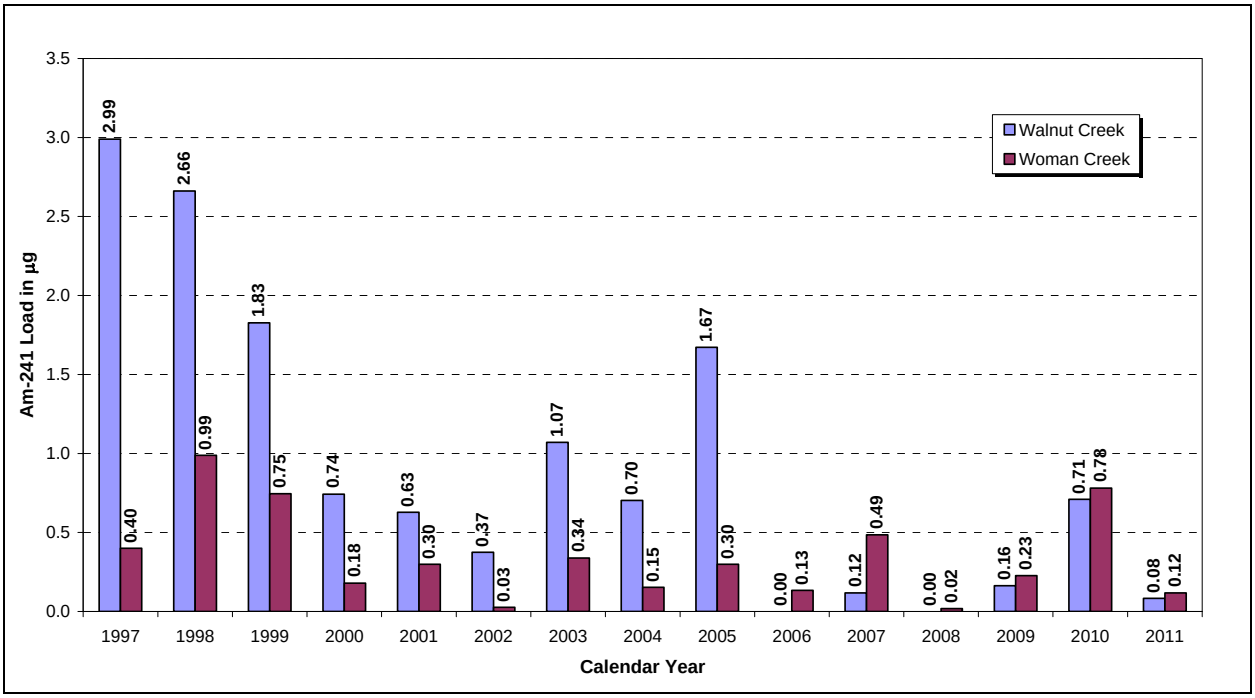
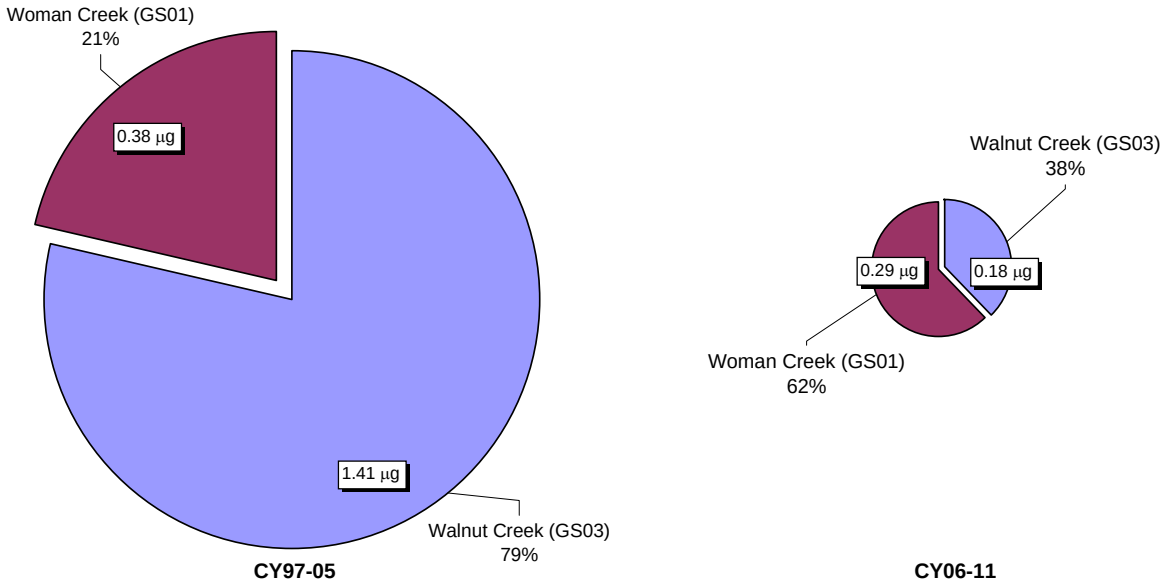


Figure 176. Annual Am Loads from Walnut and Woman Creeks: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 177. Relative Average Annual Am Load Totals from Walnut and Woman Creeks

Table 70. Total U Loads from Walnut and Woman Creeks: CY 2003−2011

Calendar Year	Total U (g)		
	Walnut Creek	**Woman Creek**	**Total**
2003	1,751	790	2,541
2004	744	808	1,551
2005	1,482	918	2,400
2006	0; No flow	235	235
2007	1,005	1,016	2,021
2008	0; No flow	174	174
2009	725	761	1,486
2010	2,311	1,162	3,473
2011	696	609	1,305
Total	8,713	6,474	15,187

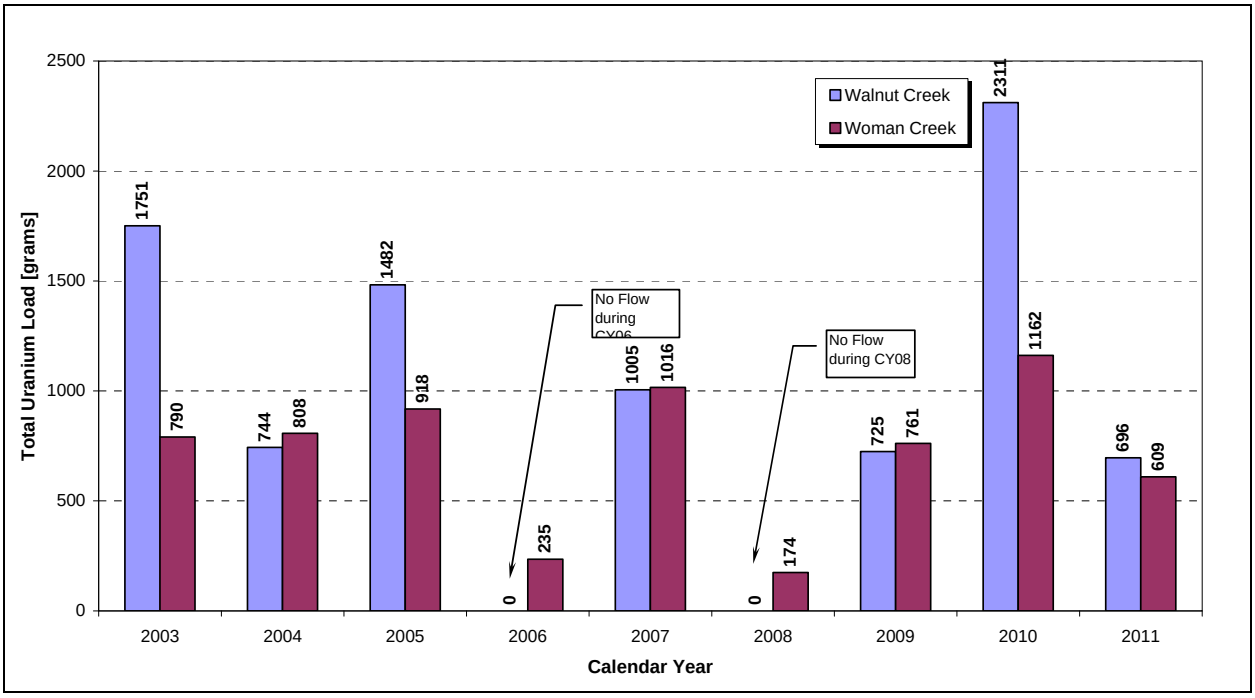
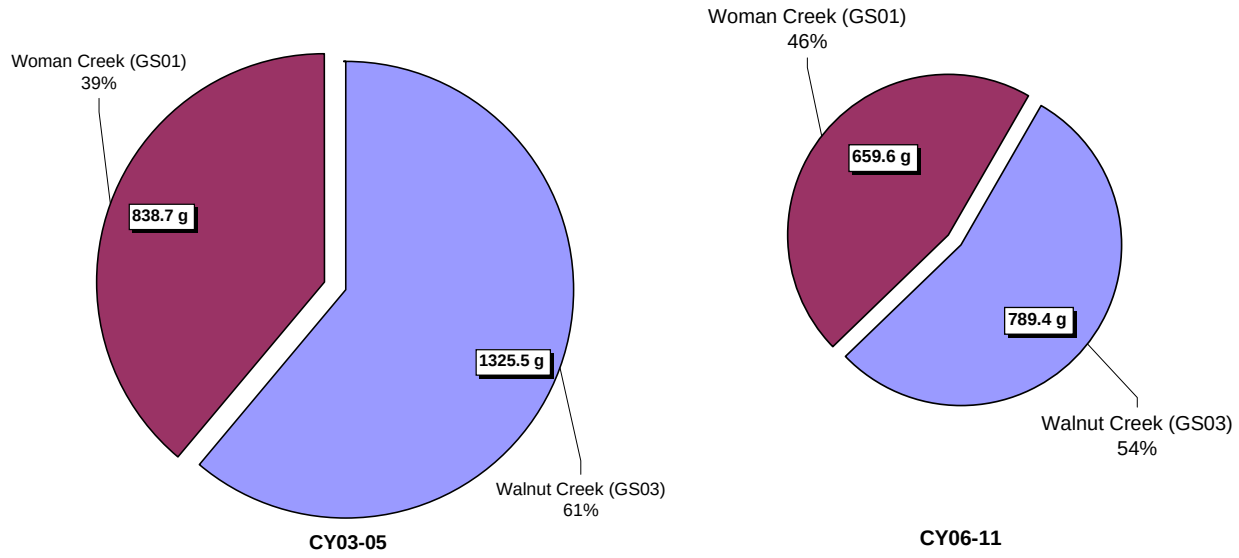


Figure 178. Annual Total U Loads from Walnut and Woman Creeks: CY 2003–2011



Note: Pie chart diameters are relative to total load.

Figure 179. Relative Average Annual Total U Load Totals from Walnut and Woman Creeks

Lower Walnut Creek

This section summarizes the calculated Pu and Am loads in Walnut Creek at GS03 (Walnut Creek at Indiana Street), GS08 (Pond B-5 outlet), and GS11 (Pond A-4 outlet). The data are presented in Table 71, Table 72, and Table 73 and are depicted on Figure 180, Figure 181, Figure 182, Figure 183, Figure 184, Figure 185, and Figure 186. Total U data collection at GS03 began on November 5, 2002; thus, only CY 2003−2010 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 181 and Figure 183). 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 the very low measured activities with the inherent analytical error at such low levels.
- Pu and Am loads are generally decreasing at GS03 (Figure 180). The slight increase in Am loads at GS03 during CY 2005 is due to increased Am contributions to the A-Series Ponds related to the decontamination and decommissioning (D&D) of B771. Treatment of Pond A-4 water was successful in reducing Am levels well below the applicable standard (0.15 pCi/L), but the Am activity of the discharged water was somewhat higher than normal. Pond B-5 also showed some increased Am activity due to temporarily increased Am load associated with solids transport resulting from the construction of FC-4. These slightly higher Am activities were subsequently also measured at GS03 (Figure 183). The measurable increase in CY 2010 loads is primarily due to large flow volumes and not an increase in activity.

- Annual Pu and Am loads for all Lower Walnut Creek locations have been reduced post-closure (Figure 181 and Figure 183) due to the reduction of runoff and sediment transport resulting from the effectiveness of remedial actions, revegetation, and erosion control measures. Load reductions range between 82 percent and 98 percent.
- Pre-closure Pu and Am loads from Pond B-5 are significantly greater than loads from Pond A-4 (Table 71 and Table 72), a result of both higher activities and larger discharge volumes. Post-closure loads from Pond A-4 are slightly greater than from Pond B-5. Post-closure load reductions range between 82 percent and 98 percent.
- Total Pu loads from Ponds A-4 and B-5 for the entire period of 1997 through 2011 are marginally greater than the loads at GS03 (Table 71), suggesting a small net loss of load to the Walnut Creek streambed below Ponds A-4 and B-5. This small loss may simply be an artifact of analytical measurement error.
- Total Am loads from Ponds A-4 and B-5 for the entire period of 1997 through 2011 are marginally less than the loads at GS03 (Table 72), indicating a net gain of load from tributaries and the Walnut Creek streambed below Ponds A-4 and B-5. This gain may simply be an artifact of analytical measurement error.
- Total U loads from Ponds A-4 and B-5 are slightly less than the loads at GS03 (Figure 186), indicating a small net gain of load from tributaries and seeps in Walnut Creek below Ponds A-4 and B-5. Post-closure reductions in U loads range between 36 percent and 49 percent depending on location; U load at GS03 has been reduced 40 percent.

Table 71. Pu Loads at GS03, GS08, and GS11: CY 1997–2011

Calendar Year	Pu-239,240 (µg)			
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC GS03
1997	59.2	8.8	68.0	262.4
1998	20.0	22.4	42.4	172.2
1999	23.8	261.4	285.2	150.2
2000	28.4	244.6	273.0	26.0
2001	4.7	32.3	37.0	58.6
2002	0.1	7.8	7.9	37.4
2003	7.3	111.5	118.8	57.6
2004	2.2	27.1	29.3	33.1
2005	2.2	17.9	20.1	30.3
2006	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0	0.0 No flow
2007	7.8	1.9	9.6	17.2
2008	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0	0.0 No flow
2009	2.3	3.0	5.3	9.5
2010	6.4	5.4	11.9	46.9
2011	1.0	1.8	2.8	3.2
Total	165.5	745.9	911.4	904.5

Table 72. Am Loads at GS03, GS08, and GS11: CY 1997–2011

Calendar Year	Am-241 (µg)			
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC GS03
1997	0.70	0.25	0.95	2.99
1998	1.25	0.35	1.60	2.66
1999	0.20	1.81	2.01	1.83
2000	0.02	3.14	3.16	0.74
2001	0.11	0.46	0.57	0.63
2002	0.04	0.25	0.29	0.37
2003	0.18	0.54	0.72	1.07
2004	0.14	0.58	0.73	0.70
2005	0.43	0.97	1.39	1.67
2006	0.0 No A-4 discharge	0.0; No B-5 discharge	0.00	0.0 No flow
2007	0.02	0.03	0.05	0.12
2008	0.0 No A-4 discharge	0.0; No B-5 discharge	0.00	0.0 No flow
2009	0.09	0.02	0.11	0.16
2010	0.14	0.11	0.25	0.71
2011	0.05	0.02	0.07	0.08
Total	3.38	8.53	11.92	13.74

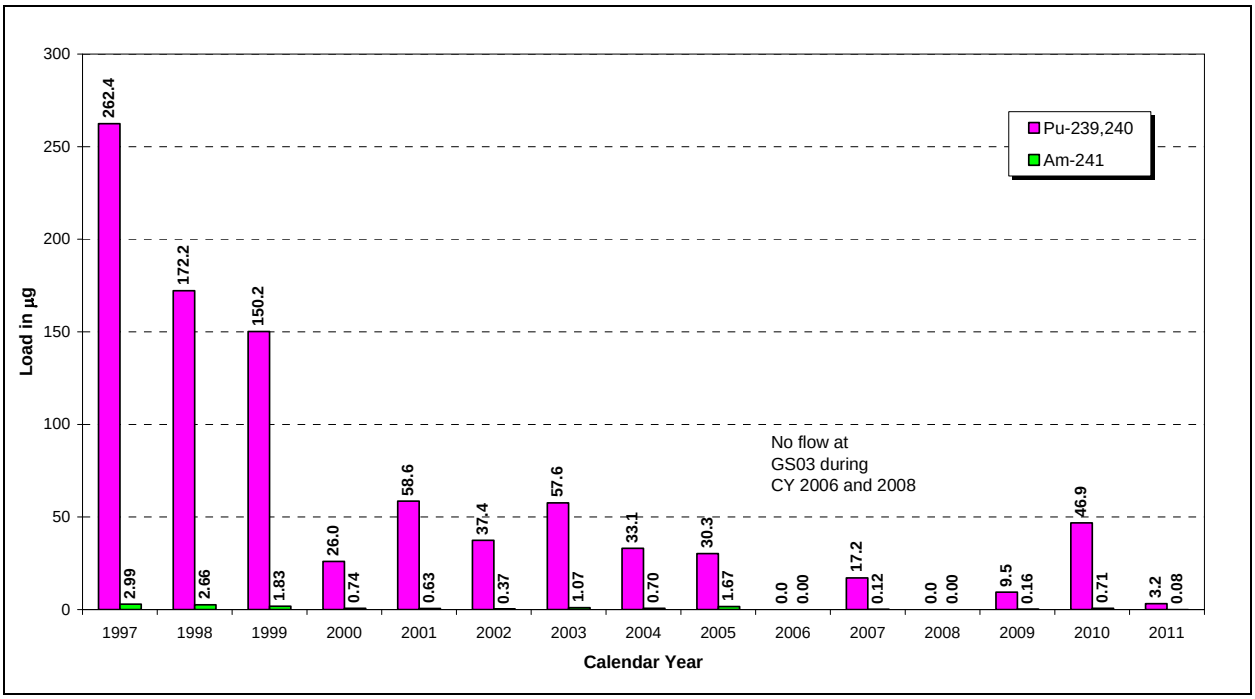


Figure 180. Annual Pu and Am Loads at GS03: CY 1997–2011

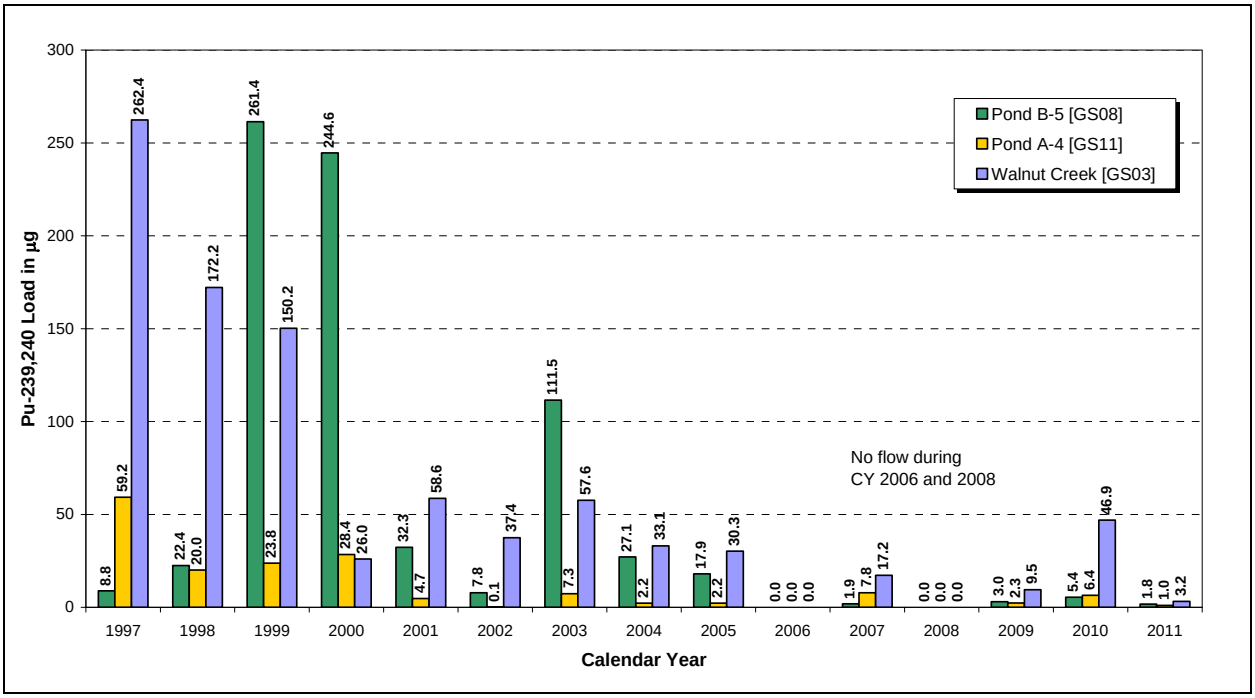
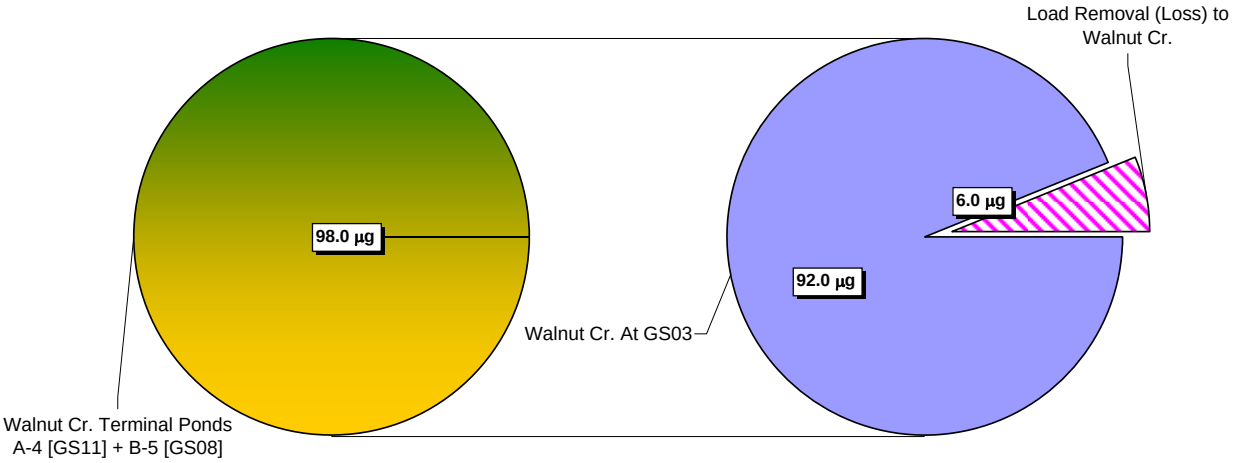
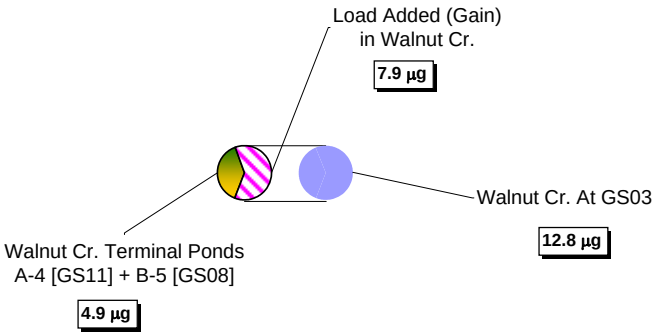


Figure 181. Annual Pu Loads at GS03, GS08, and GS11: CY 1997–2011



CY97-05



CY06-11

Note: Pie chart diameters are relative to total load.

