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Supplementary Information

Table S1. Controlled tests to determine the efficiency of the vacuum. Known masses of fine sediment (< 63µm) were weighed out, ranging from 0.49 to 102.16 g. The material was vacuumed from a clean granite countertop, and the collection mass was weighed. Efficiency is the control mass divided by the vacuumed mass multiplied by 100.

Control mass, g	Mass collected by vacuum, g	Efficiency%
0.49	0.49	100
0.99	0.93	93.9
4.99	4.87	97.6
10.01	9.88	98.7
50.01	49.36	98.7
12.31	12.26	99.6
26.27	25.83	98.3
41.28	40.82	98.9
102.16	101.01	98.9
Average		98.3

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Table S2. Summary of radionuclide activity for pavement, suspended sediment, and bed samples collected in this study. A) ^{7}Be; B) $^{210}Pb_{ex}$; C) ^{137}Cs.

A) Beryllium-7

Start date	End date	^{7}Be rain activity, Bq/L	^{7}Be sweep average, Bq/g	^{7}Be Alexander Avenue Culvert suspended sediment, Bq/g	^{7}Be Dead Run suspended sediment, Bq/g	^{7}Be Dead Run bed, sediment, Bq/g
Initial sweep	14 July 2017		0.88			0.20
14 July 2017	27 July 2017	4.01	0.95	3.88	0.89	0.22
27 July 2017	1 Aug 2017	0.70	1.20	3.30	0.69	0.20
1 Aug 2017	3 Aug 2017	2.14	1.68	6.68	2.15	0.32
3 Aug 2017	4 Aug 2017	3.02		6.51	1.33	0.23
4 Aug 2017	10 Aug 2017	1.57	1.77	4.18	1.42	0.37
10 Aug 2017	17 Aug 2017	1.52	1.58	2.06	0.94	0.25
Initial Sweep	20 Oct 2017		1.40			0.13
20 Oct 2017	24 Oct 2017	2.56	1.39	5.81	0.40	0.13
24 Oct 2017	31 Oct 2017	1.61	1.87	3.97	0.31	0.13
31 Oct 2017	10 Nov 2017	1.14	2.45	2.88	0.28	0.10
27 Feb 2018	6 Mar 2018	3.33	1.58	2.10	1.59	0.19
6 Mar 2018	19 Mar 2018		1.54			0.20
19 Mar 2018	26 Mar 2018	1.75		2.07		0.33
26 Mar 2018	4 Apr 2018	4.82	2.27	2.87	2.08	0.73
4 Apr 2018	18 Apr 2018	1.26	1.27	2.17	0.94	0.15
18 Apr 2018	26 Apr 2018	1.71	1.70	0.22	0.80	0.17
26 Apr 2018	2 May 2018	1.71	1.84	2.26		0.14
2 May 2018	14 May2018	4.31	1.69	4.55	1.94	0.30

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B) Excess Lead-210

Start date	End date	$^{210}Pb_{ex}$ rain activity Bq/L	$^{210}Pb_{ex}$ sweep average, Bq/g	$^{210}Pb_{ex}$ Alexander Avenue Culvert suspended sediment, Bq/g	$^{210}Pb_{ex}$ Dead Run suspended sediment, Bq/g	$^{210}Pb_{ex}$ Dead Run bed sediment, Bq/g
Initial sweep	14 July 2017		0.42			0.10
14 July 2017	27 July 2017	0.44	0.35	1.13	0.22	0.10
27 July 2017	1 Aug 2017	0.06	0.36	0.75	0.18	0.07
1 Aug 2017	3 Aug 2017	0.20	0.45	1.35	0.40	0.10
3 Aug 2017	4 Aug 2017	0.32		1.03	0.29	0.07
4 Aug 2017	10 Aug 2017	0.18	0.51	0.91	0.28	0.09
10 Aug 2017	17 Aug 2017	0.10	0.47	0.44	0.21	0.08
Initial Sweep	20 Oct 2017		0.55			0.06
20 Oct 2017	24 Oct 2017	0.20	0.79	1.92	0.09	0.07
24 Oct 2017	31 Oct 2017	0.07	0.59	1.08	0.04	0.08
31 Oct 2017	10 Nov 2017	0.20	0.70	0.86	0.05	0.04
27 Feb 2018	6 Mar 2018	0.14	0.78	0.50	0.27	0.08
6 Mar 2018	19 Mar 2018		0.72			0.09
19 Mar 2018	26 Mar 2018	0.15		0.56		0.12
26 Mar 2018	4 Apr 2018	0.36	0.76	0.79	0.47	0.20
4 Apr 2018	18 Apr 2018	0.07	0.49	0.51	0.22	0.08
18 Apr 2018	26 Apr 2018	0.07	0.52	0.04	0.12	0.05
26 Apr 2018	2 May 2018	0.20	0.55	0.40		0.06
2 May 2018	14 May 2018	0.43	0.43	0.78	0.36	0.11

