Attachment I: Source Loads by Area

Section 1: Introduction

This appendix summarizes the delivered loads to Falls Lake as annual averages over the UNRBA study period. This period includes an initialization year for the model (2014) as well as the model calibration years (2015 to 2016) and validation years (2017 and 2018). WARMF tracks loads by source as an annual average over the five-year modeling period and does not track this information by year. This appendix includes loads by tributary, loads by county (including municipalities located in the county), and loads by jurisdiction (municipalities and counties separately).

Section 2: Loads by Tributary

Table I-1 summarizes the total nitrogen, total phosphorus, and total organic carbon loads by tributary to Falls Lake, and Table I-2 shows the percent contribution by tributary in terms of loads and drainage area. Both tables are sorted from largest to smallest drainage area. The subsections show the delivered loads by source as pie charts for each of the five largest tributaries, "other tributaries," and the near lake area including direct deposition to Falls Lake. "Other tributaries" include those listed in Table I-1 from Ledge Creek through Cedar Creek. A map of the tributaries is show in Figure I-1.

Table I-1. Average Annual Delivered Loads to Falls Lake by Tributary for UNRBA Study Period (2014 to 2018) Sorted by Largest to Smallest Drainage Area

Tributary	TN (lb/yr)	TP (lb/yr)	TOC (lb/yr)	Area (ac)
Flat River	297,403	26,698	2,861,499	108,708
Eno	303,839	35,264	2,347,707	96,558
Little River	144,676	15,124	1,453,555	67,465
Near Lake & Direct Deposition	264,351	32,601	1,848,986	64,646
Knap of Reeds	107,263	14,440	885,044	28,726
Ellerbe Creek	179,528	17,532	736,112	14,929
Ledge Creek	58,193	4,933	489,684	14,100
Little Lick Creek	36,119	5,420	299,821	9,566
Robertson Creek	41,809	4,624	430,836	9,439
Horse Creek	16,542	2,065	124,884	9,226
New Light Creek	13,792	2,647	115,552	8,913
Beaverdam Creek	38,244	4,213	404,893	8,733
Lick Creek	23,379	3,890	206,306	8,430
Lower Barton Creek	20,777	1,794	101,048	7,249
Smith Creek	12,746	2,186	114,566	6,733
Upper Barton Creek	21,200	1,872	103,296	5,491
Unnamed Tributary 184	15,331	1,459	122,490	3,504
Honeycutt Creek	5,825	708	45,403	3,148
Panther Creek	8,511	943	76,752	2,937
Little Ledge Creek	10,753	908	102,853	2,443
Laurel Creek	6,121	642	54,558	2,227
Unnamed Tributary 183	9,707	1,655	98,511	2,179
Buckhorn Creek	2,421	315	17,704	1,980
Lowery Creek	3,127	343	24,884	1,742
Unnamed Tributary 195	2,638	286	19,289	1,391
Unnamed Tributary 219	3,529	359	33,832	1,054

Table I-1. Average Annual Delivered Loads to Falls Lake by Tributary for UNRBA Study Period (2014 to 2018) Sorted by Largest to Smallest Drainage Area				
Tributary	TN (lb/yr)	TP (lb/yr)	TOC (lb/yr)	Area (ac)
Water Fork	1,012	165	7,666	569
Cedar Creek	2,976	359	22,765	179
Total	**1,651,813**	**183,444**	**13,150,496**	**492,265**

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

Table I-2. Percent of the Average Annual Delivered Loads to Falls Lake by Tributary for UNRBA Study Period (2014 to 2018) Sorted by Largest to Smallest Drainage Area				
Tributary	Total Nitrogen	Total Phosphorus	Total Organic Carbon	Area
Flat River	18%	15%	22%	22%
Eno	18%	19%	18%	20%
Little River	8.8%	8.2%	11.1%	14%
Near Lake & Direct Deposition	16%	18%	14%	13%
Knap of Reeds	6.5%	7.9%	6.7%	6%
Ellerbe Creek at Falls Lake	11%	10%	6%	3%
Ledge Creek	3.5%	2.7%	3.7%	2.9%
Little Lick Creek	2.2%	3.0%	2.3%	1.9%
Robertson Creek	2.5%	2.5%	3.3%	1.9%
Horse Creek	1.0%	1.1%	0.9%	1.9%
New Light Creek	0.8%	1.4%	0.9%	1.8%
Beaverdam Creek	2.3%	2.3%	3.1%	1.8%
Lick Creek	1.4%	2.1%	1.6%	1.7%
Lower Barton Creek	1.3%	1.0%	0.8%	1.5%
Smith Creek	0.8%	1.2%	0.9%	1.4%
Upper Barton Creek	1.3%	1.0%	0.8%	1.1%
Unnamed Tributary 184	0.9%	0.8%	0.9%	0.7%
Honeycutt Creek	0.4%	0.4%	0.3%	0.6%
Panther Creek	0.5%	0.5%	0.6%	0.6%
Little Ledge Creek	0.7%	0.5%	0.8%	0.5%
Laurel Creek	0.4%	0.4%	0.4%	0.5%
Unnamed Tributary 183	0.6%	0.9%	0.7%	0.4%
Buckhorn Creek	0.1%	0.2%	0.1%	0.4%
Lowery Creek	0.2%	0.2%	0.2%	0.4%
Unnamed Tributary 195	0.2%	0.2%	0.1%	0.3%
Unnamed Tributary 219	0.2%	0.2%	0.3%	0.2%
Water Fork	0.1%	0.1%	0.1%	0.1%
Cedar Creek	0.2%	0.2%	0.2%	0.04%
Total Load	**100%**	**100%**	**100%**	**100%**