Figure 182. Relative Average Annual Pu Load Totals at GS03, GS08, and GS11

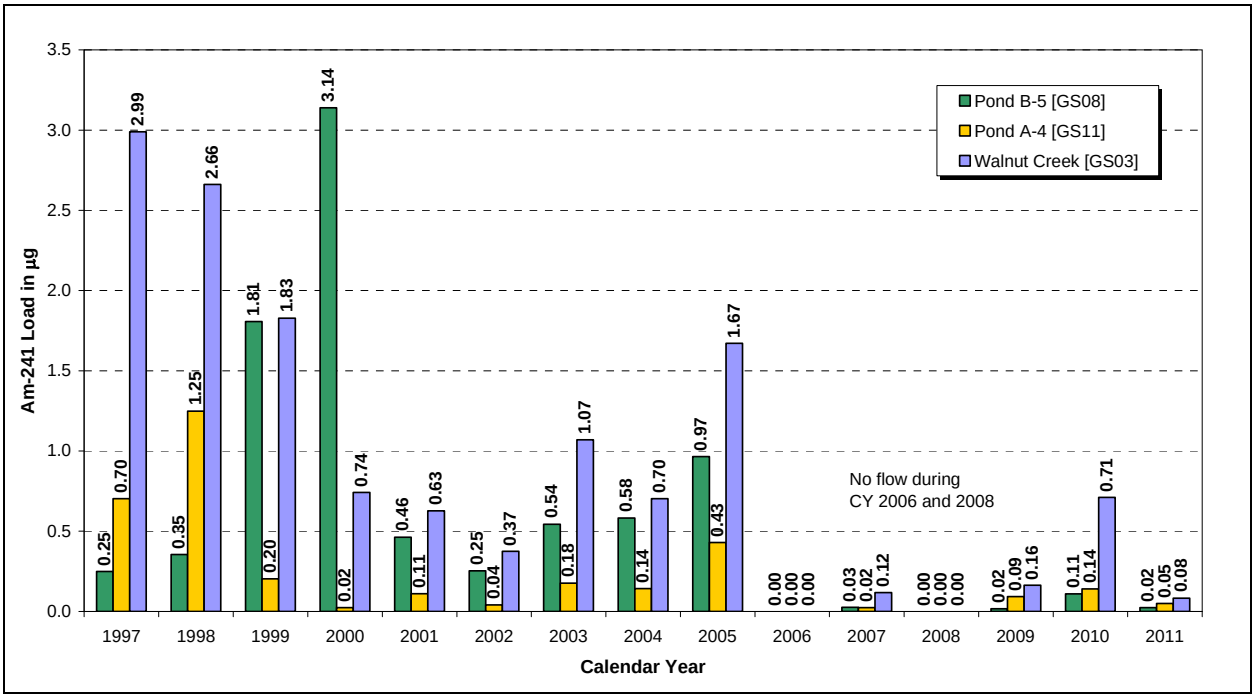
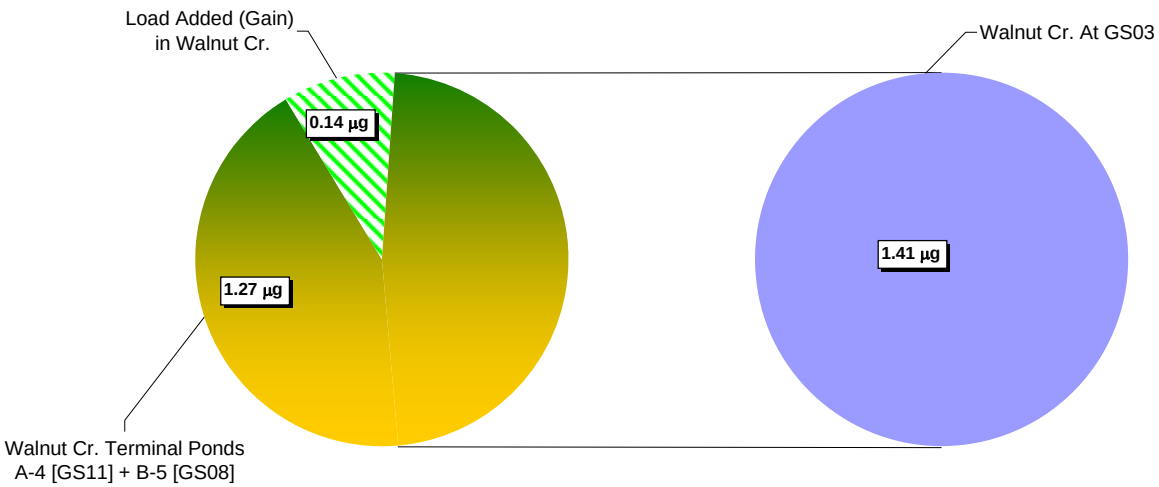
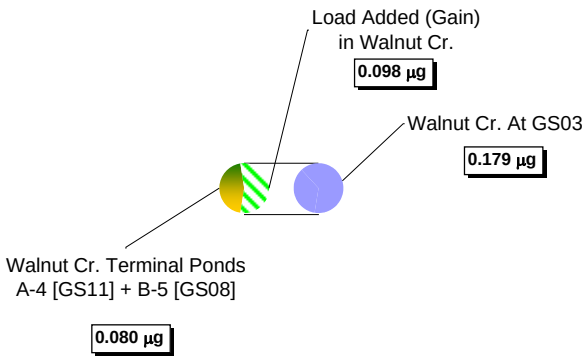


Figure 183. Annual Am Loads at GS03, GS08, and GS11: CY 1997–2011



CY97-05



CY06-11

Note: Pie chart diameters are relative to total load.

Figure 184. Relative Average Annual Am Load Totals at GS03, GS08, and GS11

Table 73. Total U Loads at GS03, GS08, and GS11: CY 2003−2011

Calendar Year	Total U (g)			
	Pond A-4 (GS11)	Pond B-5 (GS08)	Walnut Creek Terminal Ponds Total	POC GS03
2003	865	610	1,474	1,751
2004	316	390	705	744
2005	165	1,389	1,554	1,482
2006	0; No A-4 discharge	0; No B-5 discharge	0	0 No flow
2007	411	481	892	1,005
2008	0; No A-4 discharge	0; No B-5 discharge	0	0 No flow
2009	405	322	728	725
2010	1,199	746	1,945	2,311
2011	430	315	745	696
Total	3,790	4,252	8,043	8,713

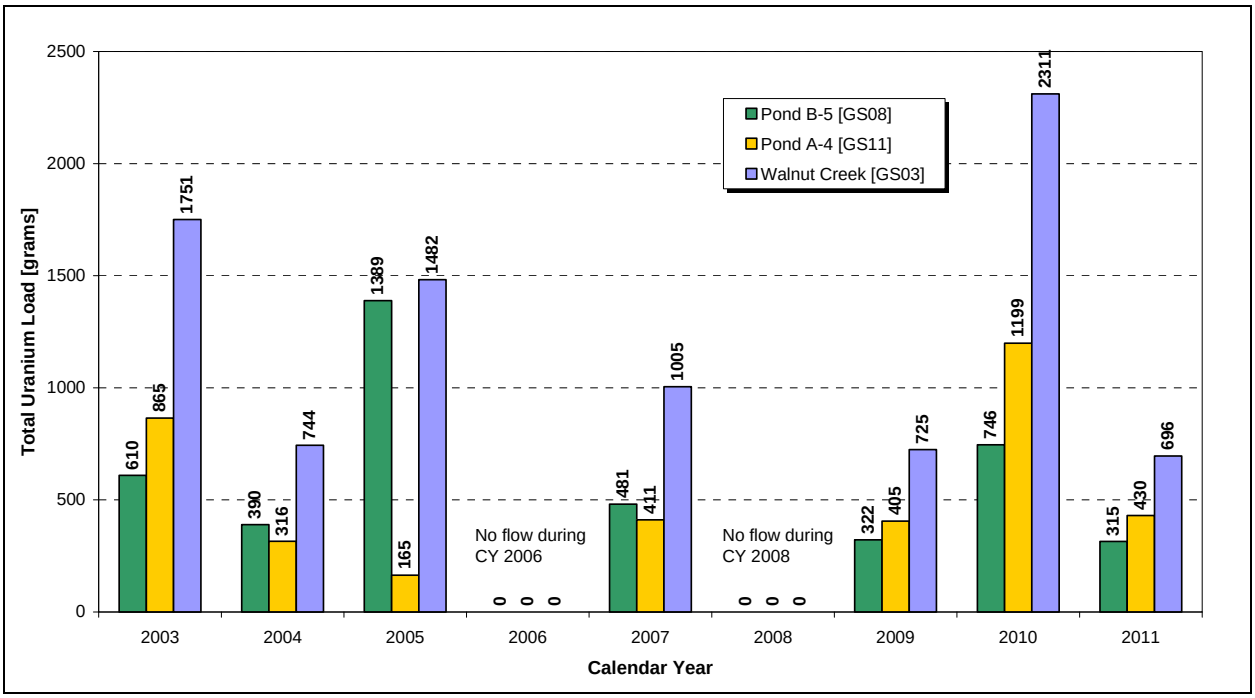
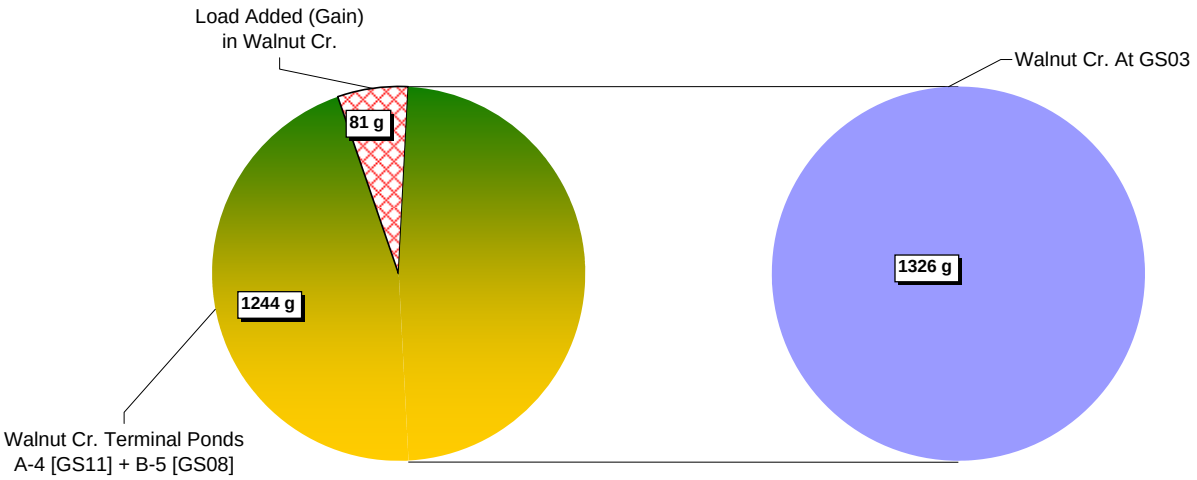


Figure 185. Annual Total U Loads at GS03, GS08, and GS11: CY 2003−2011



Note: Pie chart diameters are relative to total load.

Figure 186. Relative Average Annual Total U Load Totals at GS03, GS08, and GS11

Lower Woman Creek

This section summarizes the calculated Pu, Am, and total U loads in Woman Creek at GS01 (Woman Creek at Indiana Street) and GS31 (Pond C-2 outlet). The data are presented in Table 74, Table 75, and Table 76, and depicted on Figure 187, Figure 188, Figure 189, Figure 190, Figure 191, Figure 192, and Figure 193. Total U data collection began at GS01 on February 3, 2003; therefore, only CY 2003−2011 data are shown. The following points are noted:

- Annual Pu and Am loads generally vary by up to two orders of magnitude year to year (Figure 188 and Figure 190). The significant annual variability in Pu and Am loads is primarily due to large variation in stream discharge volumes and the very low measured activities with inherent analytical error at such low levels.

- Pu and Am loads are variable at GS01 (Figure 187). During CY 2007 and CY 2010, there is a measurable load increase compared to adjacent years. This increase can be attributed to larger-than-normal flow volumes, and not increases in activity.
- Total Pu loads from Pond C-2 are less than the loads at GS01 (Table 74 and Figure 189), indicating a gain of load from the Woman Creek drainage. Post-closure, Pond C-2 accounts for approximately 3 percent of the Pu load at GS01. This gain in Pu load is primarily due to large stream discharge volumes and analytical error associated with the very low measured activities at GS01; Pu activities are well below the RFLMA standard of 0.15 pCi/L.
- Total Am loads from Pond C-2 are less than the loads at GS01 (Table 75 and Figure 191), also indicating a gain of load from the Woman Creek drainage. Post-closure, Pond C-2 accounts for approximately 3 percent of the Am load at GS01. This gain in Am load is primarily due to large stream discharge volumes and analytical error associated with the very low measured activities at GS01; Am activities are well below the RFLMA standard of 0.15 pCi/L.
- Total U load for CY 2003–2010 from Pond C-2 is significantly less than the load at GS01 (Table 76 and Figure 193), indicating a gain of load most likely from naturally occurring U in the Woman Creek drainage. Post-closure, Pond C-2 accounts for less than 7 percent of the U load at GS01.

Table 74. Pu Loads at GS01 and GS31: CY 1997–2011

Calendar Year	Pu-239,240 (µg)	
	Pond C-2 (GS31)	POC GS01
1997	16.7	47.9
1998	2.2	55.4
1999	26.9	56.7
2000	0.0; No C-2 discharge	6.1
2001	11.0	22.4
2002	0.2	0.8
2003	11.0	25.9
2004	11.5	4.7
2005	5.0	12.5
2006	0.0; No C-2 discharge	1.4
2007	0.0; No C-2 discharge	68.0
2008	0.0; No C-2 discharge	1.1
2009	4.1	26.7
2010	0.4	70.6
2011	1.0	5.2
Total	90.0	405.3

Note: 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 has been upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch.

Table 75. Am Loads at GS01 and GS31: CY 1997–2011

Calendar Year	Am-241 (µg)	
	Pond C-2 (GS31)	**POC GS01**
1997	0.17	0.40
1998	0.27	0.99
1999	0.13	0.75
2000	0.00; No C-2 discharge	0.18
2001	0.14	0.30
2002	<0.01	0.03
2003	0.09	0.34
2004	0.11	0.15
2005	0.04	0.30
2006	0.0; No C-2 discharge	0.13
2007	0.0; No C-2 discharge	0.49
2008	0.0; No C-2 discharge	0.02
2009	0.03	0.23
2010	0.02	0.78
2011	0.01	0.12
Total	1.01	5.19

Note: 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 has been upgraded and configured to prevent Woman Creek flows from entering the Mower Ditch.