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C) Cesium-137

Start	End Date	Sweep average, (^{137}Cs, Bq/g)	Alexander Avenue Culvert suspended sediment, (^{137}Cs, Bq/g)	Dead Run suspended sediment, (^{137}Cs, Bq/g)	Dead Run bed sediment, (^{137}Cs, Bq/g)
Initial sweep	14 July 2017	0.0016			0.0039
14 July 2017	27 July 2017	0.0012	0.0002	0.0027	0.0034
27 July 2017	1 Aug 2017	0.0013	0.0035	0.0017	0.0016
1 Aug 2017	3 Aug 2017	0.0024	0.0054	0.0029	0.0023
3 Aug 2017	4 Aug 2017		0.0051	0.0030	0.0037
4 Aug 2017	10 Aug 2017	0.0026	0.0066	0.0031	0.0030
10 Aug 2017	17 Aug 2017	0.0017	0.0038	0.0026	0.0044
Initial Sweep	20 Oct 2017	0.0017			0.0041
20 Oct 2017	24 Oct 2017	0.0016	0.0022	0.0021	0.0034
24 Oct 2017	31 Oct 2017	0.0024	0.0042	0.0014	0.0031
31 Oct 2017	10 Nov 2017	0.0019	0.0021	0.0016	0.0018
27 Feb 2018	6 Mar 2018	0.0012	0.0039	0.0028	0.0042
6 Mar 2018	19 Mar 2018	0.0016			0.0035
19 Mar 2018	26 Mar 2018		0.0007		0.0034
26 Mar 2018	4 Apr 2018	0.0021	0.0015	0.0027	0.0042
4 Apr 2018	18 Apr 2018	0.0019	0.0015	0.0018	0.0019
18 Apr 2018	26 Apr 2018	0.0010	0.0002	0.0023	0.0028
26 Apr 2018	2 May 2018	0.0012	0.0002		0.0027
2 May 2018	14 May 2018	0.0029	0.0045	0.0026	0.0048

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Table S3. Rainfall examined from the National Weather Service, BWI Airport raingage (https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USW00093721/detail) for the historic record (1967-2017) and for each of the three sampling periods. Rainfall collected at Dead Run gage (UMBC) is also shown for each study period.

Sampling ‘Period	BWI, Airport (1967-2017), mm	BWI, Airport (study period), mm	Dead Run gage (study period), mm
14 July -17 Aug 2017	113	202	188
20 Oct – 10 Nov 2017	63	86	110
27 Feb – 14 May 2018	220	155	169

Table S4. Mann-Whitney Rank Sum test results of the difference in street sediment fallout radionuclide activity for ^{7}Be, $^{210}Pb_{ex}$, and ^{137}Cs between individual sweep sites. Data available Clifton et al. (2019).

^{7}Be					
	Street-A	Street-B	Street-C	Street-D	Parking lot -E
Street-A		P = 0.16	P = 0.04	P = <0.001	P = 0.003
Street-B			P = 0.01	P = 0.005	P = 0.001
Street-C				P = <0.001	P = 0.23
Street-D					P = <0.001
Median	1.48	1.26	1.87	0.84	2.24
$^{210}Pb_{ex}$					
	Street-A	Street-B	Street-C	Street-D	Parking lot -E
Street-A		P = 0.45	P = 0.84	P = 0.004	P = 0.49
Street-B			P = 0.37	P = 0.001	P = 0.60
Street-C				P = 0.003	P = 0.41
Street-D					P = 0.001
Median	0.53	0.40	0.48	0.70	0.46
^{137}Cs					
	Street-A	Street-B	Street-C	Street-D	Parking lot -E
Street-A		P = <0.001	P = 0.34	P = 1.000	P = 0.03
Street-B			P = 0.04	P = <0.001	P = <0.001
Street-C				P = 0.38	P = 0.02
Street-D					P = 0.05
Median	0.0014	0.003	0.0016	0.0012	0.0006

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Table S5. Apportionment results for fluvial sediment at Alexander Culvert and Dead Run using an unmixing model (eqs. 3,4). [Res is the residual sum of squares]