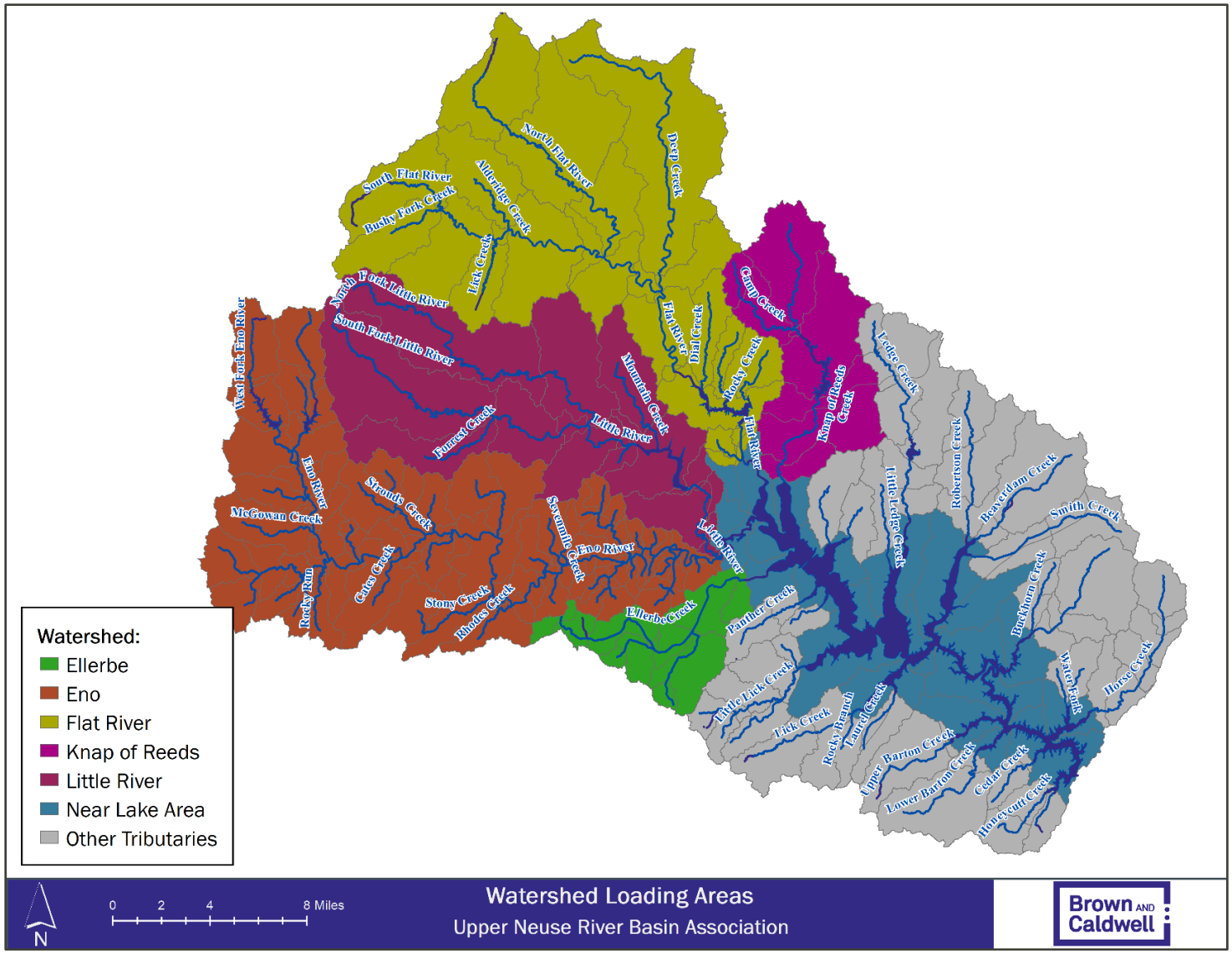

Figure I-1. Tributaries in the Falls Lake Watershed

2.1 Ellerbe Creek

The Ellerbe Creek subwatershed represents 3.0 percent of the area draining to Falls Lake. This subwatershed includes much of the City of Durham as well as the North Durham Wastewater Treatment Plant. Figure I-2 through Figure I-5 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this subwatershed to Falls Lake.