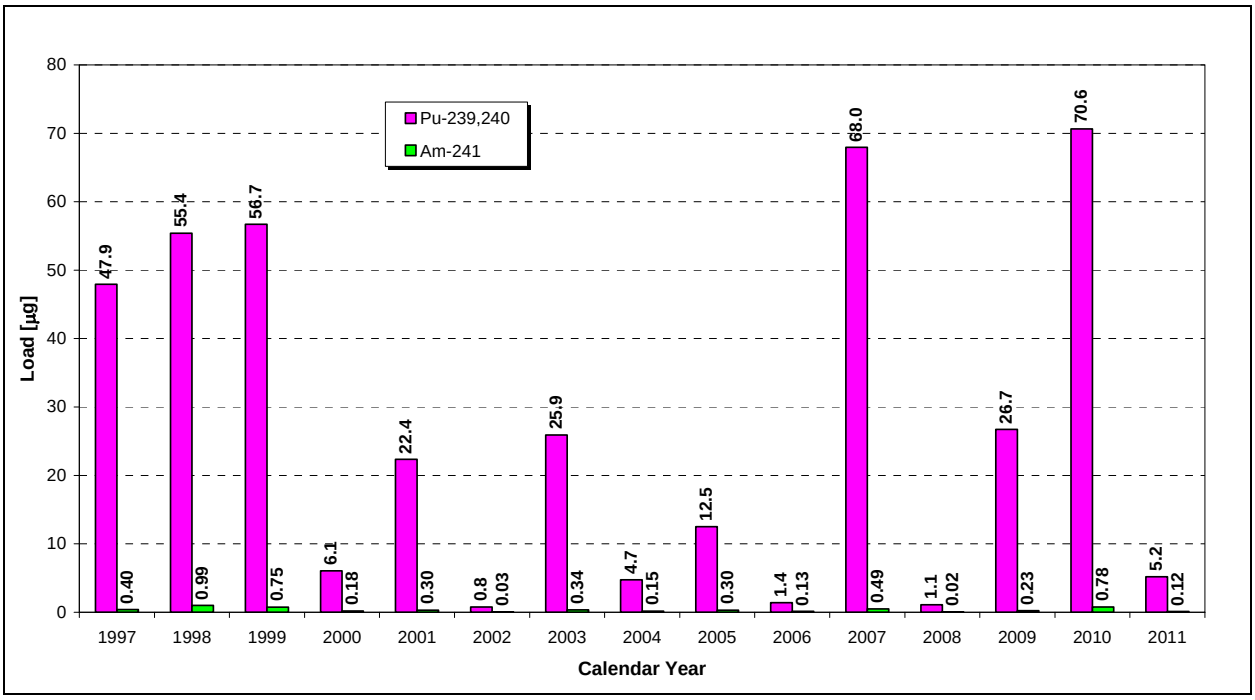


Figure 187. Annual Pu and Am Loads at GS01: CY 1997–2011

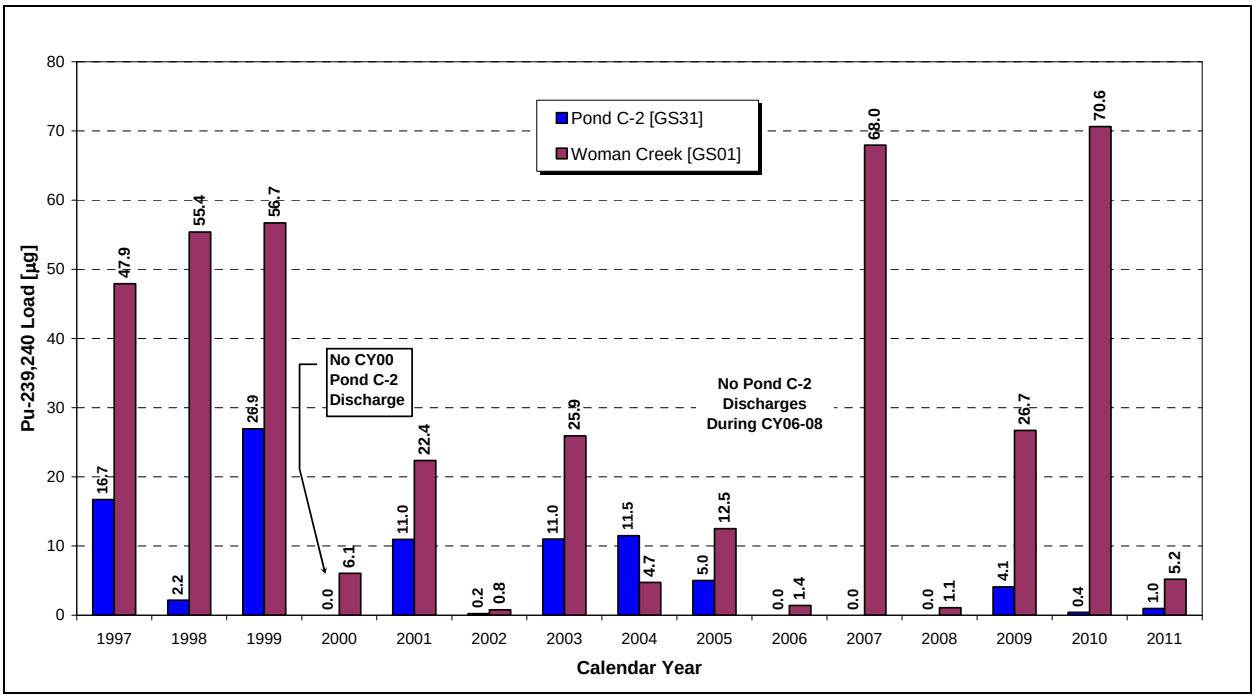
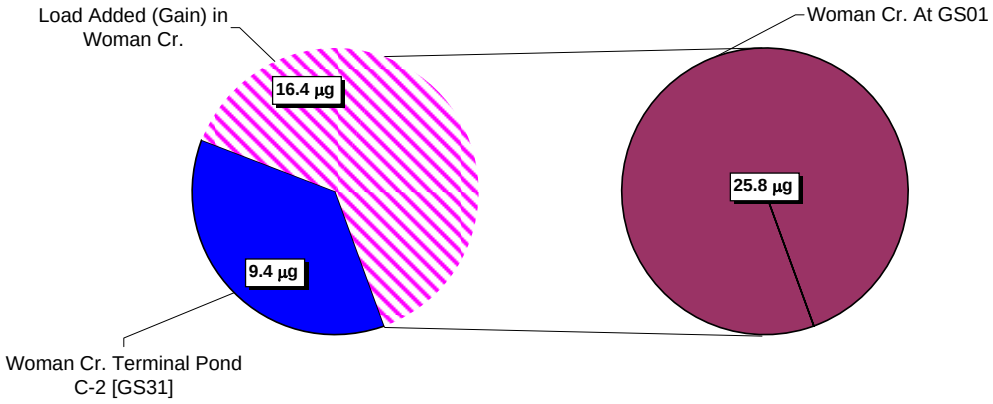
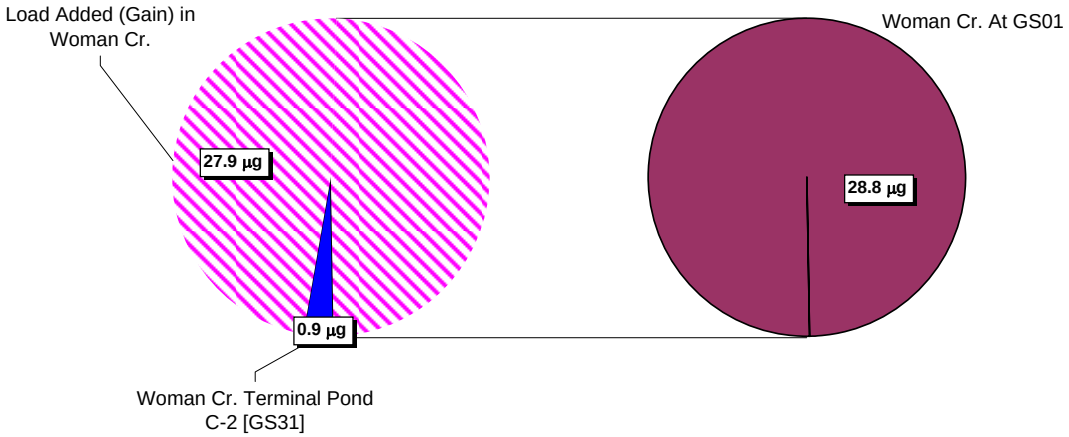


Figure 188. Annual Pu Loads at GS01 and GS31: CY 1997–2011



CY97-05



CY06-11

Note: Pie chart diameters are relative to total load.

Figure 189. Relative Average Annual Pu Load Totals at GS01 and GS31

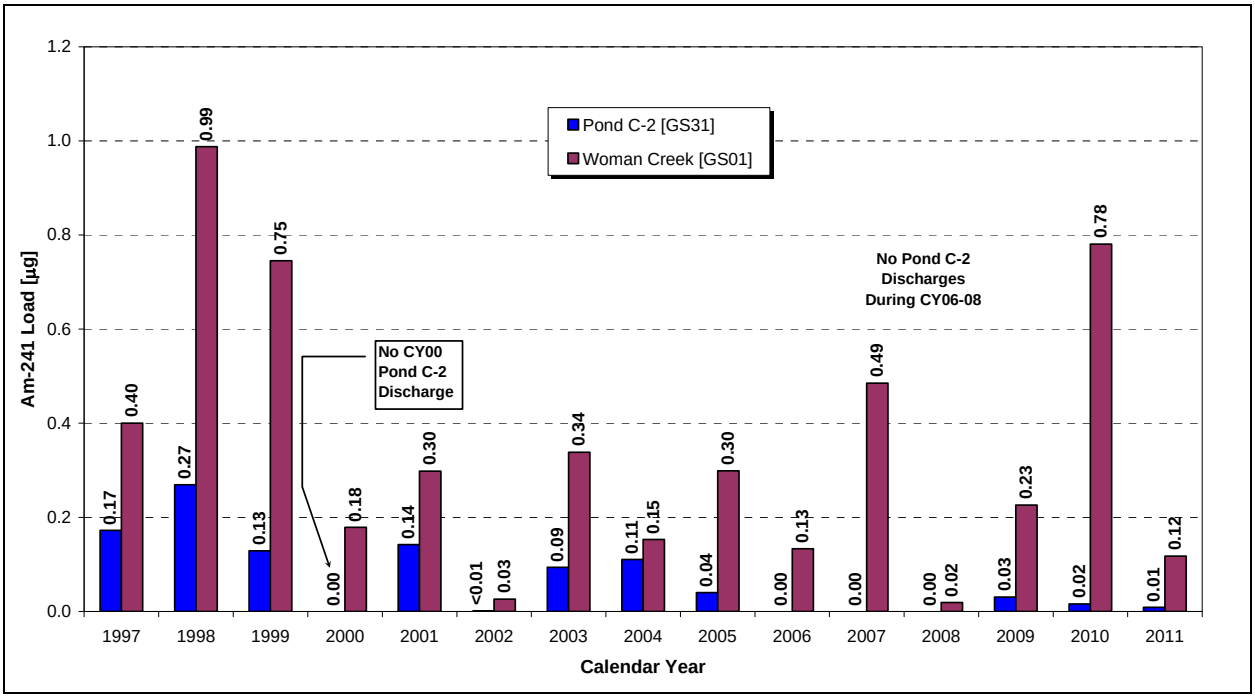
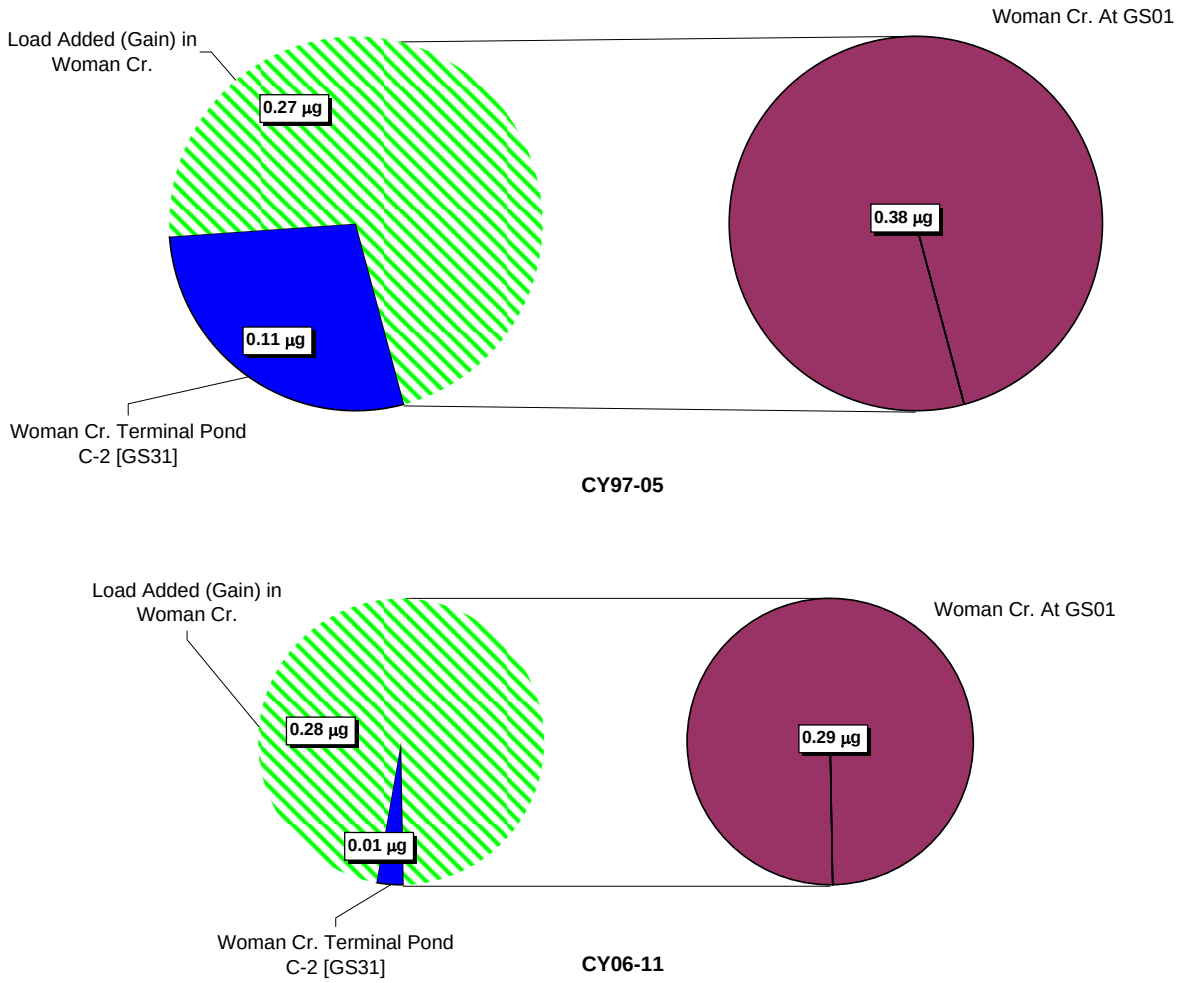


Figure 190. Annual Am Loads at GS01 and GS31: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 191. Relative Average Annual Am Load Totals at GS01 and GS31

Table 76. Total U Loads at GS01 and GS31: CY 2003−2011

Calendar Year	Total U (g)	
	Pond C-2 (GS31)	POC GS01
2003	129	790
2004	92	808
2005	115	918
2006	0; No C-2 discharge	235
2007	0; No C-2 discharge	1,016
2008	0; No C-2 discharge	174
2009	95	761
2010	61	1,162
2011	102	609
Total	593	6,474

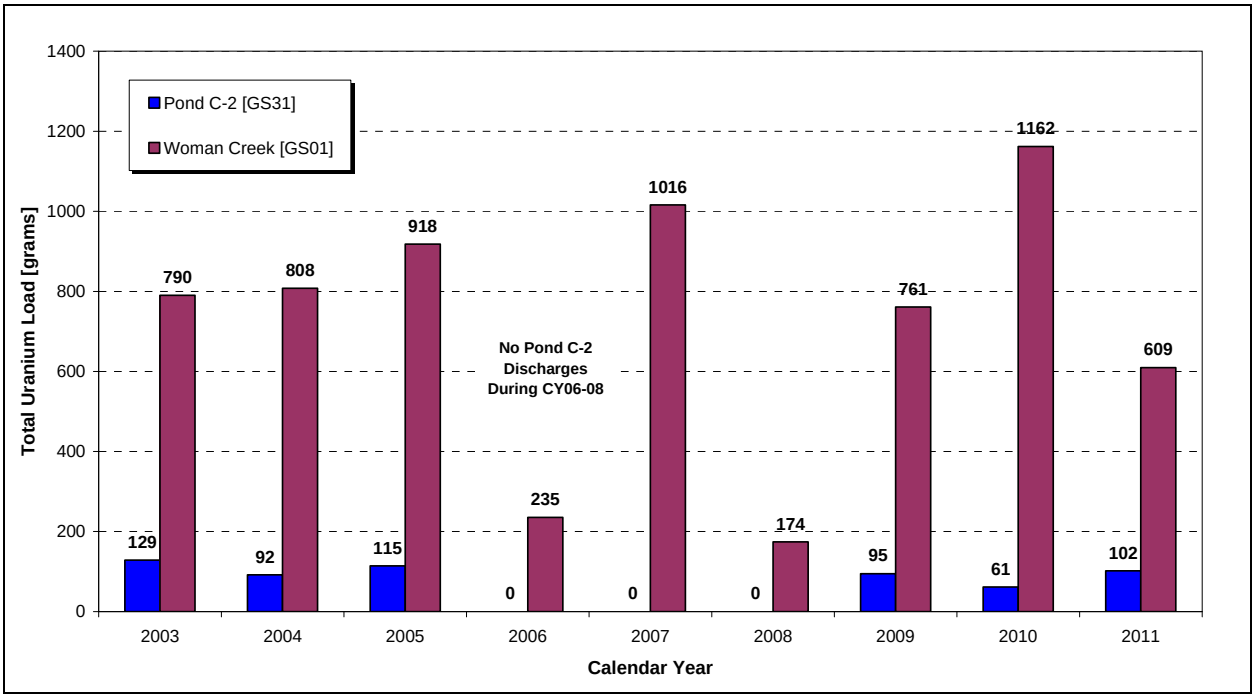
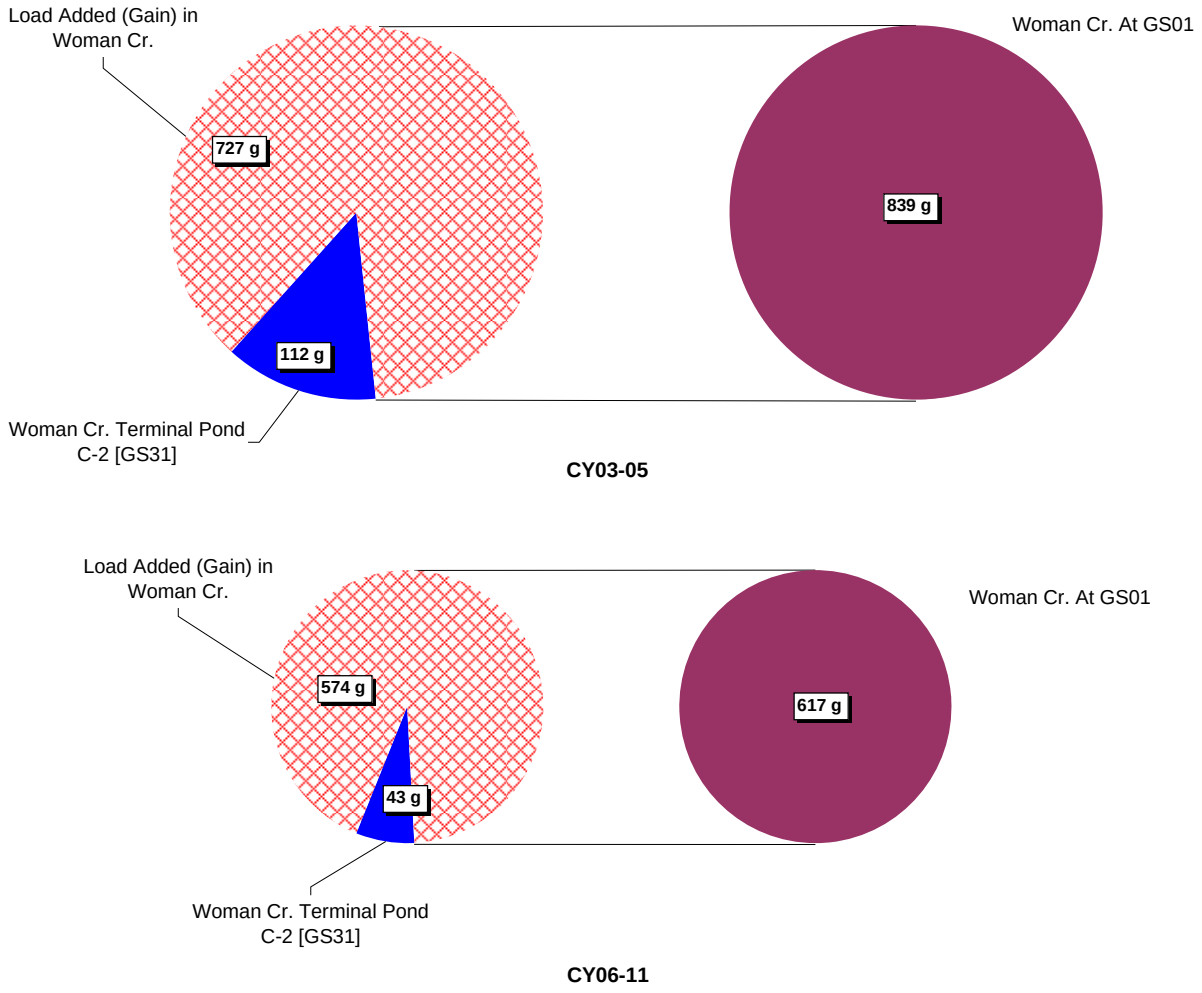


Figure 192. Annual Total U Loads at GS01 and GS31: CY 2003−2011



Note: Pie chart diameters are relative to total load.

Figure 193. Relative Average Annual Total U Load Totals at GS01 and GS31

Terminal Ponds A-4, B-5, and C-2

This section summarizes the calculated Pu, Am, and total U loads from terminal Ponds A-4, B-5, and C-2. The data are presented in Table 77 and Table 78, and depicted on Figure 194, Figure 195, Figure 196, Figure 197, Figure 198, and Figure 199. The following points are noted:

- Annual Pu and Am loads vary significantly year to year (Figure 194 and Figure 196). A general reduction in Pu and Am loads is noted during active closure, with a significant reduction post-closure due to the reduction of runoff and sediment transport attributed to the effectiveness of remedial actions, revegetation, and erosion control measures.
- Pond B-5 accounts for most (76 percent) of the Pu load from the terminal ponds (Figure 195) pre-closure. With the reduction of both discharge volume and activity, Pond B-5 accounts for 34 percent of the post-closure load; Pond A-4 accounts for 50 percent of the post-closure Pu load due to larger discharge volumes, and not higher Pu activity. Post-closure Pu loads from the terminal ponds have been reduced 95 percent overall.

- Pond B-5 accounts for most (67 percent) of the Am load from the terminal ponds (Figure 197) pre-closure. With the reduction of both discharge volume and activity, Pond B-5 accounts for 33 percent of the post-closure load; Pond A-4 accounts for 57 percent of the post-closure Am load due to larger discharge volumes, and not higher Am activity. Post-closure Am loads from the terminal ponds have been reduced 93 percent overall.
- Pond A-4 accounts for a slim majority (46 percent) of the total U loads from the terminal ponds (Figure 199) pre-closure. Comparable proportions are noted post-closure. Post-closure U loads from the terminal ponds have been reduced 44 percent overall.