Sample Date	Sample ID	Sample Location &Type	Pavement %	Soil %	Bank %	Res
6 Mar 2018	DEAD-BED030618	Dead Run bed sediment	3	50	47	0.0931
26 Mar 2018	DEAD-BED032618	Dead Run bed sediment	6	42	52	0.0840
4 Apr 2018	DEAD-BED040418	Dead Run bed sediment	12	52	36	0.1352
18 Apr 2018	DEAD-BED041818	Dead Run bed sediment	3	24	73	0.0002
26 Apr 2018	DEAD-BED042618	Dead Run bed sediment	2	30	68	0.2266
2 May 2018	DEAD-BED050218	Dead Run bed sediment	2	32	66	0.0870
14 May 2018	DEAD-BED051418	Dead Run bed sediment	4	56	39	0.1618
19 Mar 2018	DEADRUN-BED031918	Dead Run bed sediment	3	44	53	0.0468
14 July 2017	DEADRUN-BED071417	Dead Run bed sediment	4	50	47	0.0281
27 July 2017	DEADRUN-BED072717	Dead Run bed sediment	4	43	53	0.0347
1 Aug 2017	DEADRUN-BED080117	Dead Run bed sediment	4	19	78	0.0685
3 Aug 2017	DEADRUN-BED080317	Dead Run bed sediment	5	27	67	0.1024
4 Aug 2017	DEADRUN-BED080417	Dead Run bed sediment	3	41	56	0.2629
8 Aug 2017	DEADRUN-BED080817	Dead Run bed sediment	5	35	60	0.2386
14 Aug 2017	DEADRUN-BED081417	Dead Run bed sediment	3	49	48	0.2363
20 Oct 2017	DEADRUN-BED102017	Dead Run bed sediment	2	44	55	0.1728
24 Oct 2017	DEADRUN-BED102417	Dead Run bed sediment	2	42	55	0.0352
31 Oct 2017	DEADRUN-BED103117	Dead Run bed sediment	2	41	57	0.0064
10 Nov 2017	DEADRUN-BED111017	Dead Run bed sediment	2	21	77	0.0791
		Average	4	39	57	
		Standard Deviation	2	11	12	
27 Jul 2017	DEADRUN-PAS072717	Dead Run suspended sediment	14	33	53	0.1399
1 Aug 2017	DEADRUN-PAS080117	Dead Run suspended sediment	12	19	69	0.1014
3 Aug 2017	DEADRUN-PAS080317	Dead Run suspended sediment	28	34	39	0.2600

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4 Aug 2017	DEADRUN-PAS080417	Dead Run suspended sediment	19	36	45	0.2005
8 Aug 2017	DEADRUN-PAS080817	Dead Run suspended sediment	18	37	45	0.2576
14 Aug 2017	DEADRUN-PAS081417	Dead Run suspended sediment	13	32	55	0.2002
24 Oct 2017	DEADRUN-PAS102417	Dead Run suspended sediment	5	25	71	0.2766
31 Oct 2017	DEADRUN-PAS103117	Dead Run suspended sediment	2	15	83	0.5434
10 Nov 2017	DEADRUN-PAS111017	Dead Run suspended sediment	3	17	80	0.3496
6 Mar 2018	DEAD-PAS030618	Dead Run suspended sediment	18	33	49	0.3157
4 Apr 2018	DEAD-PAS040418	Dead Run suspended sediment	32	30	38	0.1658
18 Apr 2018	DEADRUN-PAS041818	Dead Run suspended sediment	14	21	65	0.1672
26 Apr 2018	DEAD-PAS042618	Dead Run suspended sediment	7	27	66	0.4439
14 May 2018	DEAD-PAS051418	Dead Run suspended sediment	25	30	45	0.2563
		Average	15	28	57	
		Standard Deviation	9	7	15	
27 Jul 2017	ALEXANDER-PAS072717	Alexander Culvert suspended sediment	6	0	94	1.8486
1 Aug 2017	ALEXANDER-PAS080117	Alexander Culvert suspended sediment	52	38	10	0.1532
3 Aug 2017	ALEXANDER-PAS080317	Alexander Culvert suspended sediment	72	28	0	0.5070
4 Aug 2017	ALEXANDER-PAS080417	Alexander Culvert suspended sediment	62	38	0	0.4521
8 Aug 2017	ALEXANDER-PAS080817	Alexander Culvert suspended sediment	56	44	0	0.3569
14 Aug 2017	ALEXANDER-PAS081417	Alexander Culvert suspended sediment	29	45	25	0.2042
24 Oct 2017	ALEXANDER-PAS102417	Alexander Culvert suspended sediment	100	0	0	0.2204
31 Oct 2017	ALEXANDER-PAS103117	Alexander Culvert suspended sediment	66	34	0	0.1376
10 Nov 2017	ALEXANDER-PAS111017	Alexander Culvert suspended sediment	58	16	26	0.0428
6 Mar 2018	ALEX-PAS030618	Alexander Culvert suspended sediment	33	47	20	0.1489
26 Mar 2018	ALEX-PAS032618	Alexander Culvert suspended sediment	39	1	60	0.0695
4 Apr 2018	ALEX-PAS040418	Alexander Culvert suspended sediment	55	9	36	0.0671
18 Apr 2018	ALEX-PAS041818	Alexander Culvert suspended sediment	36	12	52	0.1333
26 Apr 2018	ALEX-PAS042618	Alexander Culvert suspended sediment	0	0	100	1.7766