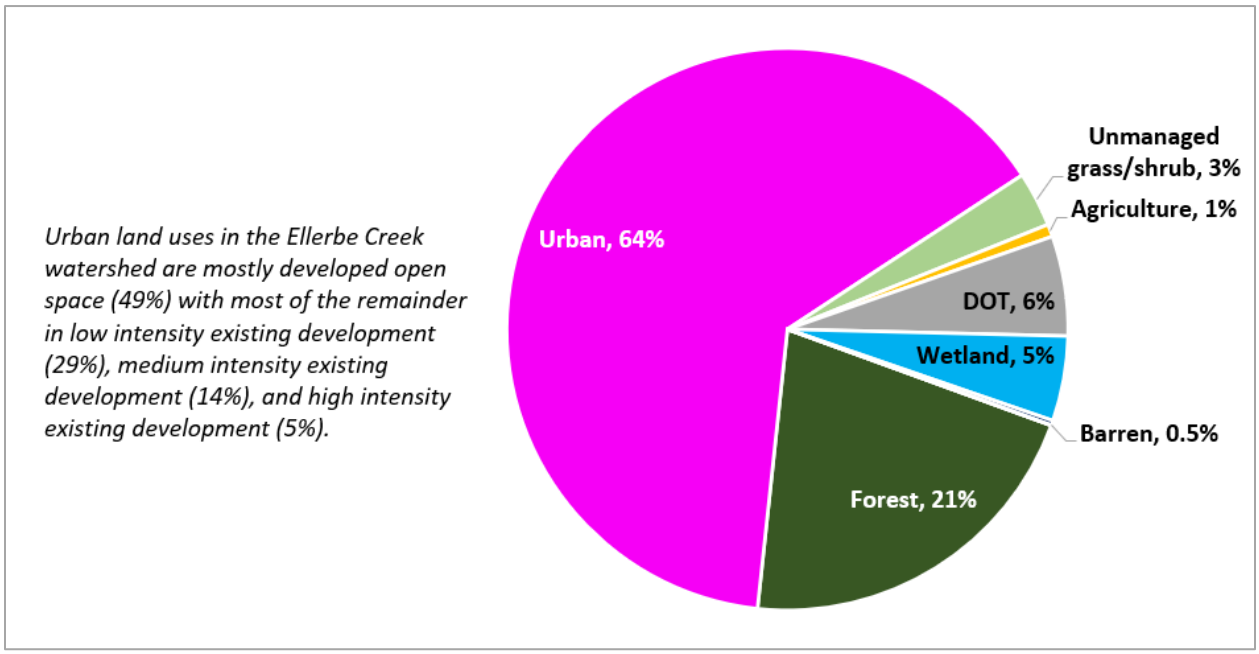

Figure I-2. Land Use Areas in the Ellerbe Creek Watershed (14,929 acres)

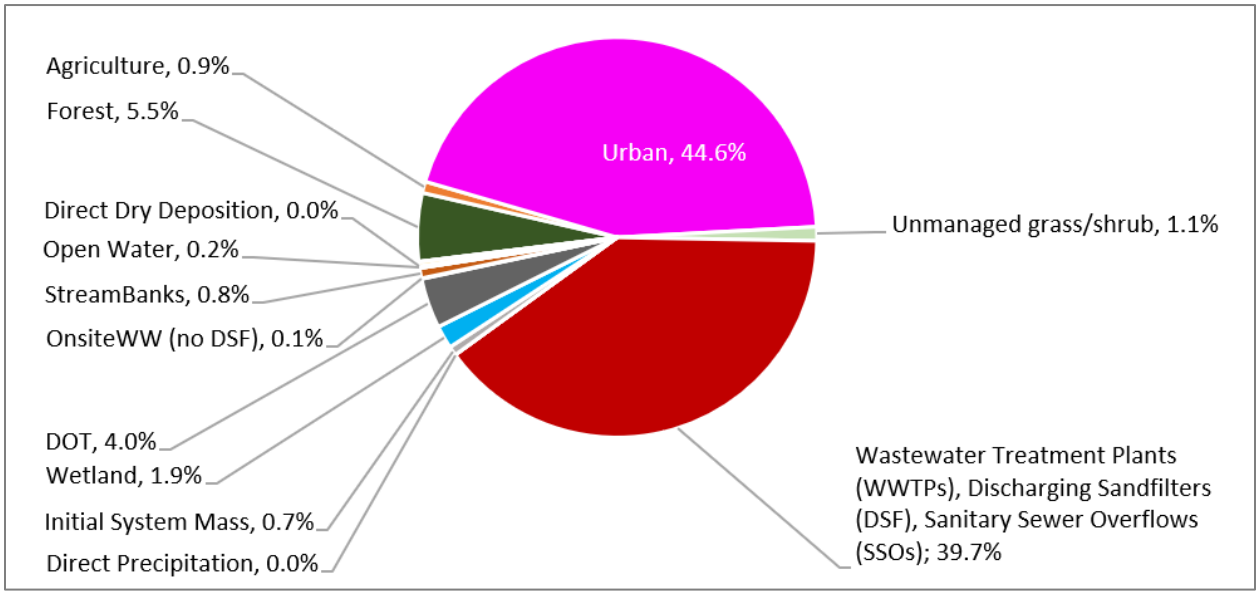

Figure I-3. Sources of Total Nitrogen Load (~180,000 pounds per year) Delivered to Falls Lake from the Ellerbe Creek Watershed for the UNRBA Study Period (2014 to 2018)