Table 77. Pu and Am Loads from Terminal Ponds A-4, B-5, and C-2: CY 1997–2011

Calendar Year	Pu-239,240 (µg)			Am-241 (µg)		
	Pond A-4 (GS11)	Pond B-5 (GS08)	Pond C-2 (GS31)	Pond A-4 (GS11)	Pond B-5 (GS08)	Pond C-2 (GS31)
1997	59.2	8.8	16.7	0.70	0.25	0.17
1998	20.0	22.4	2.2	1.25	0.35	0.27
1999	23.8	261.4	26.9	0.20	1.81	0.13
2000	28.4	244.6	0.0; No C-2 discharge	0.02	3.14	0.00; No C-2 discharge
2001	4.7	32.3	11.0	0.11	0.46	0.14
2002	0.1	7.8	0.2	0.04	0.25	<0.01
2003	7.3	111.5	11.0	0.18	0.54	0.09
2004	2.2	27.1	11.5	0.14	0.58	0.11
2005	2.2	17.9	5.0	0.43	0.97	0.04
2006	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0; No C-2 discharge	0.00; No A-4 discharge	0.00; No B-5 discharge	0.0; No C-2 discharge
2007	7.8	1.9	0.0; No C-2 discharge	0.02	0.03	0.0; No C-2 discharge
2008	0.0; No A-4 discharge	0.0; No B-5 discharge	0.0; No C-2 discharge	0.00; No A-4 discharge	0.00; No B-5 discharge	0.0; No C-2 discharge
2009	2.3	3.0	4.1	0.09	0.02	0.03
2010	6.4	5.4	0.4	0.14	0.11	0.02
2011	1.0	1.8	1.0	0.05	0.02	0.01
Total	165.5	745.9	90.0	3.38	8.53	1.01

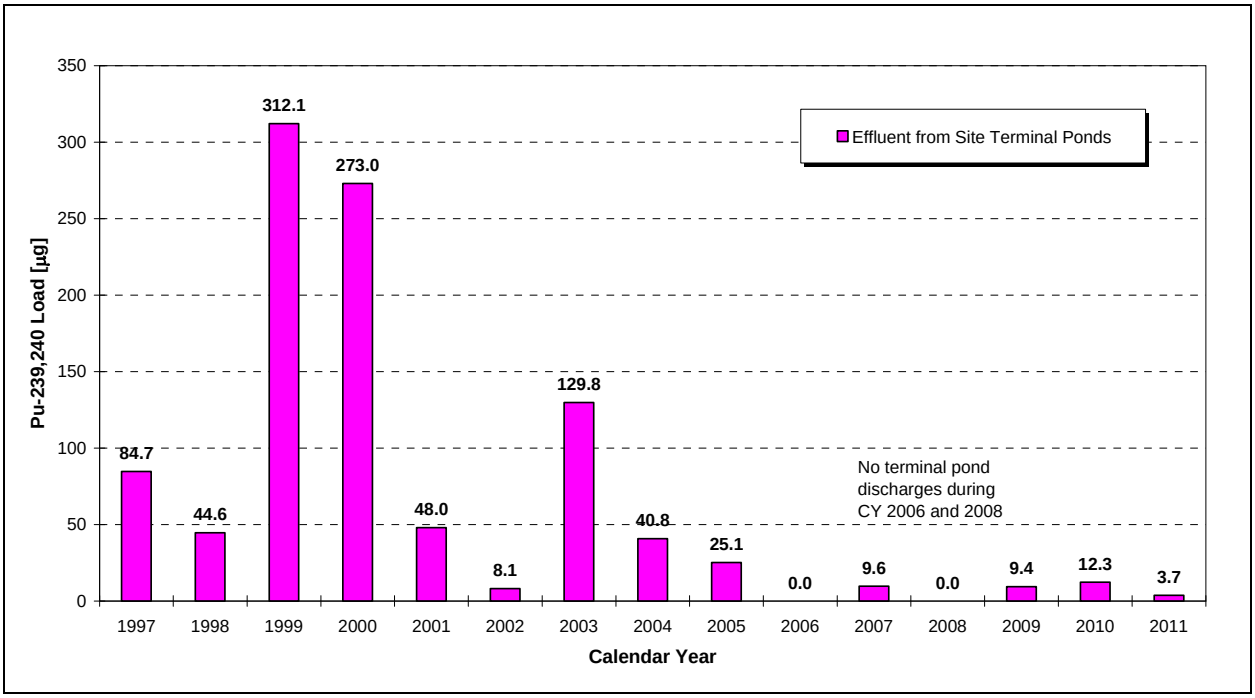
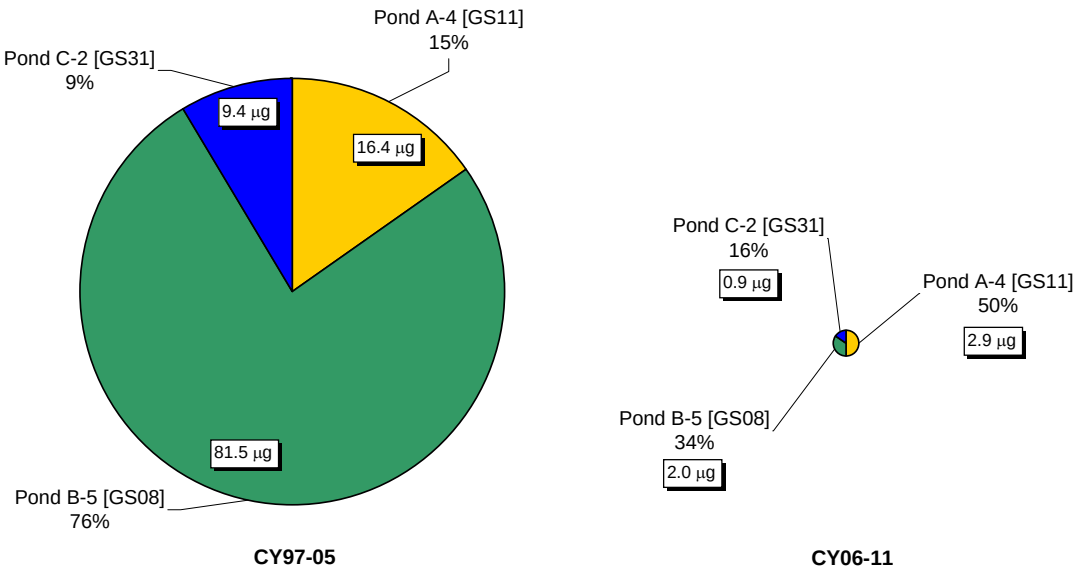


Figure 194. Annual Pu Loads from Terminal Ponds A-4, B-5, and C-2: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 195. Relative Average Annual Pu Load Totals from Terminal Ponds A-4, B-5, and C-2

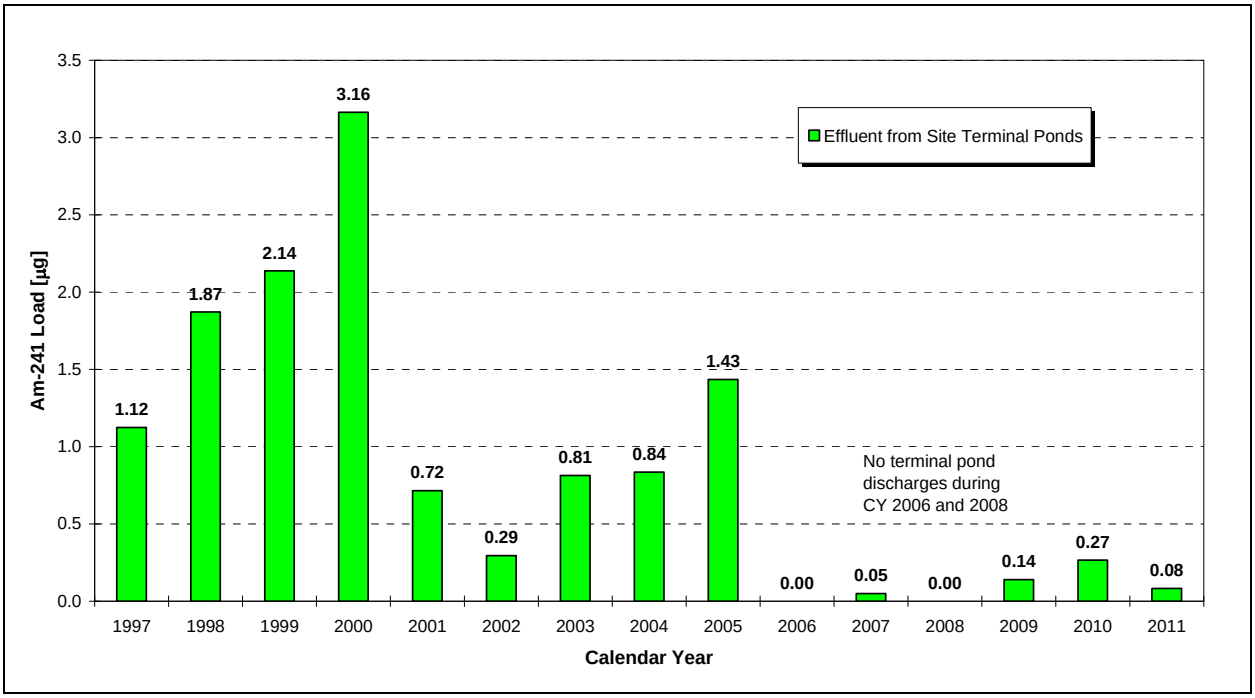
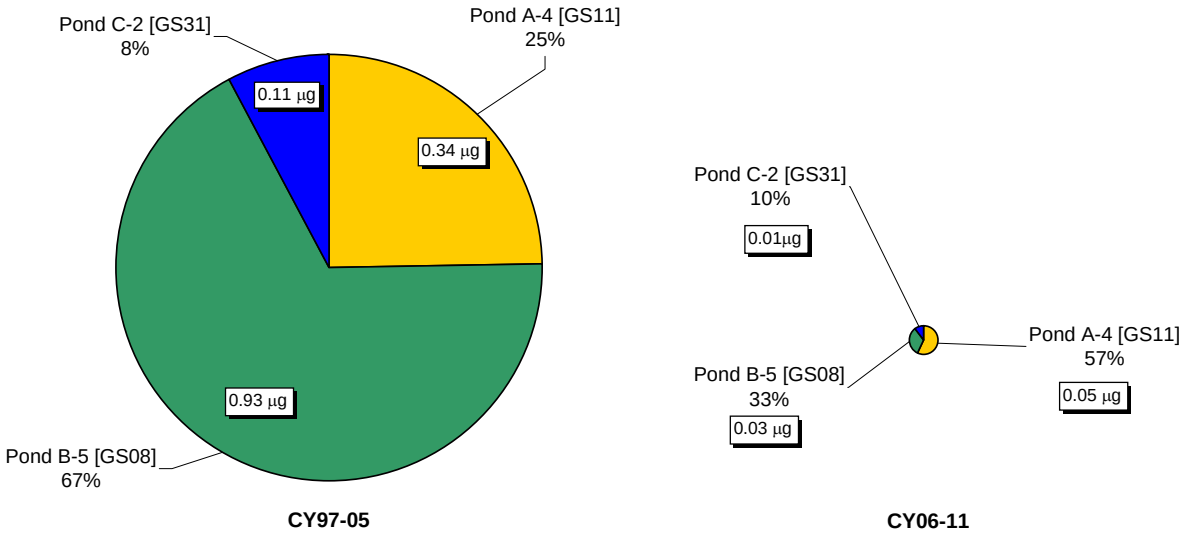


Figure 196. Annual Am Loads from Terminal Ponds A-4, B-5, and C-2: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 197. Relative Average Annual Am Load Totals from Terminal Ponds A-4, B-5, and C-2

Table 78. Total U Loads from Terminal Ponds A-4, B-5, and C-2: CY 1997–2011

Calendar Year	Total U (g)		
	Pond A-4 (GS11)	**Pond B-5 (GS08)**	**Pond C-2 (GS31)**
1997	1,365	252	231
1998	1,301	620	216
1999	633	809	189
2000	386	465	0; No C-2 discharge
2001	564	639	67
2002	132	258	1
2003	865	610	129
2004	316	390	92
2005	165	1,389	115
2006	0; No A-4 discharge	0; No B-5 discharge	0; No C-2 discharge
2007	411	481	0; No C-2 discharge
2008	0; No A-4 discharge	0; No B-5 discharge	0; No C-2 discharge
2009	405	322	95
2010	1,199	746	61
2011	430	315	102
Total	8,172	7,296	1,297

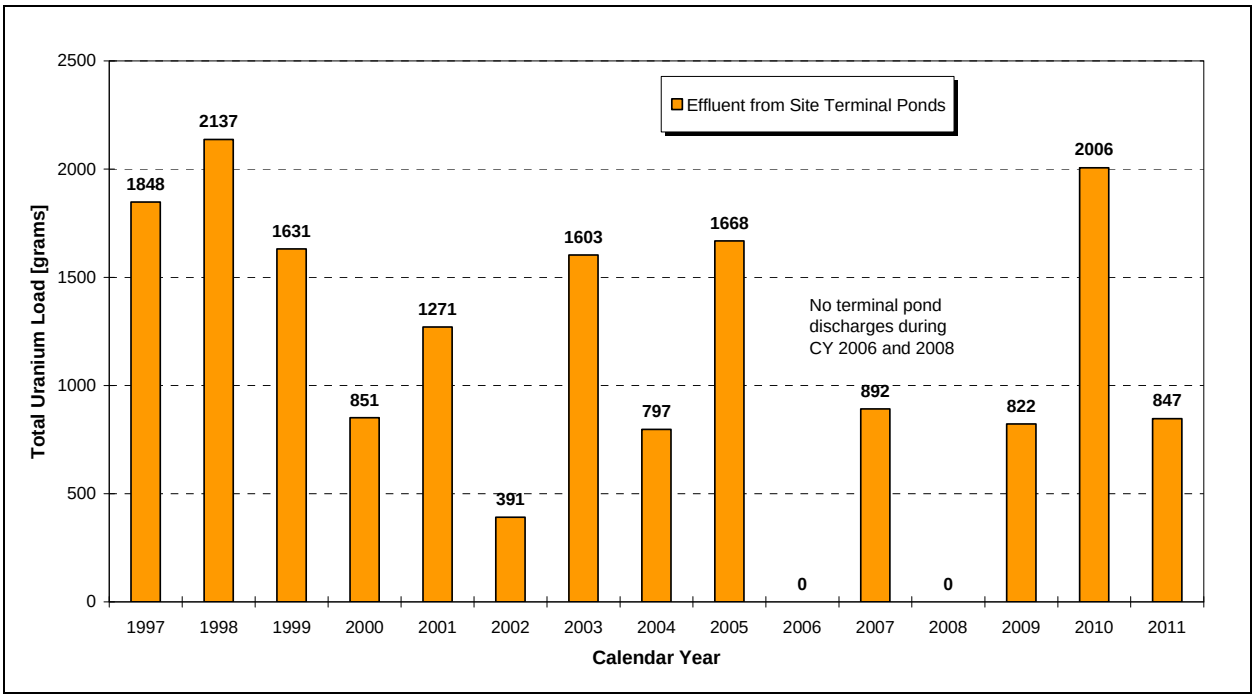
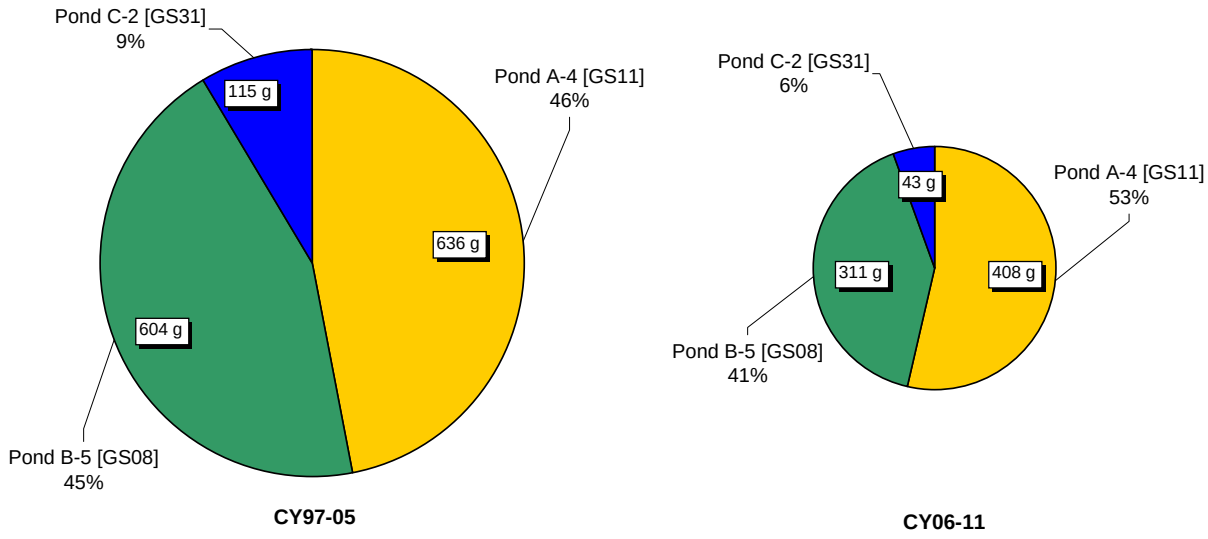


Figure 198. Annual Total U Loads from Terminal Ponds A-4, B-5, and C-2: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 199. Relative Average Annual Total U Load Totals from Terminal Ponds A-4, B-5, and C-2

A- and B-Series Ponds (POCs GS08 and GS11)

This section summarizes the calculated Pu, Am, and total U loads for the A- and B-Series Ponds. The data are presented in Table 79, Table 80, and Table 81, and are depicted on Figure 200, Figure 201, Figure 202, Figure 203, Figure 204, Figure 205, Figure 206, and Figure 207. Since water transfers occurred between ponds pre-closure, the load analysis is performed for both pond series combined. The influent load sources are GS10 and 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 79 shows GS10 with the highest influent Pu load for CY 1997–2011. Post-closure Pu loads at GS10 have been reduced 91 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 200). With the implementation of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006–2011. However, the CY 2011 load has increased due to recent increases in Pu activity at GS10 (see Section 3.1.2.2). Post-closure influent and effluent loads have been reduced by 93 percent and 95 percent, respectively.
- Table 80 shows GS10 with the highest influent Am load for CY1997–2011. Post-closure Am loads at GS10 have been reduced 90 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 202). Increased Am loads at SW093 were primarily due to contributions from B771 D&D 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 2006–2011. However, the CY 2011 load has increased due to recent increases in Am activity at GS10 (see Section 3.1.2.2). Post-closure influent and effluent loads have been reduced by 93 percent and 94 percent, respectively.

- Pre-closure annual Pu and Am loads vary significantly year to year (Figure 200 and Figure 202), primarily due to streamflow volume and solids transport variation. Post-closure loads show less variability.
- Pre-closure (Figure 204), 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 205), GS10 shows both the highest average annual concentration and load. Although total influent U concentration has increased significantly, corresponding reductions in streamflow volume have actually resulted in a *decrease* in load. Post-closure influent load has been reduced by 14 percent.
- Pre-closure (Figure 204), GS11 shows the highest effluent average annual total U concentration and load. However, with the increased concentrations in South Walnut Creek, GS08 shows the highest effluent average annual total U concentration post-closure. Again, although U activity has increased at both GS08 and GS11, corresponding reductions in discharge volume have resulted in a *decrease* in load. Post-closure effluent load has been reduced by 42 percent.