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2 May 2018	ALEX-PAS050218	Alexander Culvert suspended sediment	10	0	90	1.4165
14 May 2018	ALEX-PAS051418	Alexander Culvert suspended sediment	53	47	0	0.3011
		Average	45	22	32	
		Standard deviation	25	19	35	

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Table S6 Sediment contributions from urban and suburban areas from this study and as reported in the literature, classified as pavement (impervious surfaces), upland source (may include agricultural, forest, grasslands), combined pavement + upland sources, and streambanks.

Study Area	Urban areas, in general (%)	Urban Impervious surface sources, i.e. pavement, roads)(%)	Upland urban sources (i.e. grassland, forest, unpaved roads, top soil etc.) (%)	Streambanks and other fallout radionuclide free sources (%)	Streambanks + upland (%)	Reference
Difficult Run, Virginia, USA		8	1	91		Cashman et al. 2018
Difficult Run, Virginia, USA			36	42-70		Gellis et al., 2017
Upper Patuxent watershed, Maryland, USA			50-66	33-50		Smith and Wilcock, 2015
Anacostia River, Maryland and Washington D.C., USA		13	30	58		Devereux et al., 2011
lower reaches of the Aire and Calder Rivers, United Kingdom		19-22	20-45			Carter et al., 2003
Lago Paranoá catchment, Brasilia DF, Brazil	85		15			Franz et al., 2014
Dilúvio River, Brazil		46	23	31		Poleto et al., 2009
Orge and Yvette Rivers, France	46-60				40-54	Froger et al., 2018
Upper River Kennet, UK	14	4				Collins et al., 2011
Dead Run, MD, USA		4-45	22-39	32-57		This Study

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Table S7. Runoff Samples (Alexander Avenue Culvert and Road) collected during study period in the contributing area to Alexander Avenue Culvert. [* indicates samples were averaged; ND = non detect]

Site	Date(s)	Time	Suspended-Sediment Concentration (mg/L)	Whole water analysis of runoff, ^{7}Be (Bq/L)	Whole water analysis of runoff, $^{210}Pb_{ex}$ (Bq/L)	Dried sediment activity in runoff, ^{7}Be (Bq/g)	Dried sediment activity in runoff, $^{210}Pb_{ex}$ (Bq/g)	Rainfall ^{7}Be (Bq/L)	Rainfall $^{210}Pb_{ex}$ (Bq/L)
Sampling period 4-10 August 2017									
Alexander Avenue Culvert	7 Aug 2017	11:02 AM	59	0.322	0.051				
Alexander Avenue Culvert	7 Aug 2017	11:31 AM	38	0.693	0.114	12.62	2.65		
Alexander Avenue Culvert	7 Aug 2017	11:34 AM	72	0.676	0.115	10.37	2.41		
Alexander Avenue Culvert	7 Aug 2017	11:41 AM	92	0.602	0.125	8.81	1.66		
Alexander Avenue Culvert	7 Aug 2017	11:53 AM	87			3.24	0.647		
Dead Run Gage	4-10 Aug 2017							1.565	0.182
Sampling period 10/24-10/31/2017									
Road (Parking Lot E)	29 Oct 2017	11:15:00 AM		0.106	ND	3.30	1.87		

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Road (Parking Lot E)	29 Oct 2017	11:30:00 AM				2.53	0.95		
Alexander Avenue Culvert	29 Oct 2017	2:51:00 PM		0.046	ND				
Dead Run Gage	24-31 Oct 2017							1.608	0.066
Sampling period 10/31-11/10/2017									
Alexander Avenue Culvert	7 Nov 2017	2:05:00 PM	18	0.044	ND	6.85	1.64		
Road (Street D)	7 Nov 2017	2:20:00 PM	31	0.236	0.052	3.65	1.20		
Road (Street B)	7 Nov 2017	2:35:00 PM	10	0.180	0.045	3.08	0.68		
Road (Parking Lot E)	7 Nov 2017	2:50:00 PM	19	0.397	0.061	9.33	1.82		
Dead Run Gage	31 Oct-10 Nov 2017							1.136	0.196
Sampling period 3/26-4/4/2018									
Alexander Avenue Culvert*	30 Mar 2018	12:54,12:55				4.12	1.02		
Dead Run Gage	26 Mar-4 Apr 2018							4.816	0.359

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Table S8 Percent fines (< 63 µm) reported for select samples in the Dead Run watershed and nearby watersheds.