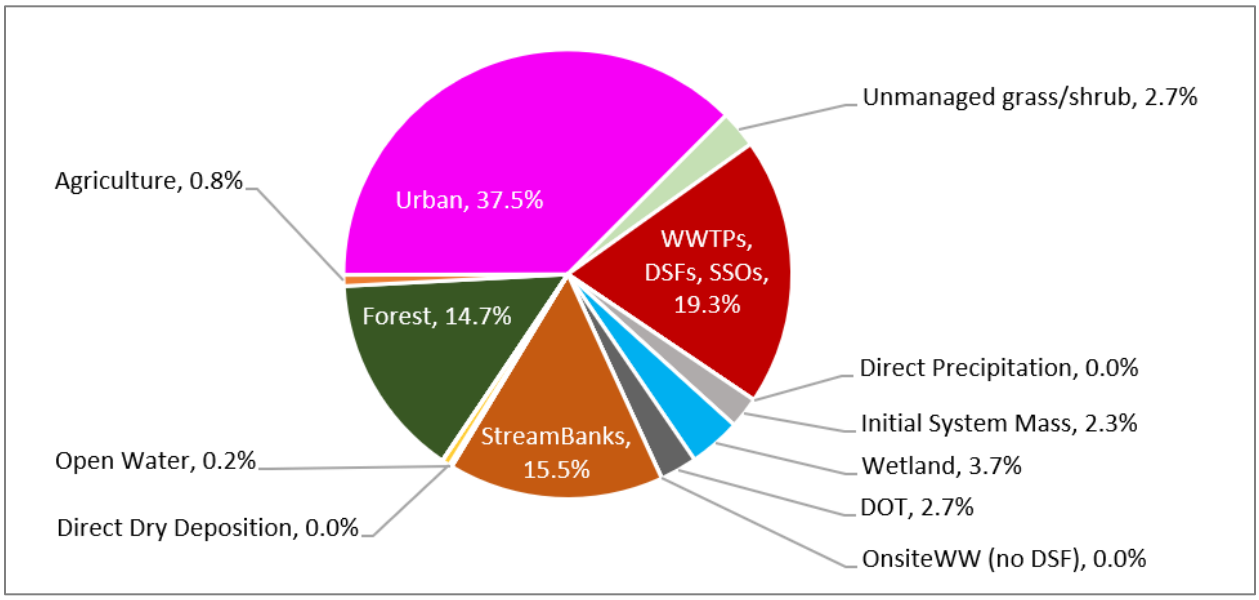

Figure I-4. Sources of Total Phosphorus Load (~17,500 pounds per year) Delivered to Falls Lake from the Ellerbe Creek Watershed for the UNRBA Study Period (2014 to 2018)

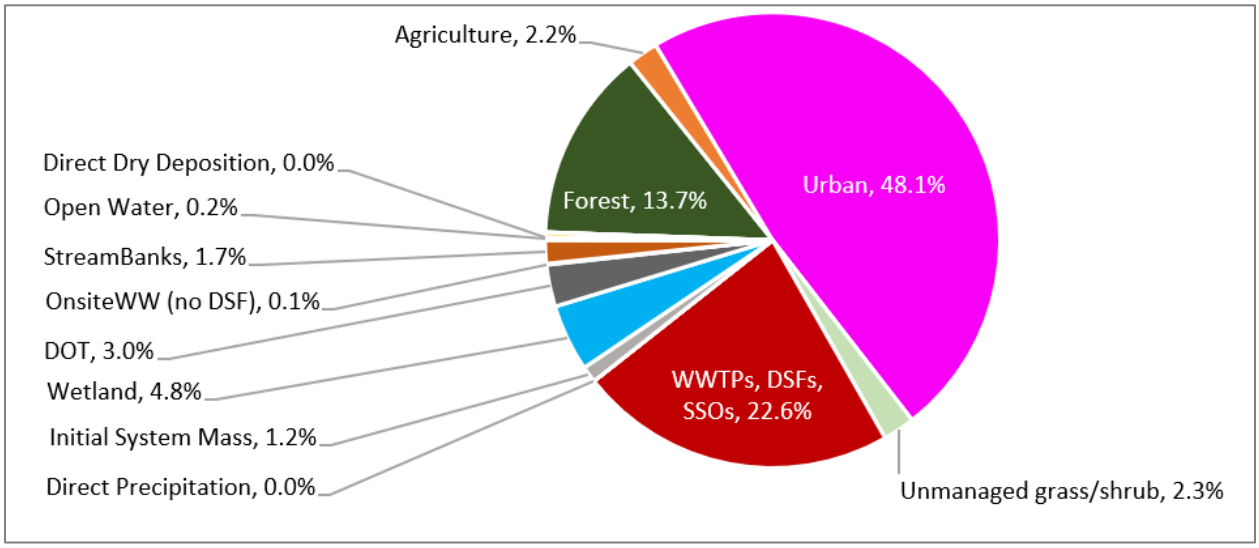

Figure I-5. Sources of Total Organic Carbon Load (~736,000 pounds per year) Delivered to Falls Lake from the Ellerbe Creek Watershed for the UNRBA Study Period (2014 to 2018)

2.2 Eno River

The Eno River subwatershed represents 19.6 percent of the area draining to Falls Lake. This subwatershed includes the Town of Hillsborough and its wastewater treatment plant. This subwatershed also includes East and West Fork Eno River Reservoirs which are two small impoundments near the headwaters. Figure I-6 through Figure I-9 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this subwatershed to Falls Lake.