Table 79. Pu Load Summary for the A- and B-Series Ponds: CY 1997–2011

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
Total	86.9	2,872.2	2,079.3	745.9	165.5

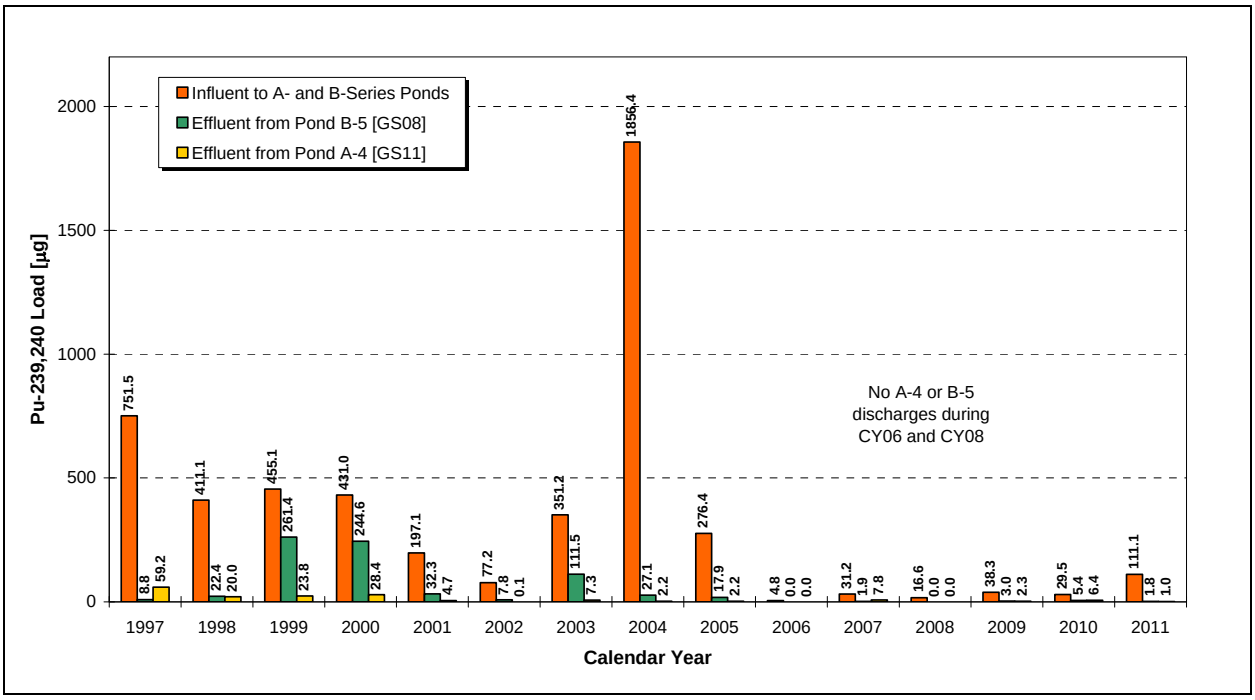
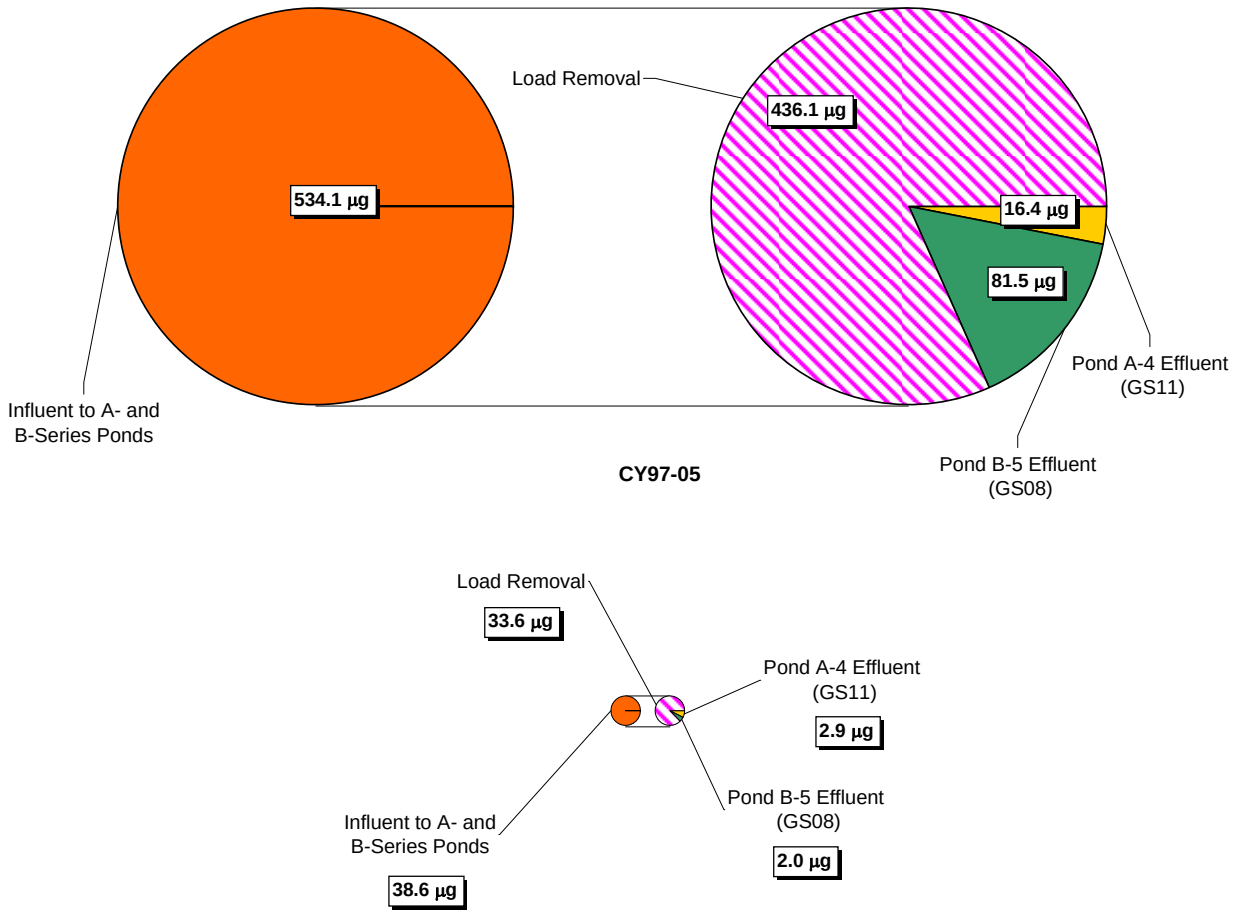


Figure 200. Annual Pu Loads for the A- and B-Series Ponds: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 201. Relative Average Annual Pu Load Totals for the A- and B-Series Ponds

Table 80. Am Load Summary for the A- and B-Series Ponds: CY 1997–2011

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
Total	2.65	65.61	39.87	8.53	3.38

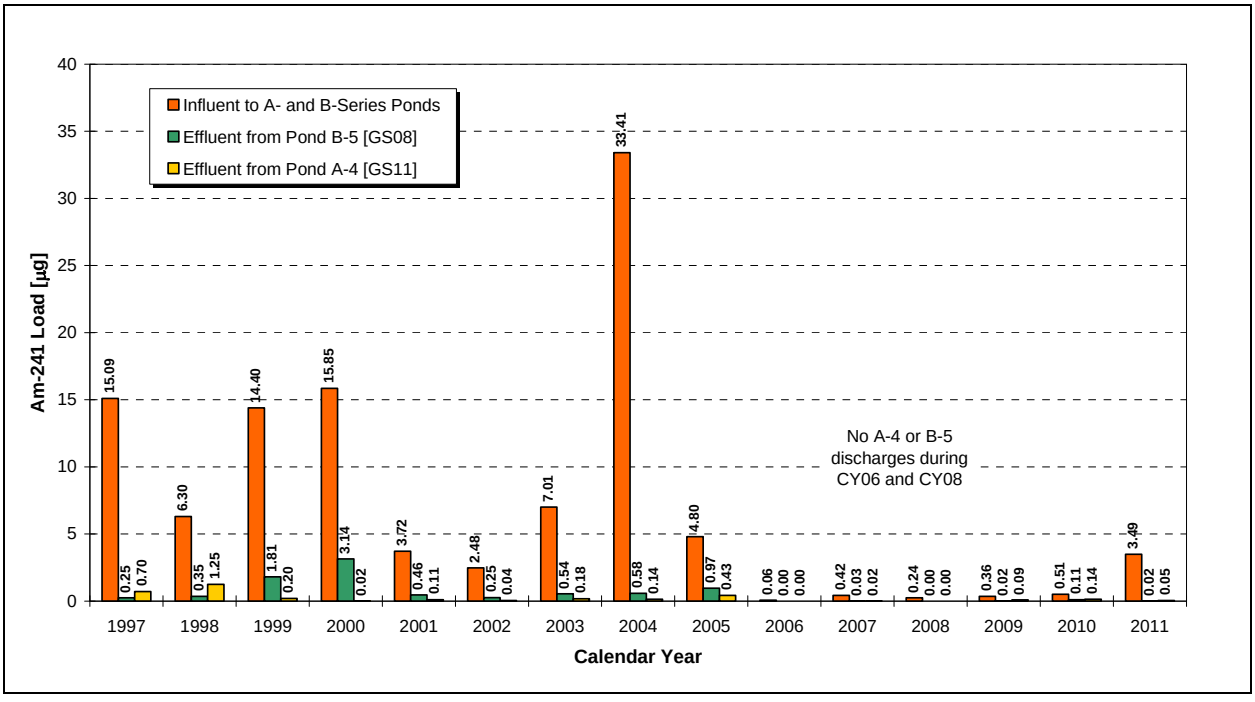
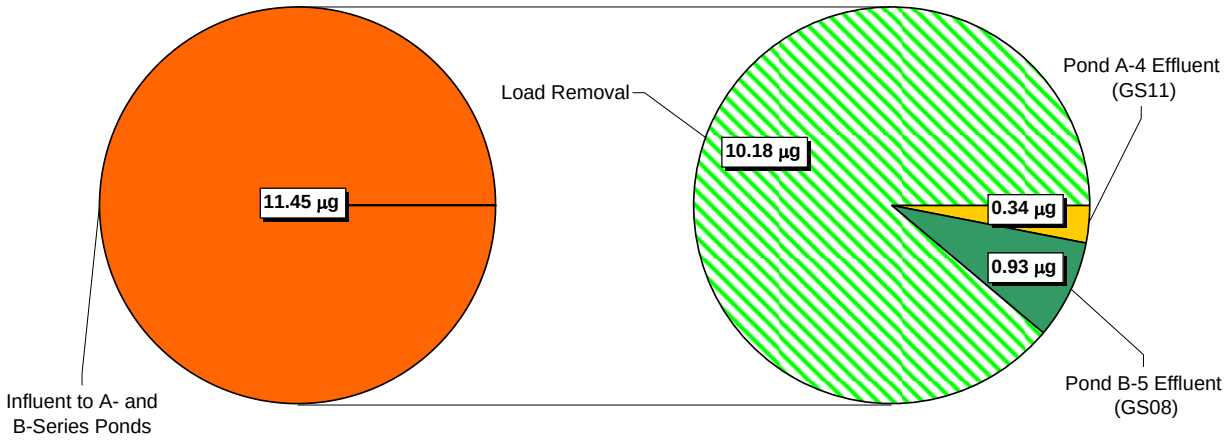
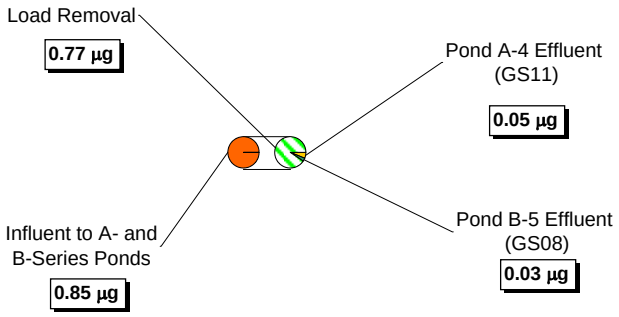


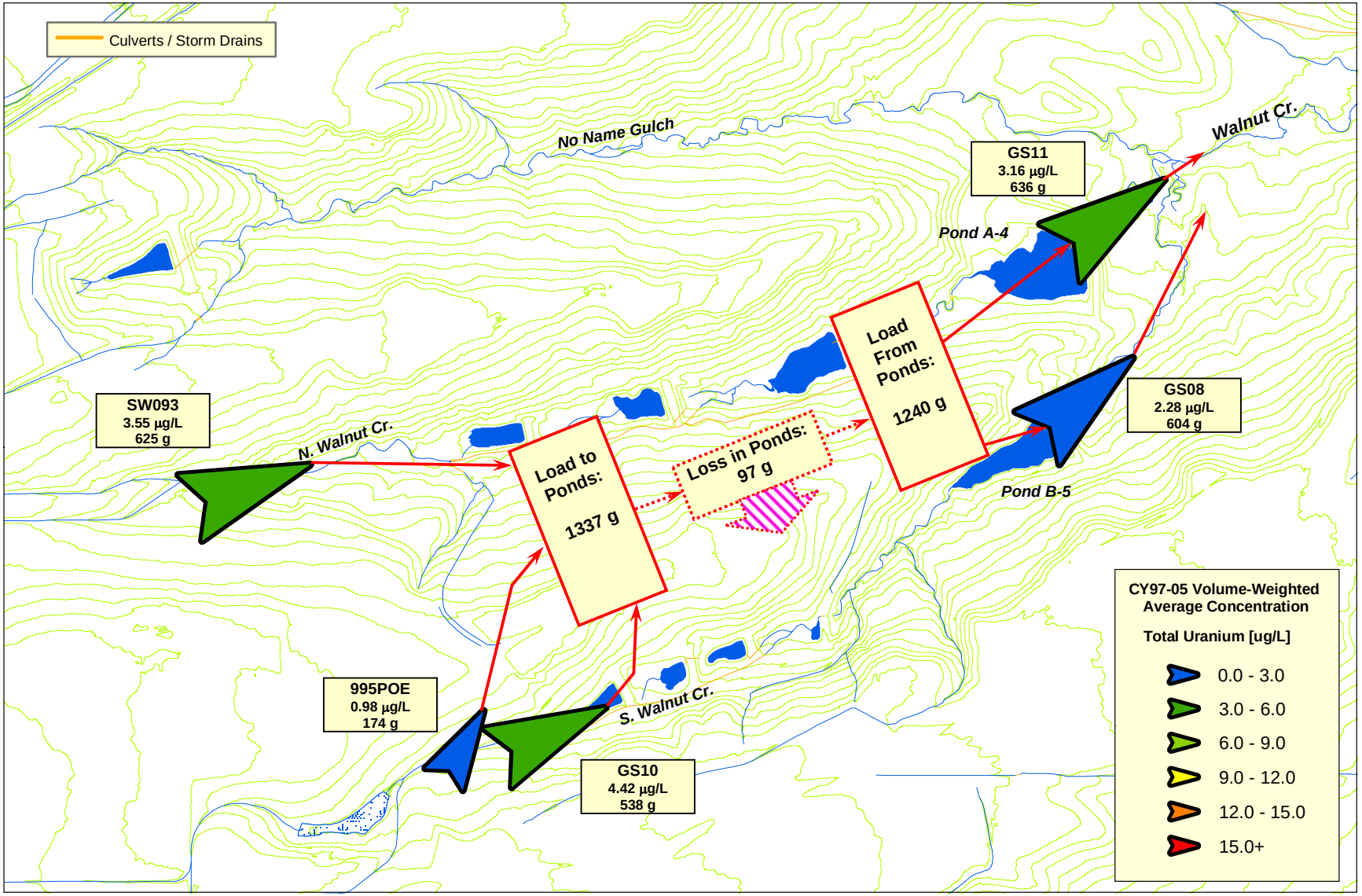
Figure 202. Annual Am Loads for the A- and B-Series Ponds: CY 1997–2011





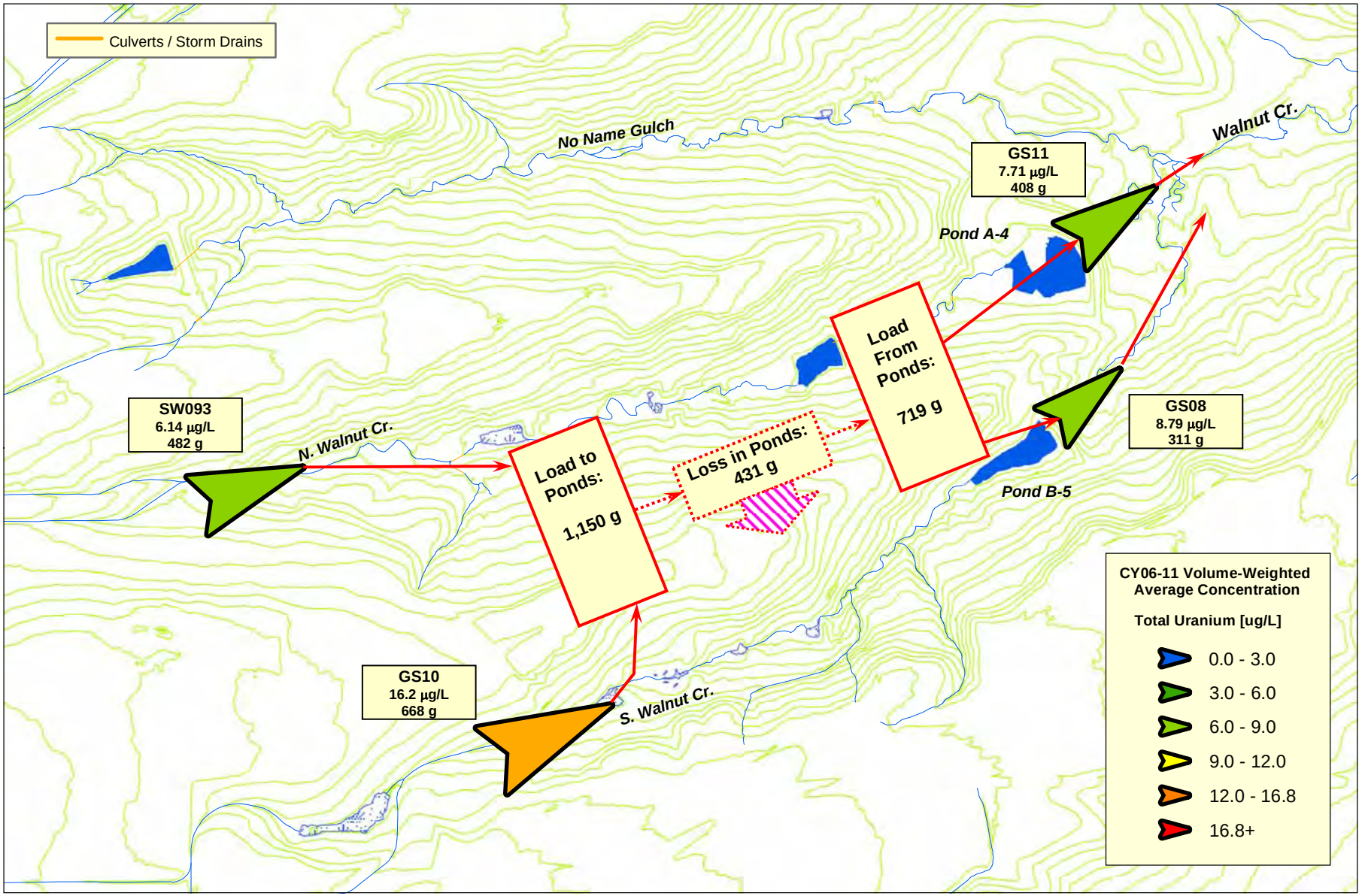
Note: Pie chart diameters are relative to total load.

Figure 203. Relative Average Annual Am Load Totals for the A- and B-Series Ponds



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 204. Relative Average Annual Total U Loading Schematic for the A- and B-Series Ponds: CY 1997–2005



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 205. Relative Average Annual Total U Loading Schematic for the A- and B-Series Ponds: CY 2006–2011

Table 81. Total U Load Summary for the A- and B-Series Ponds: CY 1997–2011

Calendar Year	Total U (g)				
	Influent (WWTP)	Influent (GS10)	Influent (SW093)	Effluent (GS08)	Effluent (GS11)
1997	257	637	853	252	1,365
1998	467	631	797	620	1,301
1999	121	589	714	809	633
2000	103	379	485	465	386
2001	259	519	646	639	564
2002	61	279	450	258	132
2003	161	501	568	610	865
2004	139	430	575	390	316
2005	0 WWTP removed	879	534	1,389	165
2006	0 WWTP removed	230	171	0; No B-5 discharge	0; No A-4 discharge
2007	0 WWTP removed	830	540	481	411
2008	0 WWTP removed	275	154	0; No B-5 discharge	0; No A-4 discharge
2009	0 WWTP removed	756	574	322	405
2010	0 WWTP removed	1,158	1,047	746	1,199
2011	0 WWTP removed	758	403	315	430
Total	1,569	8,853	8,511	7,296	8,172