Station Name	USGS STATION ID	Drainage Area, km^2	Date	Sample Time	Suspended Sediment Concentration, mg/L	Percent Finer <63µm
Dead Run Near Catonsville, Maryland	01589312	0.79	1 Oct 2015	8:46	10.0	89.4
Dead Run Tributary Near Woodlawn, Md	01589316	0.74	1 Oct 2015	9:01	10.0	96.5
Dead Run Tributary At Woodlawn, Md	01589320	1.91	1 Oct 2015	9:11	13.0	86.6
Dead Run At Woodlawn, Md	01589315	2.43	1 Oct 2015	9:26	8.0	100.0
Dead Run At Franklintown, Md	01589330	5.52	1 Oct 2015	9:41	14.0	98.4
Dead Run Near Catonsville, Maryland	01589312	0.79	10 Nov 2015	14:06	4.0	97.7
Dead Run At Franklintown, Md	01589330	5.52	11 Dec 2015	12:51	71.0	87.8
Dead Run At Woodlawn, Md	01589315	2.43	11 Dec 2015	13:06	112.0	81.9
Dead Run Tributary At Woodlawn, Md	01589320	1.91	11 Dec 2015	13:16	193.0	75.6
Dead Run Tributary Near Woodlawn, Md	01589316	0.74	11 Dec 2015	13:20	60.0	93.3
					Average	90.7

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References Cited

Carter, J., Owens, P.N., Walling, D.E., Leeks, G.J.L., 2003. Fingerprinting suspended sediment sources in a large urban river system. Science of The Total Environment 314–316, 513-534.

Cashman, M.J., Gellis, A.C.. Gorman Sanisaca, L., Noe, G., Cogliandro, V., Baker., A., 2018. Bank-derived sediment dominates in a suburban Chesapeake Bay watershed, Upper Difficult Run, Virginia, USA. River Research and Applications, published on line, DOI: 10.1002/rra.3325. https://onlinelibrary.wiley.com/doi/epdf/10.1002/rra.3325

Collins, A.L., Zhang, Y., McChesney, D., Walling, D.E., Haley, S.M., and Smith, P., 2012. Sediment source tracing in a lowland agricultural catchment in southern England using a modified procedure combining statistical analysis and numerical modelling: Sci. Total Environ. 414, 301–317.

Devereux, O.H., Prestegaard, K.L., Needelman, B.A., Gellis, A.C., 2010. Suspended-sediment sources in an urban watershed, Northeast Branch Anacostia River, Maryland. Hydrol. Process. 24, 1391–1403. http://dx.doi.org/10.1002/hyp.7604

Franz, C., Makeschin, F., Weiß, H., Lorz, C., 2014. Sediments in urban river basins: Identification of sediment sources within the Lago Paranoá catchment, Brasilia DF, Brazil – using the fingerprint approach. Sci. Total Environ. 466-467, 513–523.

Froger, C., Ayrault, S., Evrard, O., Monvoisin, G., Bordier, L., Lefèvre, I., Quantin, C., 2018. Tracing the sources of suspended sediment and particle-bound trace metal elements in an urban catchment coupling elemental and isotopic geochemistry, and FRNs: Environmental Science and Pollution Research, published online, https://doi.org/10.1007/s11356-018-2892-3

Gellis, A.C., Myers, M.K. Noe, G.B., Hupp, C.R. Schenk, E.R., Myers, L., 2017. Storms, channel changes, and a sediment budget for an urban-suburban stream, Difficult Run, Virginia, USA. Geomorphology 278, 128–148.

Poleto, C., Merten, G.H., Minella, J.P. 2009. The identification of sediment sources in a small urban watershed in southern Brazil: An application of sediment fingerprinting. Environmental Technology 30(11), 1145–1153.

Smith S.M.C., Wilcock, P.R., 2015. Upland sediment supply and its relation to watershed sediment delivery. Geomorphology **232**: 33-46.