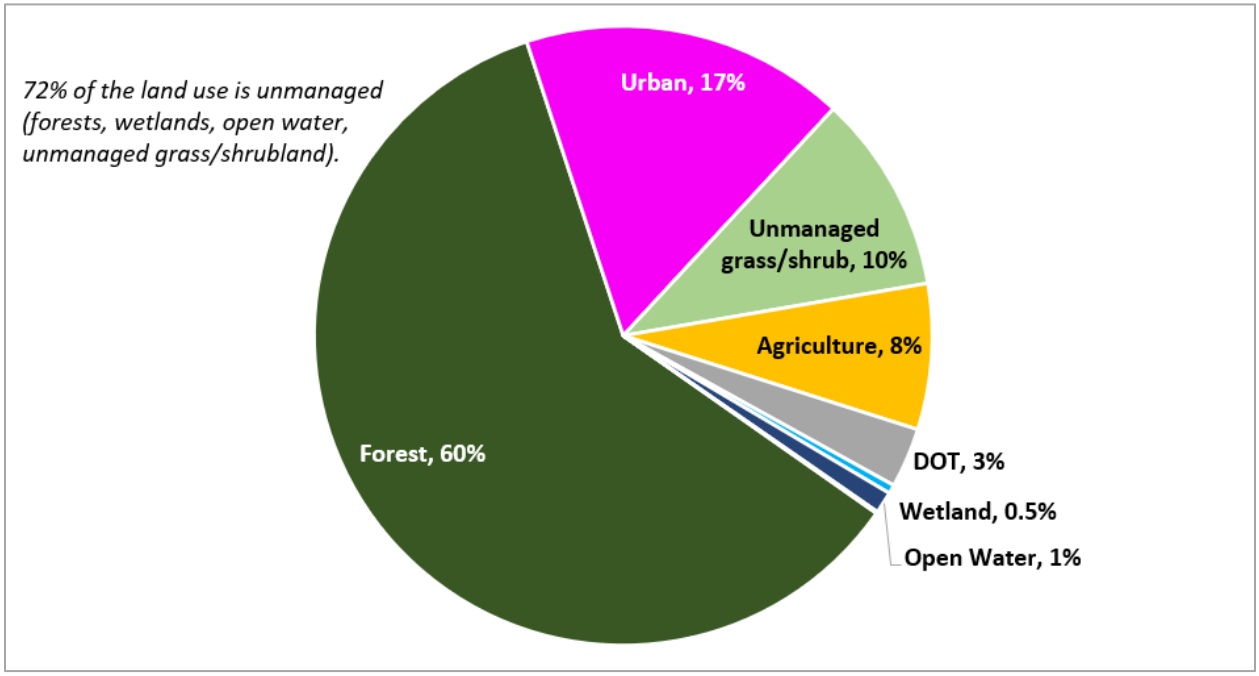

Figure I-6. Land Use Areas in the Eno River Watershed (96,558 acres)

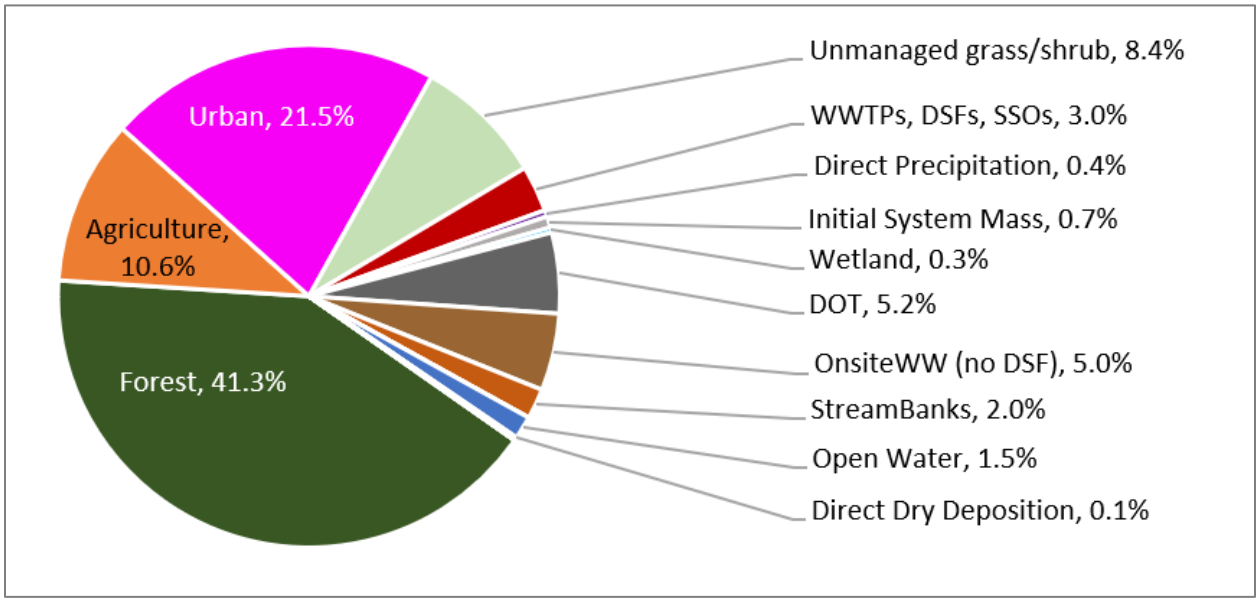

Figure I-7. Sources of Total Nitrogen Load (~304,000 pounds per year) Delivered to Falls Lake from the Eno River Watershed for the UNRBA Study Period (2014 to 2018)