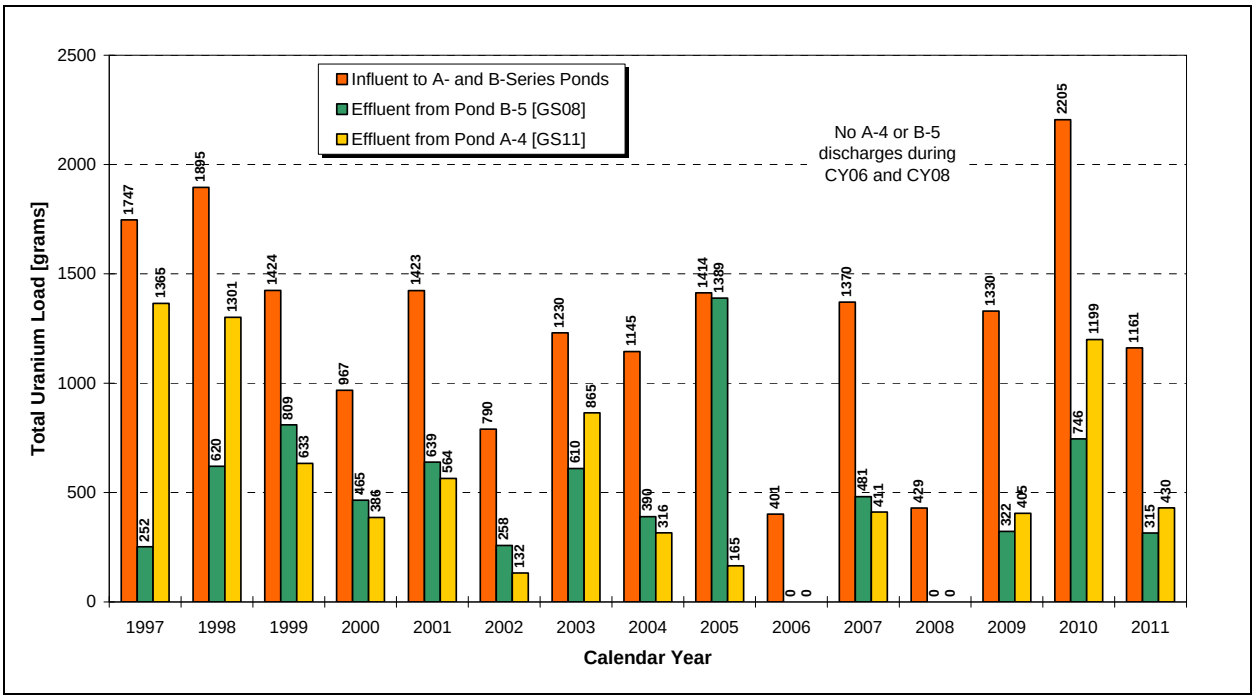
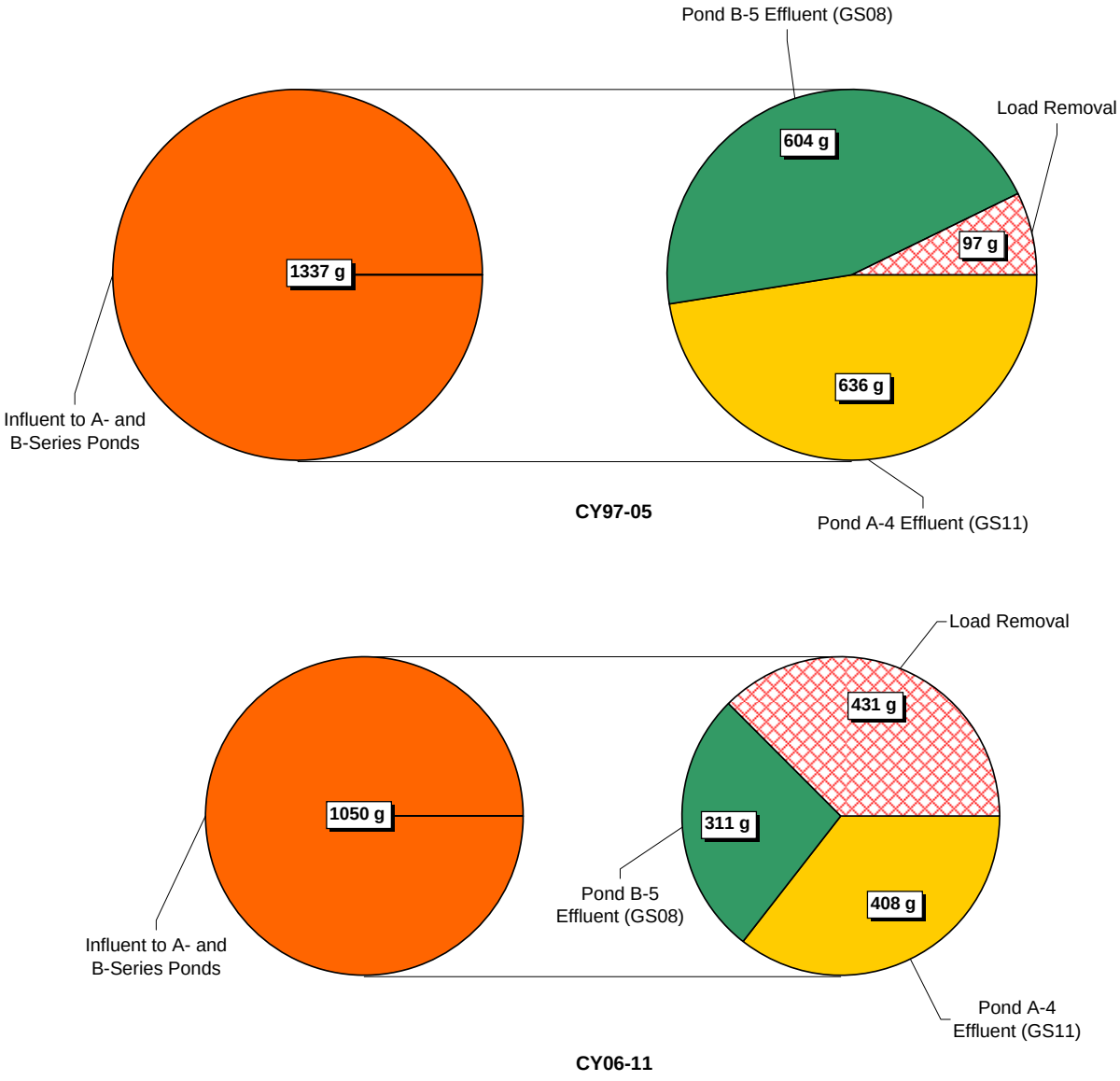


Figure 206. Annual Total U Loads for the A- and B-Series Ponds: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 207. Relative Average Annual Total U Load Totals for the A- and B-Series Ponds

Pond C-2 (POC GS31)

This section summarizes the calculated Pu, Am, and total U loads for Pond C-2. Data are presented in Table 82, Table 83, and Table 84, and depicted on Figure 208, Figure 209, Figure 210, Figure 211, Figure 212, Figure 213, Figure 214, and Figure 215. 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 208 and Figure 210). 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 erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2005−2011. Post-closure influent and effluent Pu loads have been reduced by 92 percent and 90 percent, respectively. Similarly, Post-closure influent and effluent Am loads have been reduced by 89 percent and 91 percent, respectively.

- Annual total U loads also vary significantly year to year (Figure 214). Post-closure influent and effluent U loads have been reduced by 74 percent and 63 percent, respectively.
- There is a measurable pre-closure average annual total U load gain in Pond C-2 (Figure 212). This is likely due to seepage with naturally occurring U entering Pond C-2 from the Woman Creek Diversion Canal. Post-closure, there is a similar gain in total U in Pond C-2.

Table 82. Pu Load Summary for Terminal Pond C-2: CY 1997–2011

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
Total	1,157.9	90.0

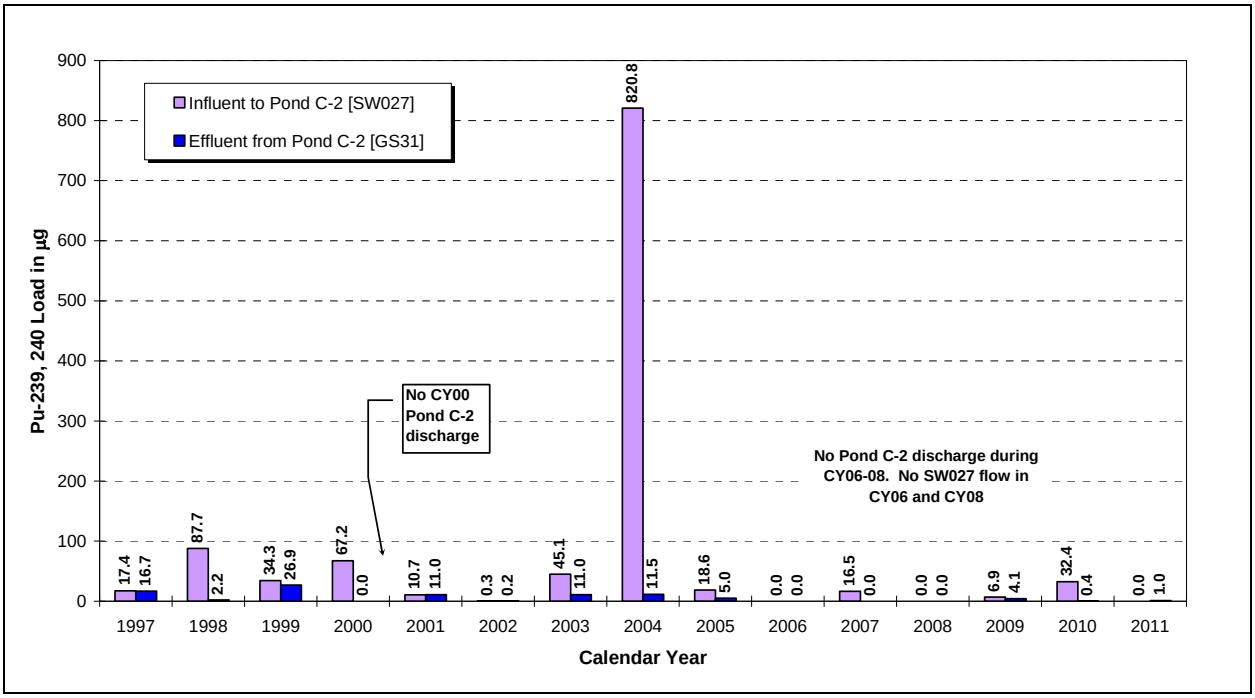
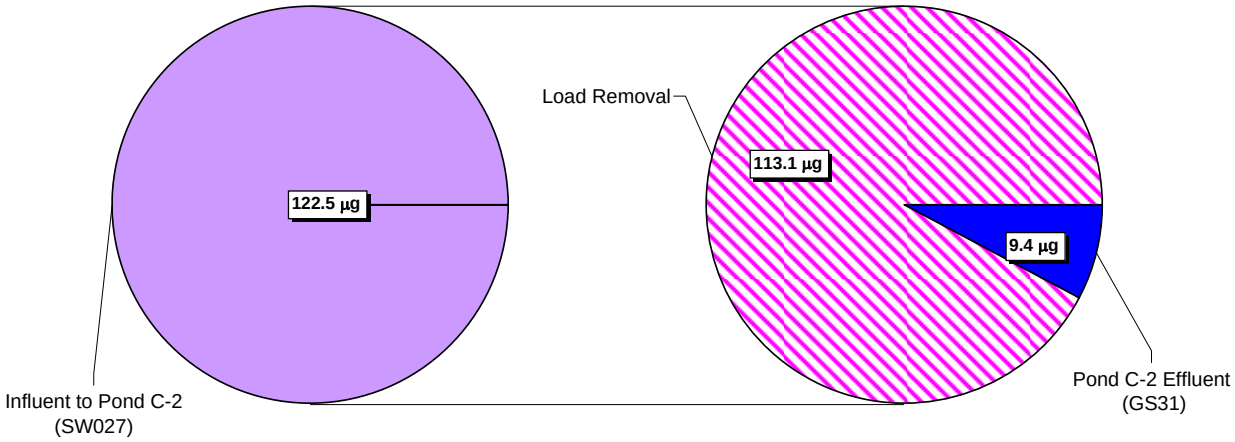
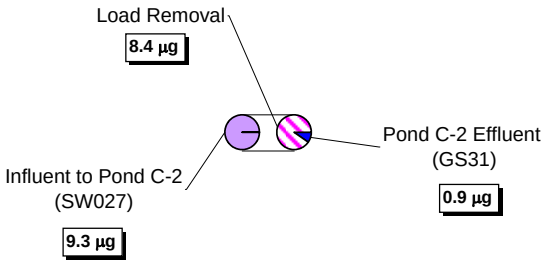


Figure 208. Annual Pu Loads for Pond C-2: CY 1997–2011



CY97-05



CY06-11

Note: Pie chart diameters are relative to total load.

Figure 209. Relative Average Annual Pu Load Totals for Pond C-2

Table 83. Am Load Summary for Terminal Pond C-2: CY 1997–2011

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
Total	4.39	1.01

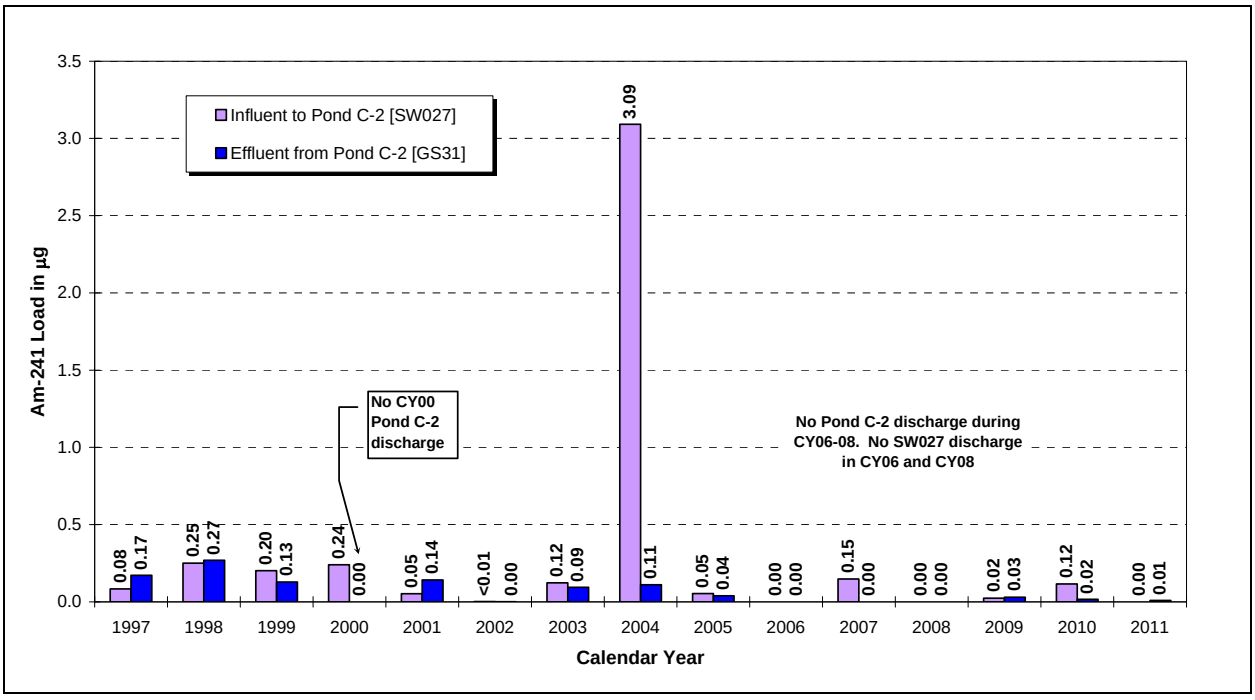
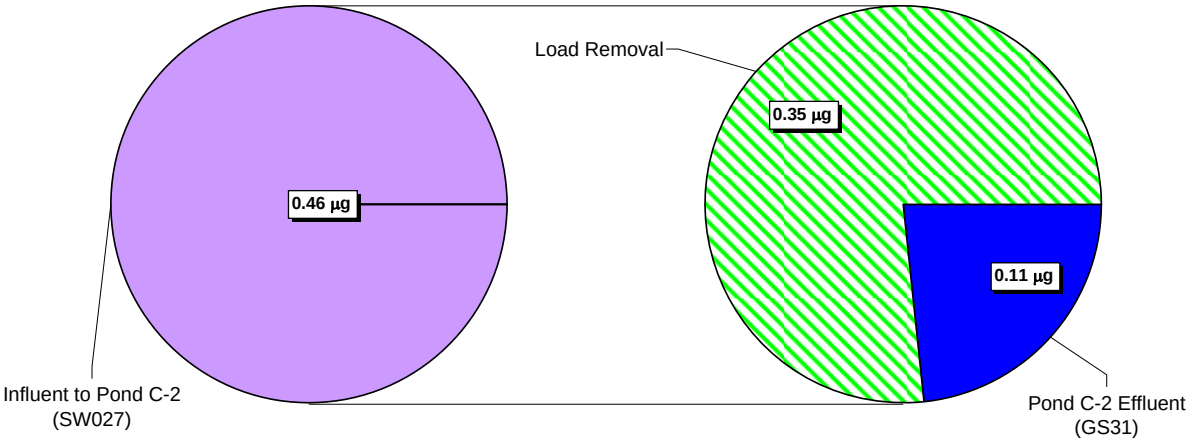
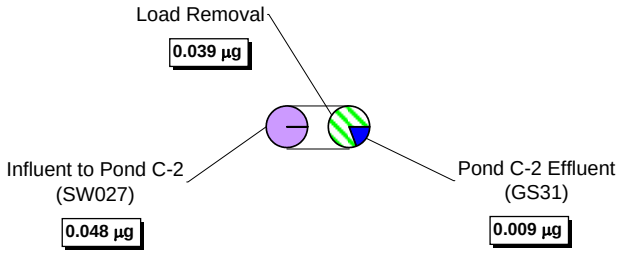


Figure 210. Annual Am Loads for Pond C-2: CY 1997–2011



CY97-05



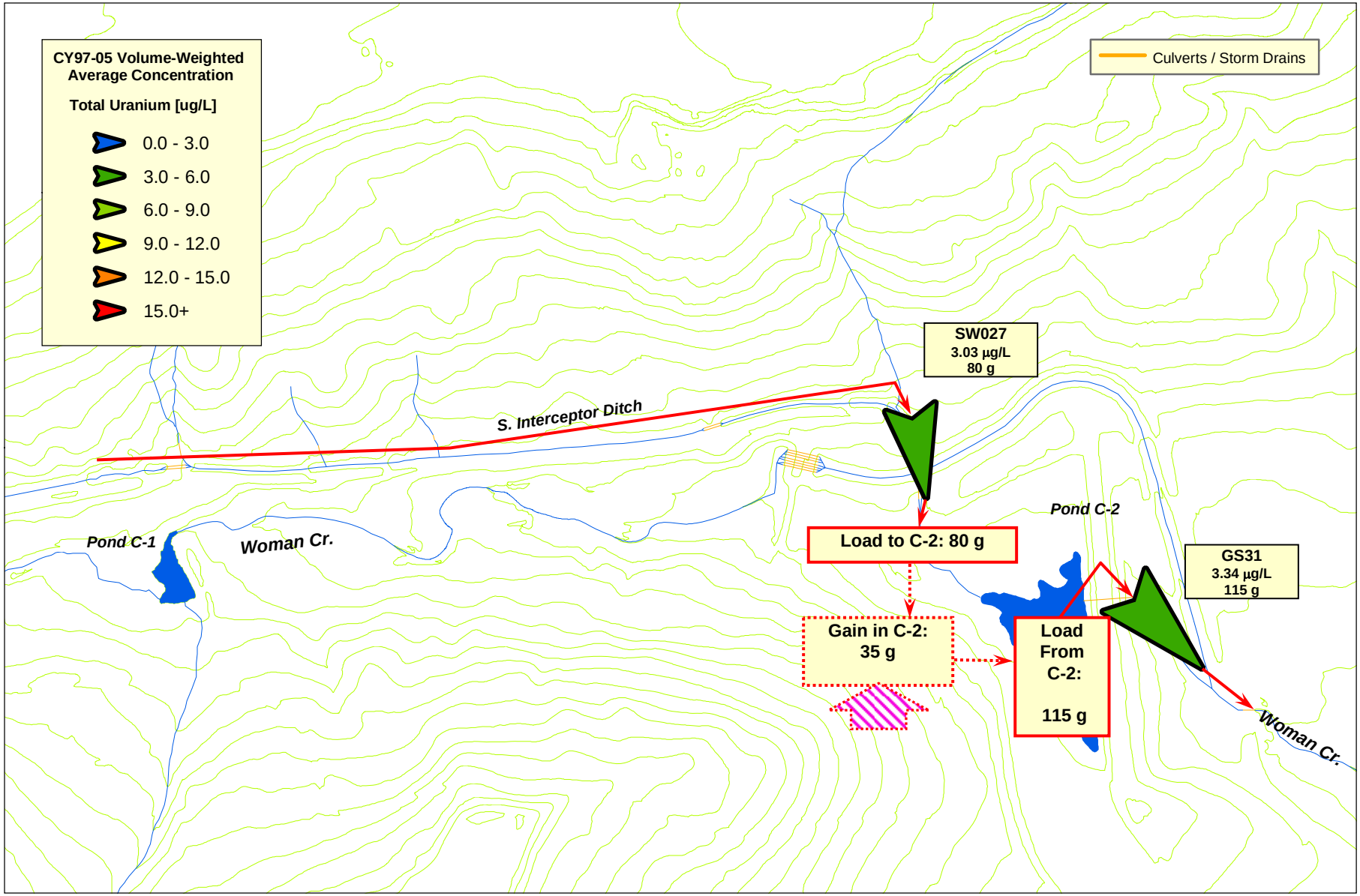
CY06-11

Note: Pie chart diameters are relative to total load.