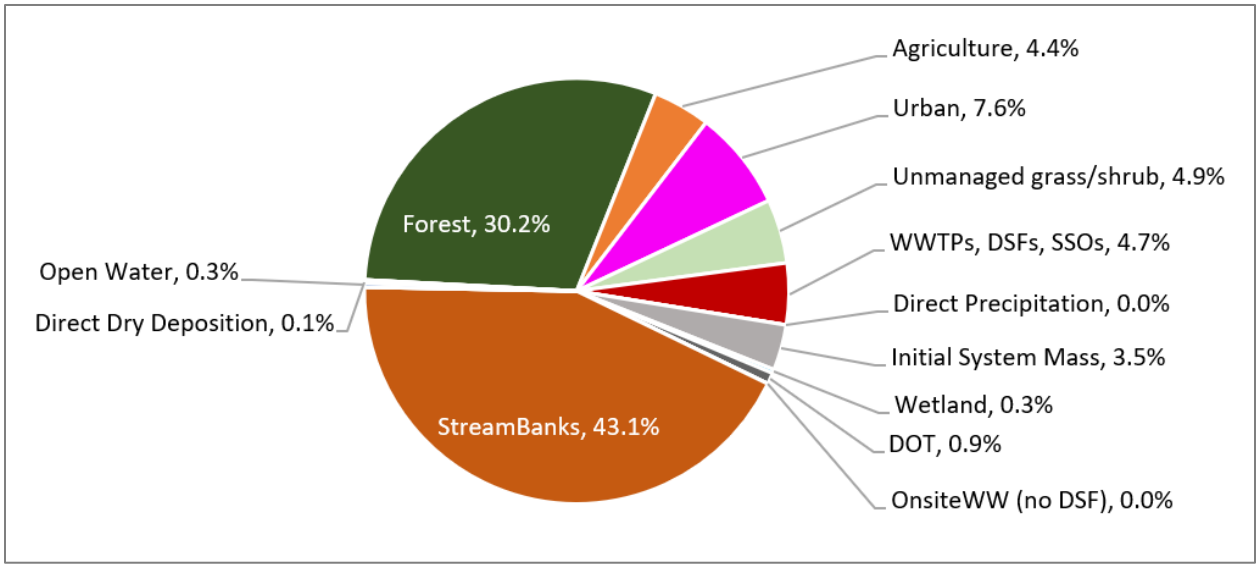

Figure I-8. Sources of Total Phosphorus Load (~35,000 pounds per year) Delivered to Falls Lake from the Eno River Watershed for the UNRBA Study Period (2014 to 2018)

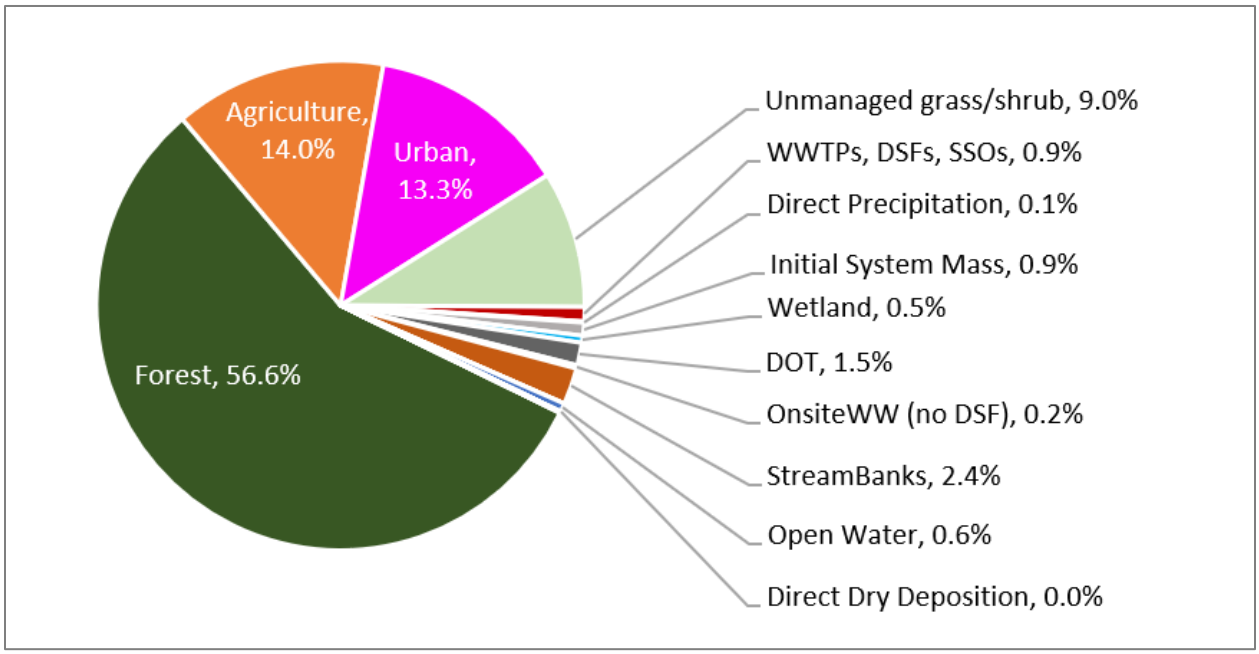

Figure I-9. Sources of Total Organic Carbon Load (~2,350,000 pounds per year) Delivered to Falls Lake from the Eno River Watershed for the UNRBA Study Period (2014 to 2018)

2.3 Flat River

The Flat River subwatershed represents 22.1 percent of the area draining to Falls Lake. This subwatershed includes Lake Michie. Figure I-10 through Figure I-13 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this subwatershed to Falls Lake.

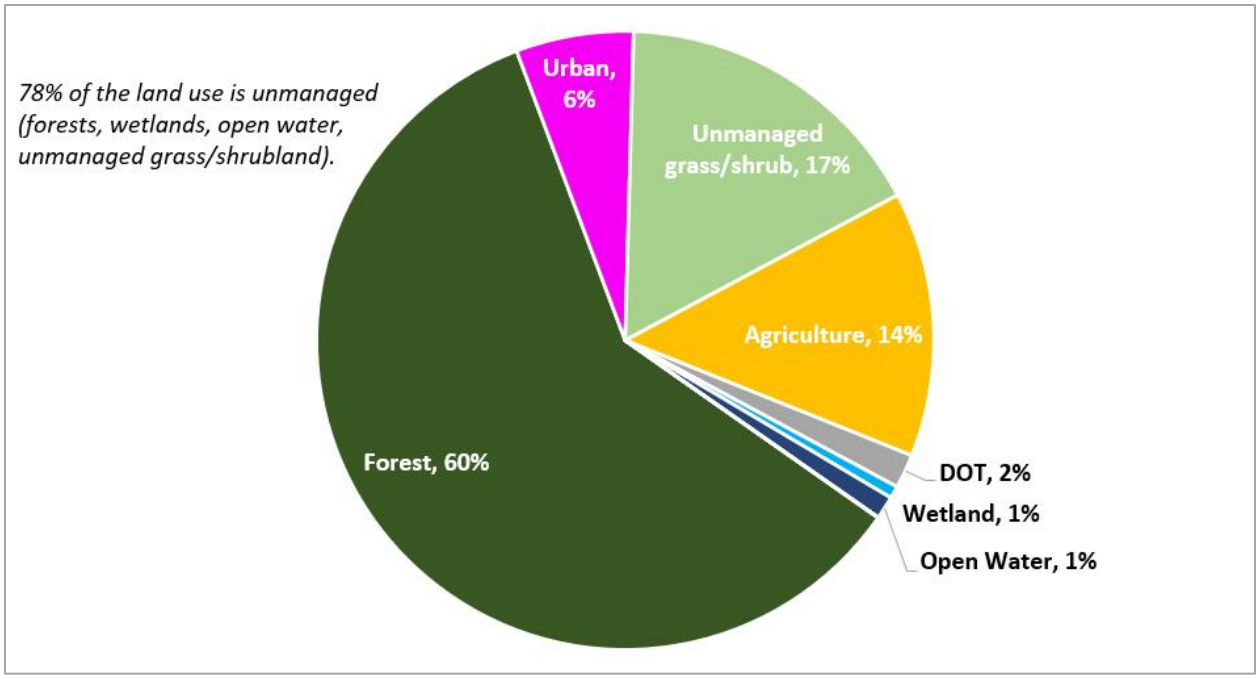

Figure I-10. Land Use Areas in the Flat River Watershed (108,708 acres)