Figure 211. Relative Average Annual Am Load Totals for Pond C-2

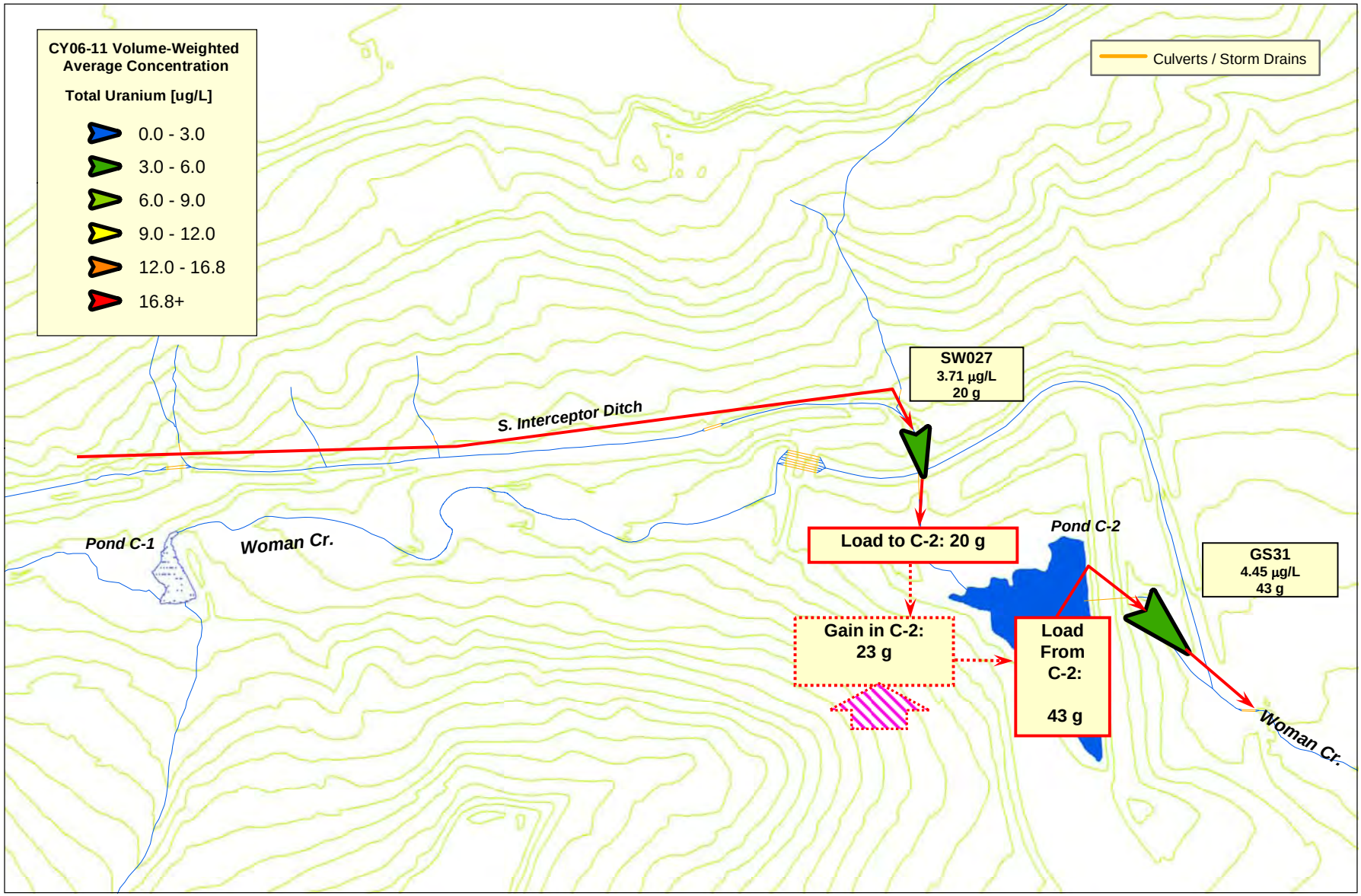
Table 84. Total U Load Summary for Terminal Pond C-2: CY 1997–2011

Calendar Year	Total U (g)	
	Influent (SW027)	Effluent (GS31)
1997	84	231
1998	239	216
1999	116	189
2000	22	0.00; No C-2 discharge
2001	66	67
2002	7	1
2003	111	129
2004	40	92
2005	33	115
2006	0; No flow	0; No C-2 discharge
2007	36	0; No C-2 discharge
2008	0; No flow	0; No C-2 discharge
2009	16	95
2010	70	61
2011	<0.1	102
Total	840	1,297



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 212. Relative Average Annual U Loading Schematic for Pond C-2: CY 1997–2005



Note: Location symbols are displayed proportional to calculated average annual load and colored according to concentration ranges in legend.

Figure 213. Relative Average Annual U Loading Schematic for Pond C-2: CY 2006–2011

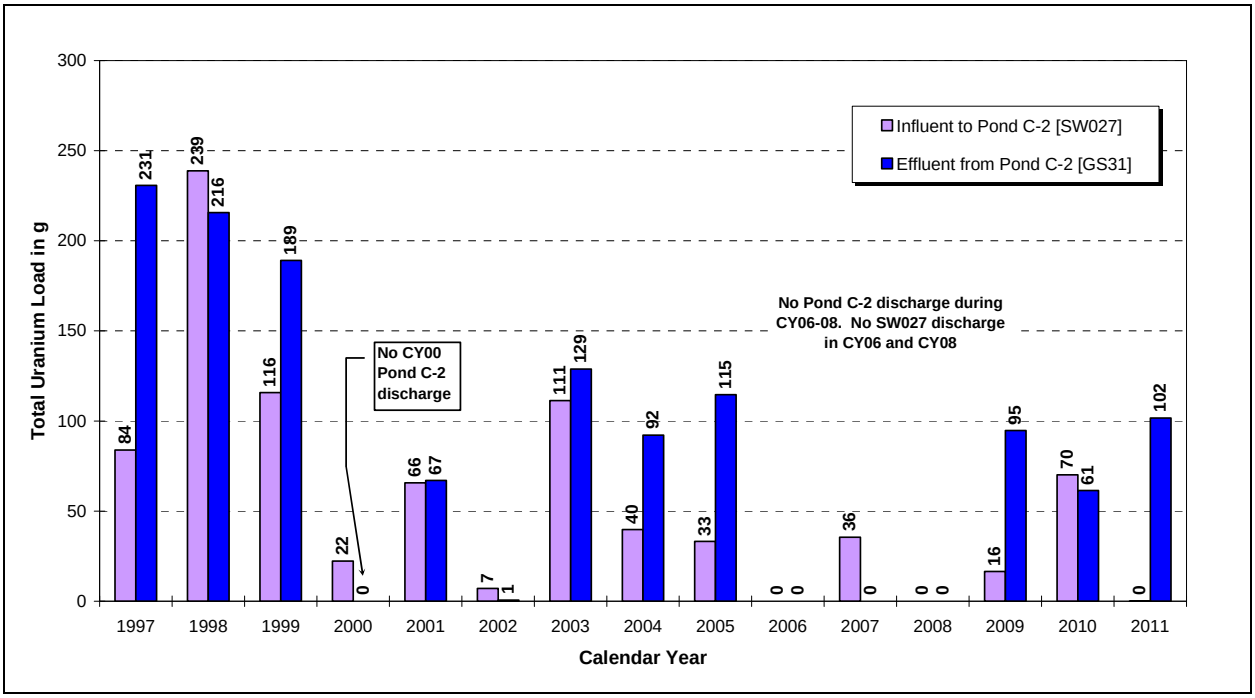
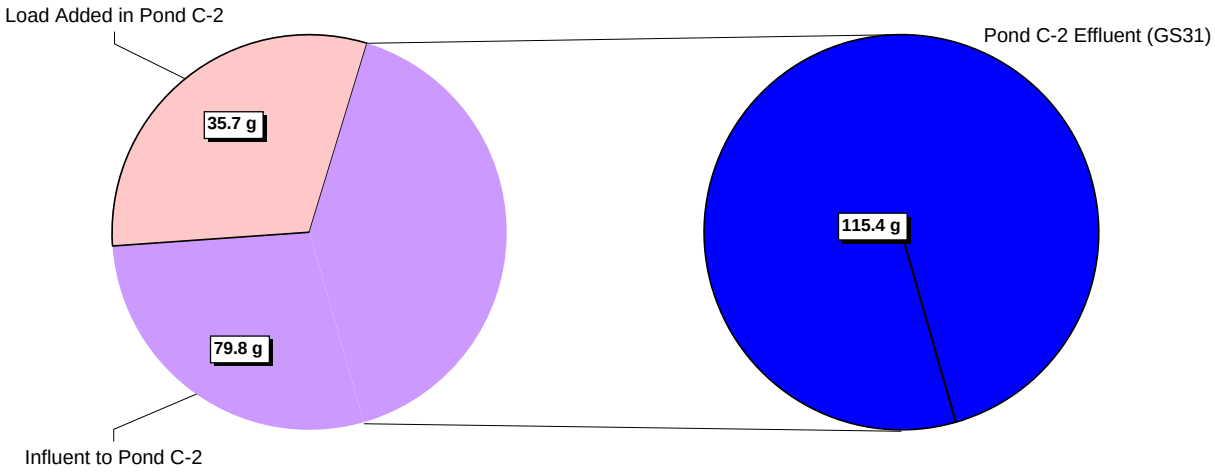
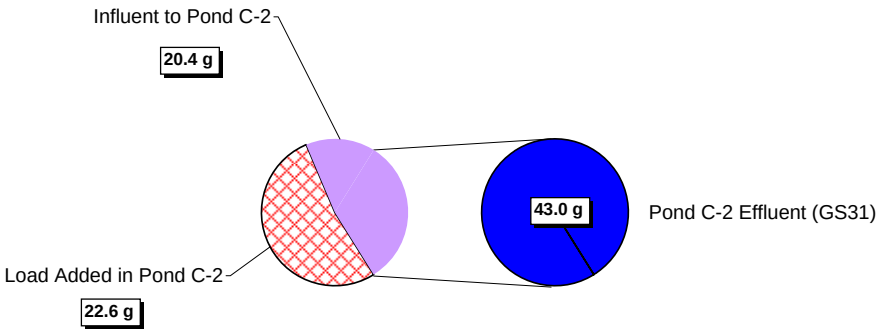


Figure 214. Annual Total U Loads for Pond C-2: CY 1997–2011



CY97-05



CY06-11

Note: Pie chart diameters are relative to total load.

Figure 215. Relative Average Annual Total U Load Totals for Pond C-2

RFLMA Points of Evaluation

Major COU Drainages

This section summarizes the calculated Pu, Am, and total U loads for the three major COU drainages: North Walnut Creek (SW093), South Walnut Creek (GS10 and the former WWTP), and the SID (SW027). Data are presented in Table 85 and Table 86 and are depicted on Figure 216, Figure 217, Figure 218, Figure 219, Figure 220, Figure 221, Figure 222, Figure 223, Figure 224, and Figure 225. The following points are noted:

- Total Pu load varies year to year and shows a significant increase in CY 2004 due to extensive soil disturbance (Figure 216). With the implementation of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006–2011. Post-closure Pu loads have been reduced by 93 percent.
- Total Am load also varies year to year and shows a measurable increase in CY 2004 due to soil disturbance and contributions from the B771 area (Figure 218). With the implementation of remedial actions, erosion controls, revegetation, and soil stabilization, a significant reduction is noted for CY 2006−2011. Data from SW093 in CY 2005 (Figure 223) also clearly show that the B771 pathway elimination was successful. Post-closure Am loads have been reduced by 92 percent.
- South Walnut Creek accounts for a majority (47 percent) of the Pu load from the COU (Figure 217) 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, South Walnut Creek remains the largest contributor (54 percent) of Pu load. The CY 2011 load has increased due to recent increases in Pu activity at GS10 (see Section 3.1.2.2).
- South Walnut Creek accounts for a majority (60 percent) of the Am load from the COU (Figure 219) 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 (75 percent) of the Am loads. The CY 2011 load has increased due to recent increases in Am activity at GS10 (see Section 3.1.2.2).
- Annual total U loads are more consistent year to year (Figure 224). The load reductions in CY 2006 and 2008 are due to flow volume reduction and not a decrease in U concentration. Similarly, the load increase in CY 2010 is due to large flow volumes and not a significant increase in U concentration. Post-closure overall U loads have been reduced by 17 percent.
- Pre-closure total U loads are fairly evenly divided (44 percent to 50 percent) between North and South Walnut Creeks (Figure 225). Post-closure, there is a slight shift toward South Walnut Creek (57 percent of the total).

Table 85. COU Pu and Am Loads: CY 1997–2011

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
Total	2,079.3	2,872.2	86.9	1,157.9	39.87	65.61	2.65	4.39

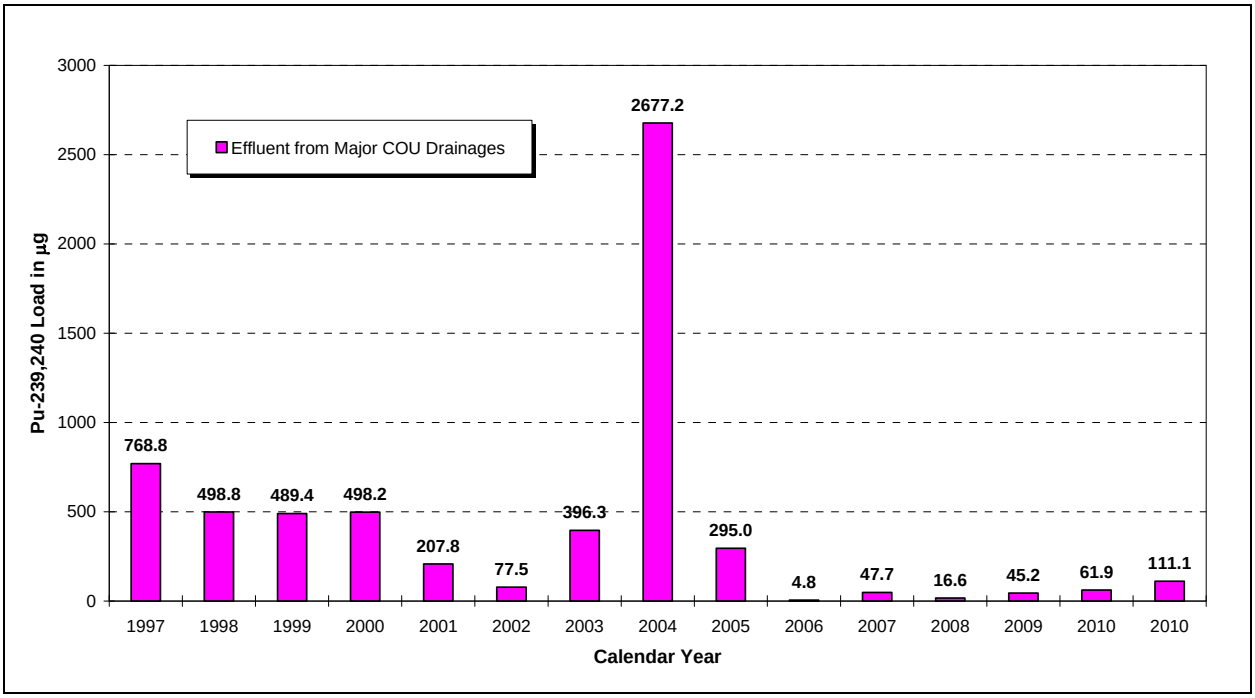
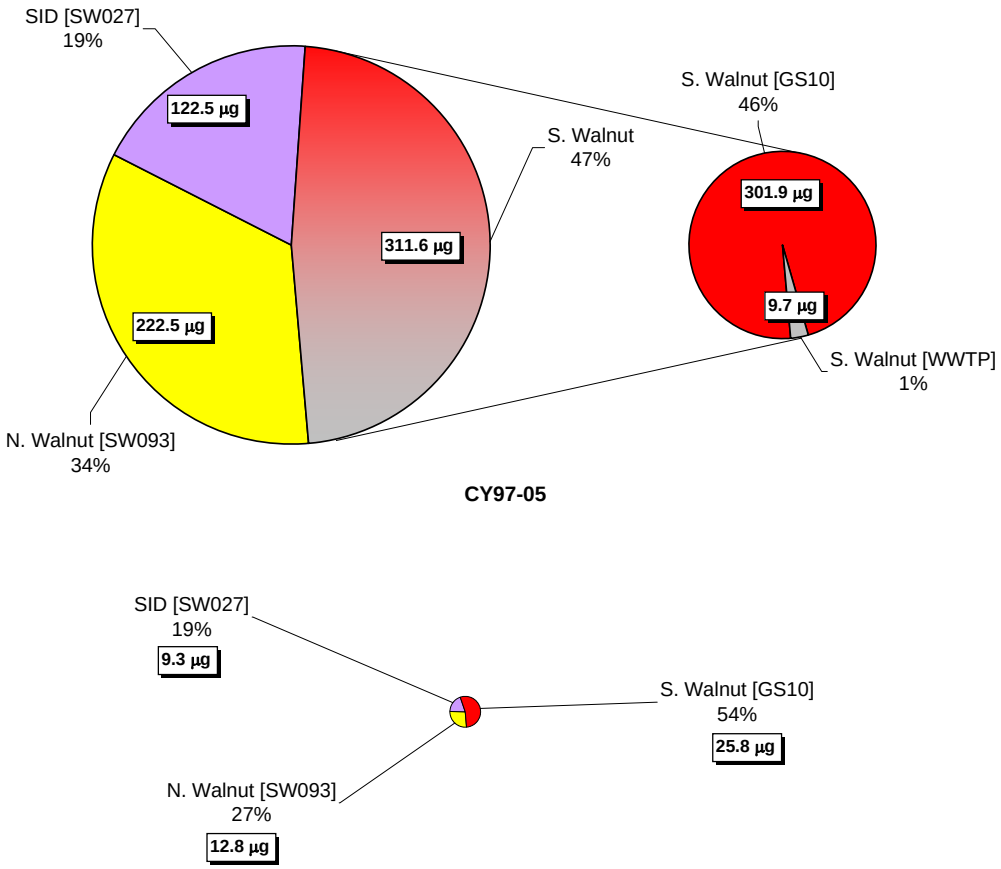


Figure 216. Combined Annual Pu Loads from Major COU Drainages and Former WWTP: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 217. Relative Average Annual Pu Load Totals from Major COU Drainages and Former WWTP

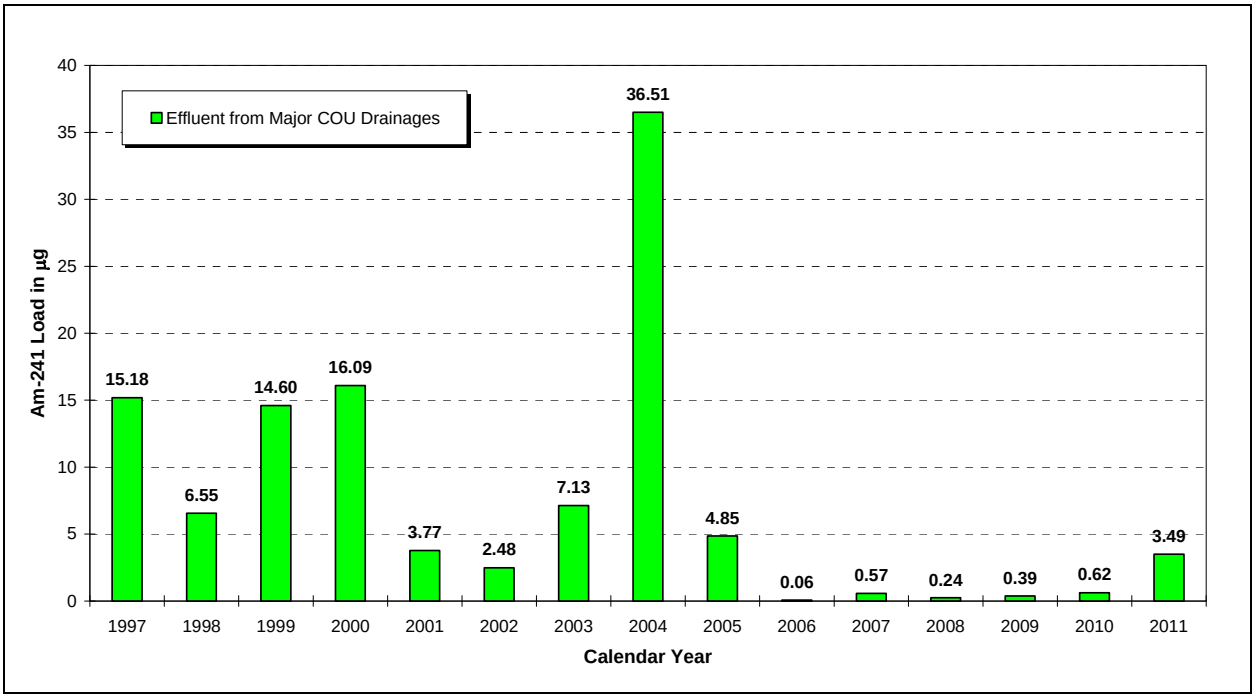
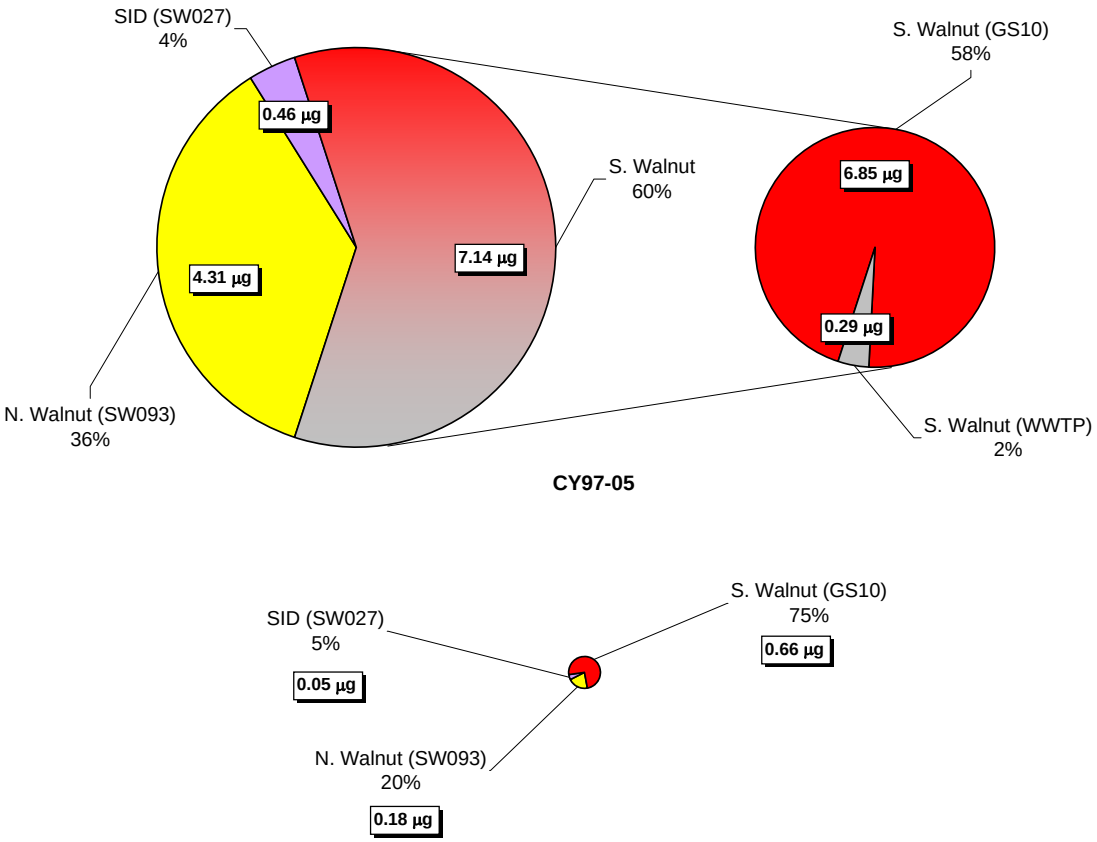


Figure 218. Annual Am Loads from Major COU Drainages and WWTP: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 219. Relative Average Annual Am Load Totals from Major COU Drainages and WWTP

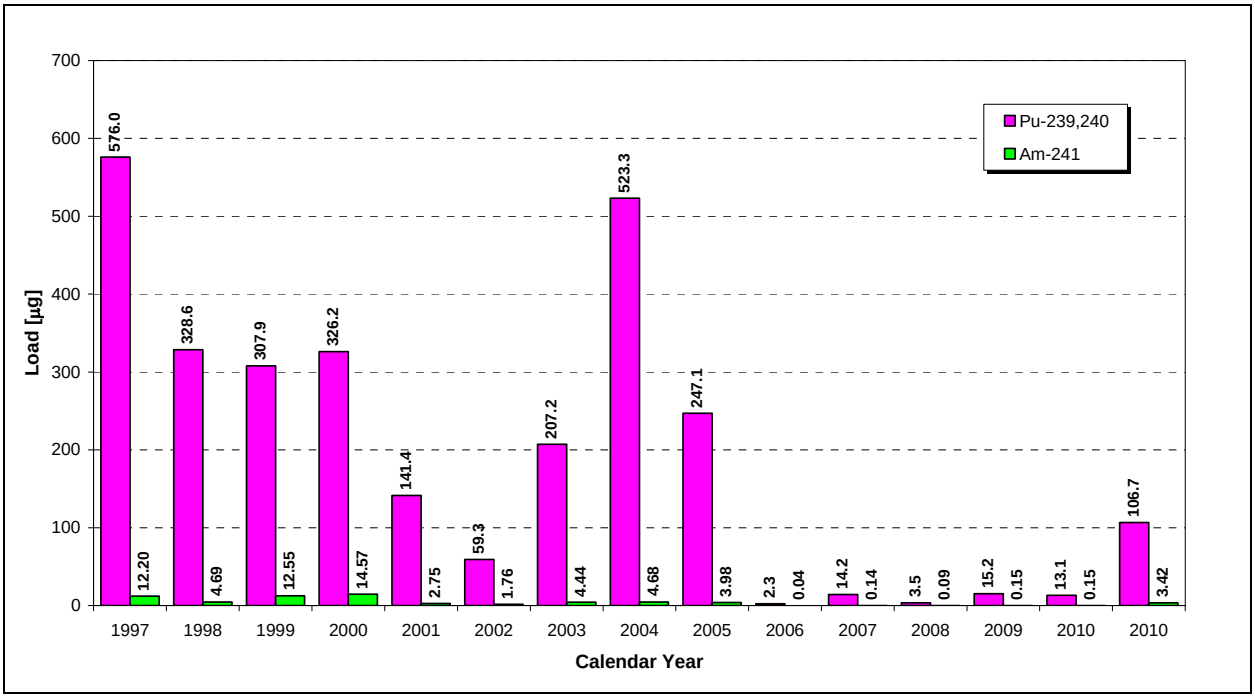


Figure 220. Annual Pu and Am Loads at GS10: CY 1997–2011

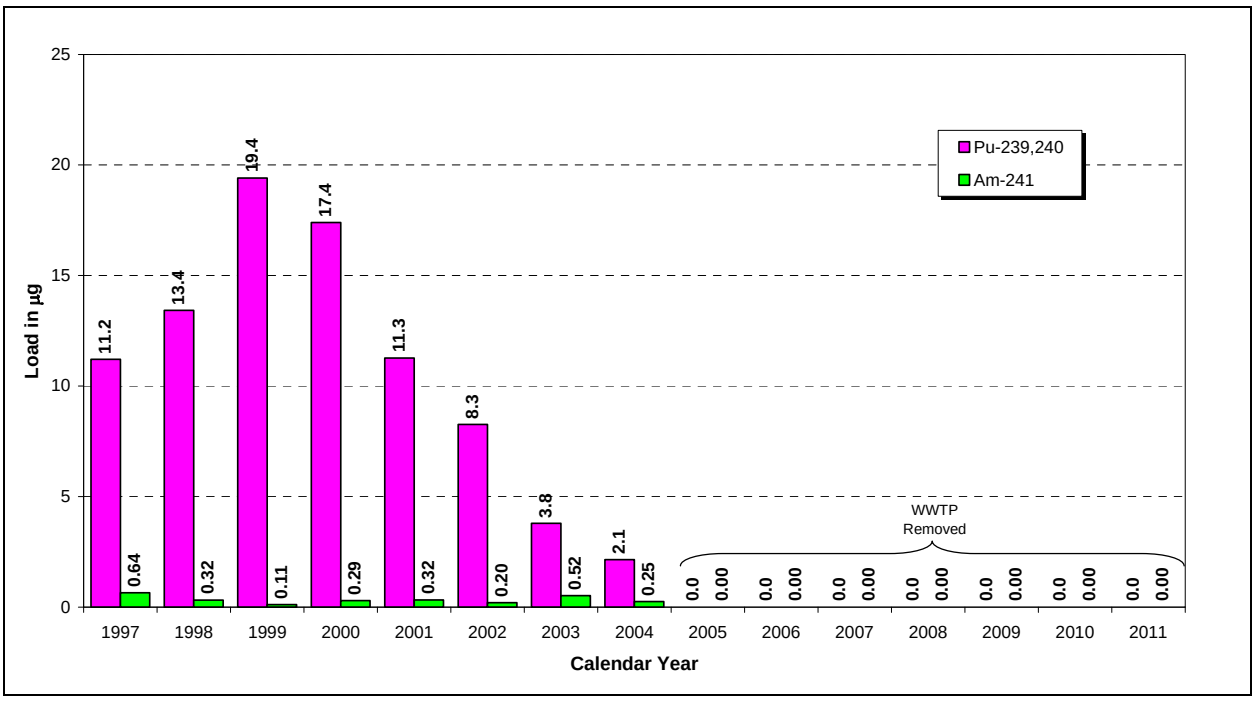


Figure 221. Annual Pu and Am Loads at the WWTP: CY 1997–2011

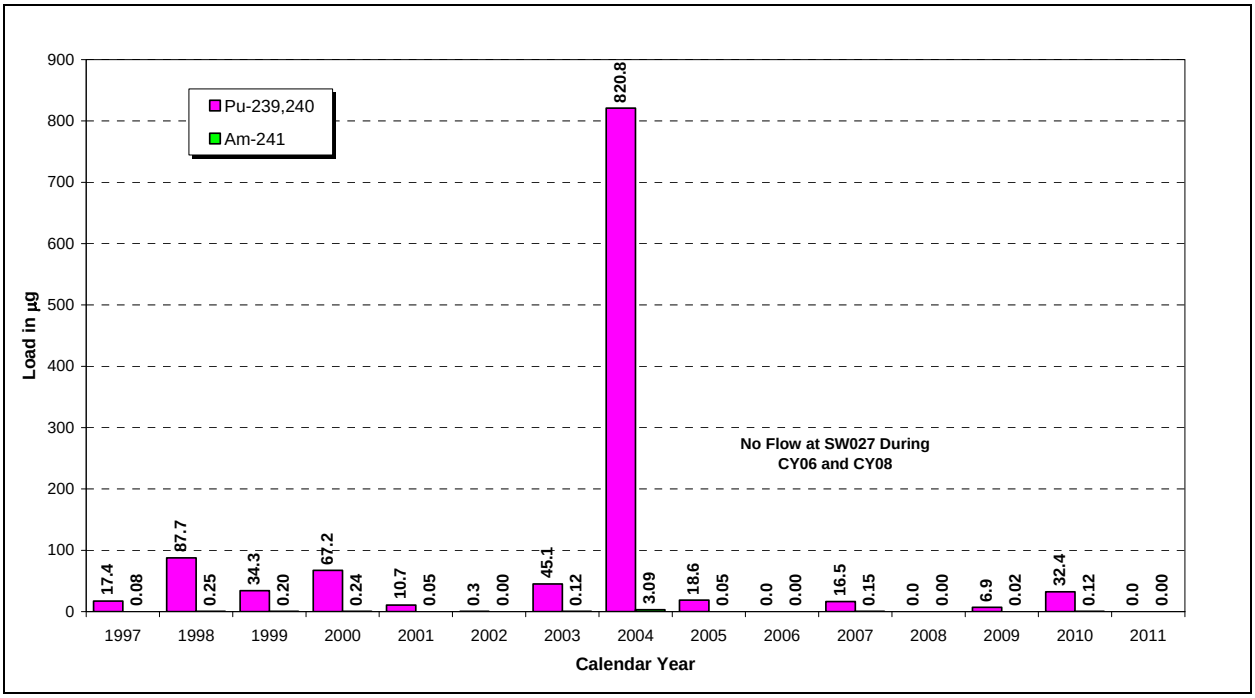


Figure 222. Annual Pu and Am Loads at SW027: CY 1997–2011

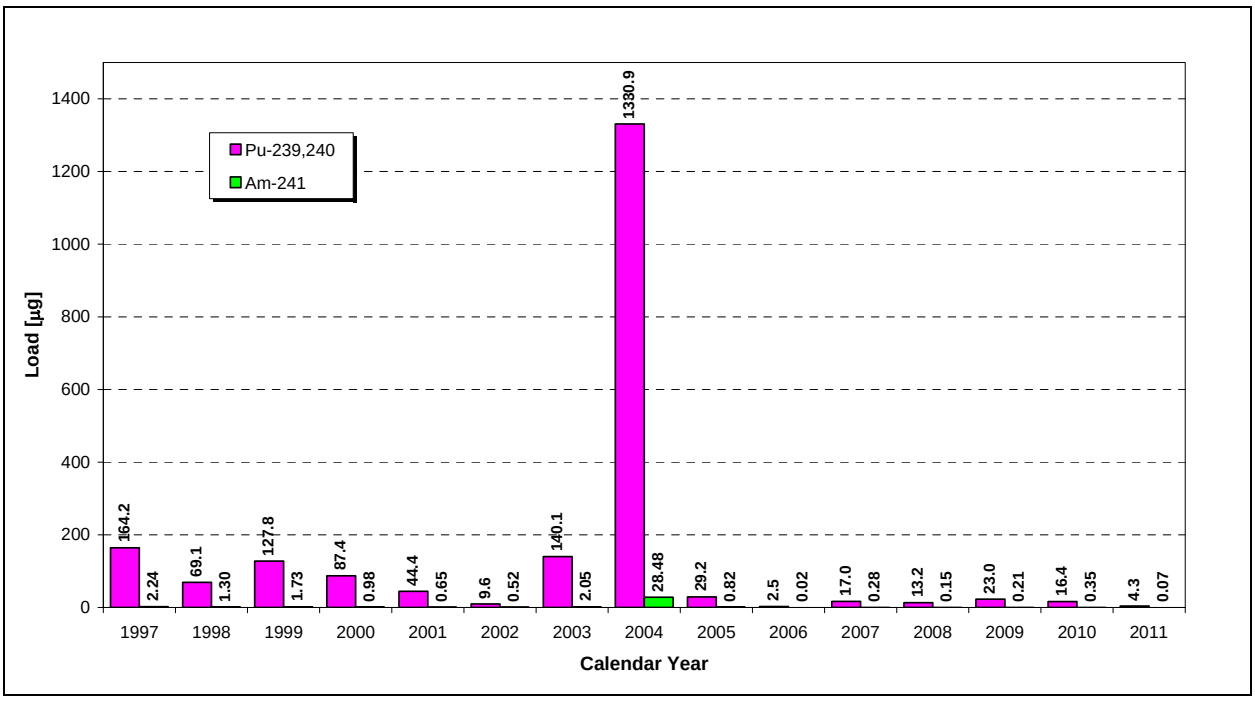


Figure 223. Annual Pu and Am Loads at SW093: CY 1997–2011

Table 86. COU Total U Loads: CY 1997–2011

Calendar Year	Total U (g)			
	North Walnut Creek (SW093)	South Walnut Creek (GS10)	South Walnut Creek (WWTP)	SID (SW027)
1997	853	637	257	84
1998	797	631	467	239
1999	714	589	121	116
2000	485	379	103	22
2001	646	519	259	66
2002	450	279	61	7
2003	568	501	161	111
2004	575	430	139	40
2005	534	879	0; WWTP removed	33
2006	171	230	0; WWTP removed	0; No flow
2007	540	830	0; WWTP removed	36
2008	154	275	0; WWTP removed	0; No flow
2009	574	756	0; WWTP removed	16
2010	1,047	1,158	0; WWTP removed	70
2011	403	758	0; WWTP removed	<0.1
Total	8,511	8,853	1,569	840

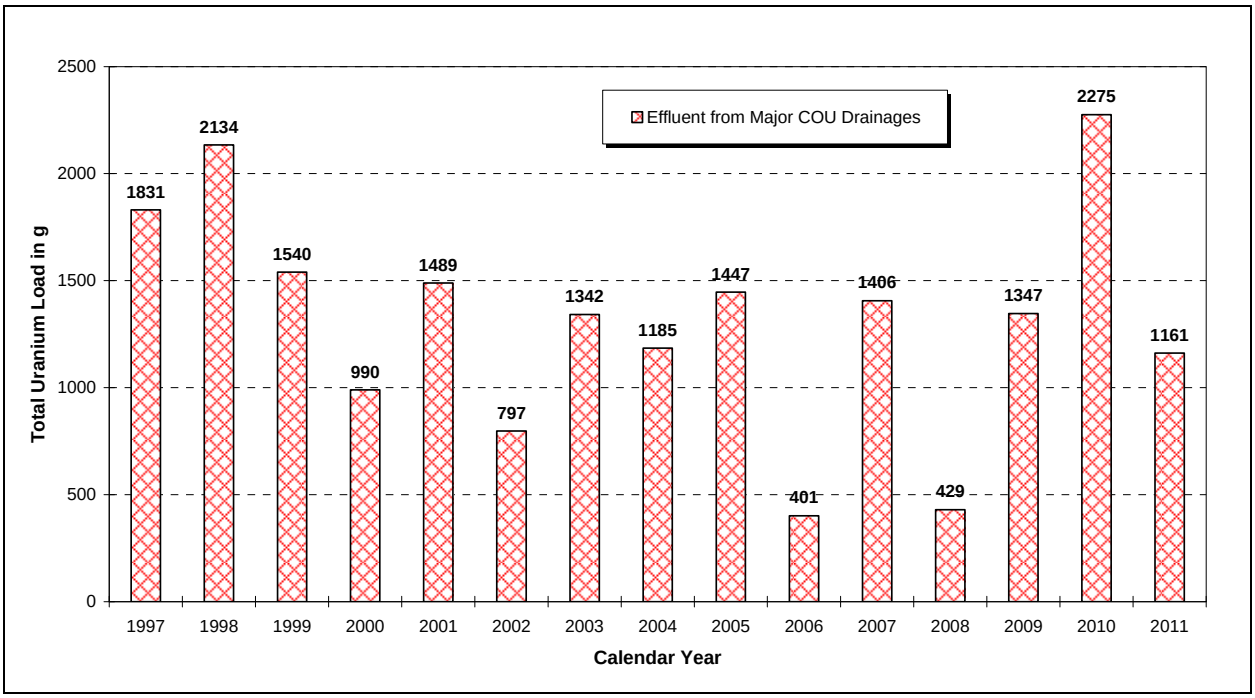
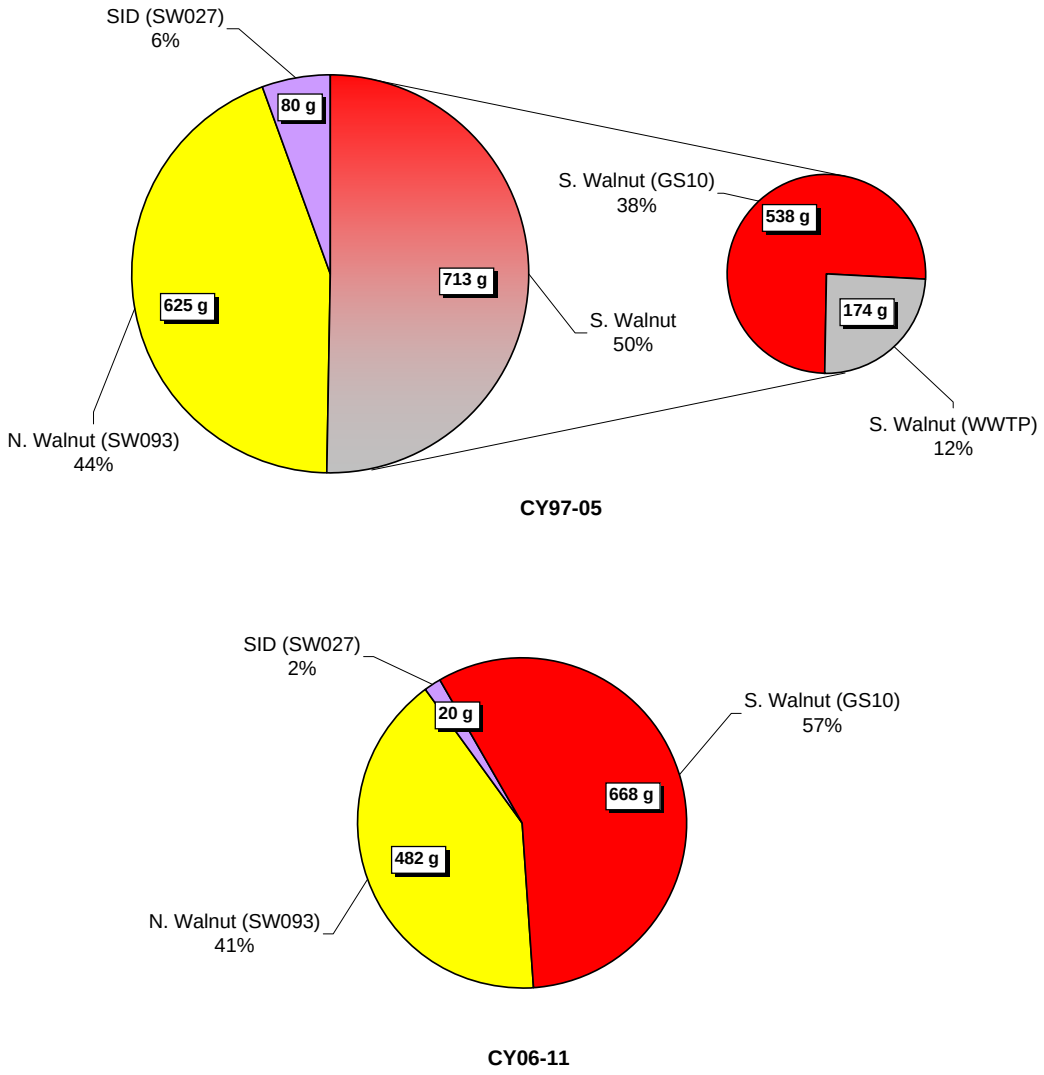


Figure 224. Annual Total U Loads from Major COU Drainages and Former WWTP: CY 1997–2011



Note: Pie chart diameters are relative to total load.

Figure 225. Relative Average Annual Total U Loads from Major COU Drainages and Former WWTP

3.1.5 Groundwater Data Interpretation and Evaluation

This section provides a summary of groundwater monitoring performed in 2011, separated into RFLMA-required and non-RFLMA-required. A discussion of groundwater conditions during 2011, focusing on the most important water-quality aspects in the areas of interest (i.e., the main plumes), is then presented.

3.1.5.1 RFLMA Groundwater Monitoring Activities of 2011

Routine activities of the groundwater monitoring program in 2011 included sample collection, water-level measurement, groundwater treatment system maintenance, and well maintenance. "Groundwater" monitoring also includes monitoring activities at several surface-water locations,