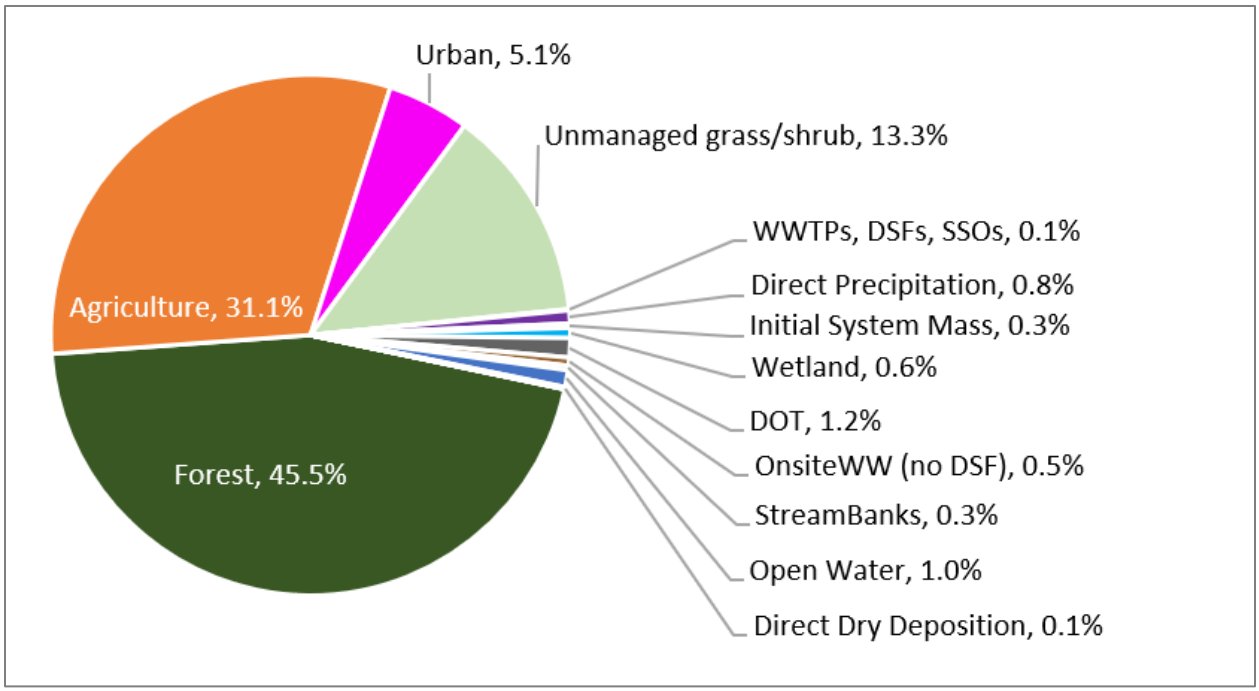

Figure I-11. Sources of Total Nitrogen Load (~300,000 pounds per year) Delivered to Falls Lake from the Flat River Watershed for the UNRBA Study Period (2014 to 2018)

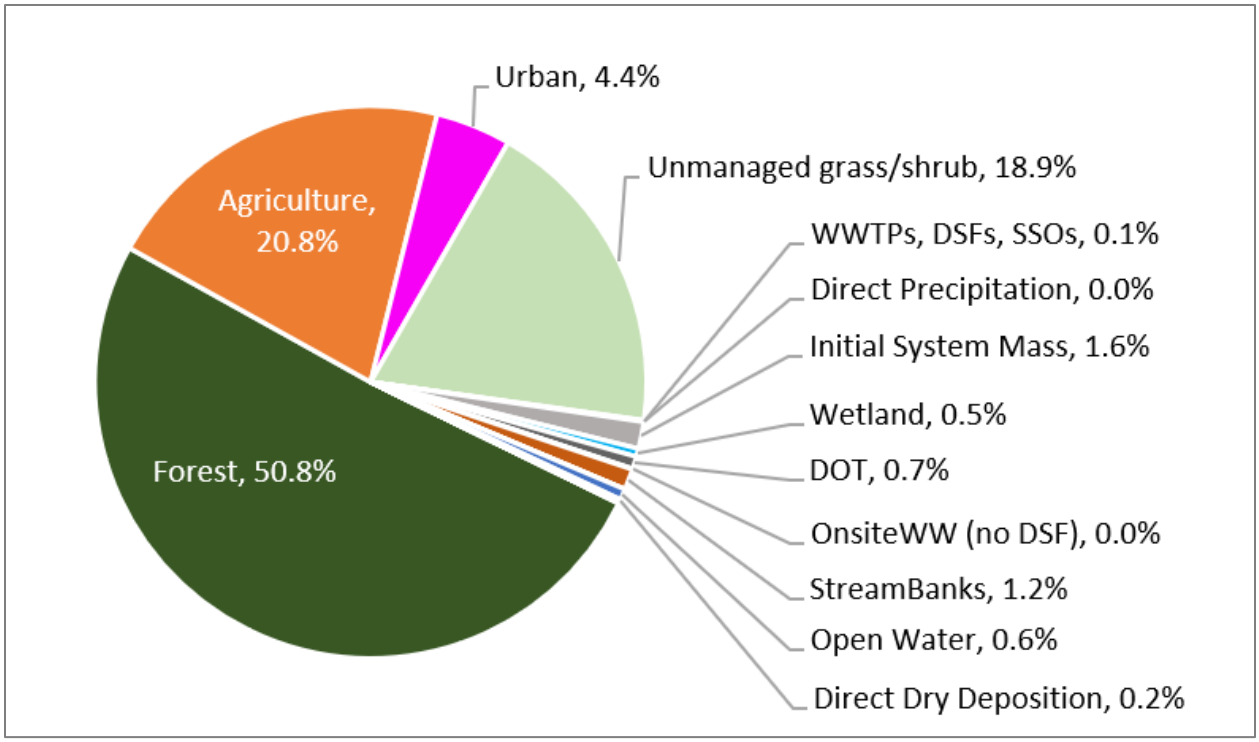

Figure I-12. Sources of Total Phosphorus Load (~27,000 pounds per year) Delivered to Falls Lake from the Flat River Watershed for the UNRBA Study Period (2014 to 2018)

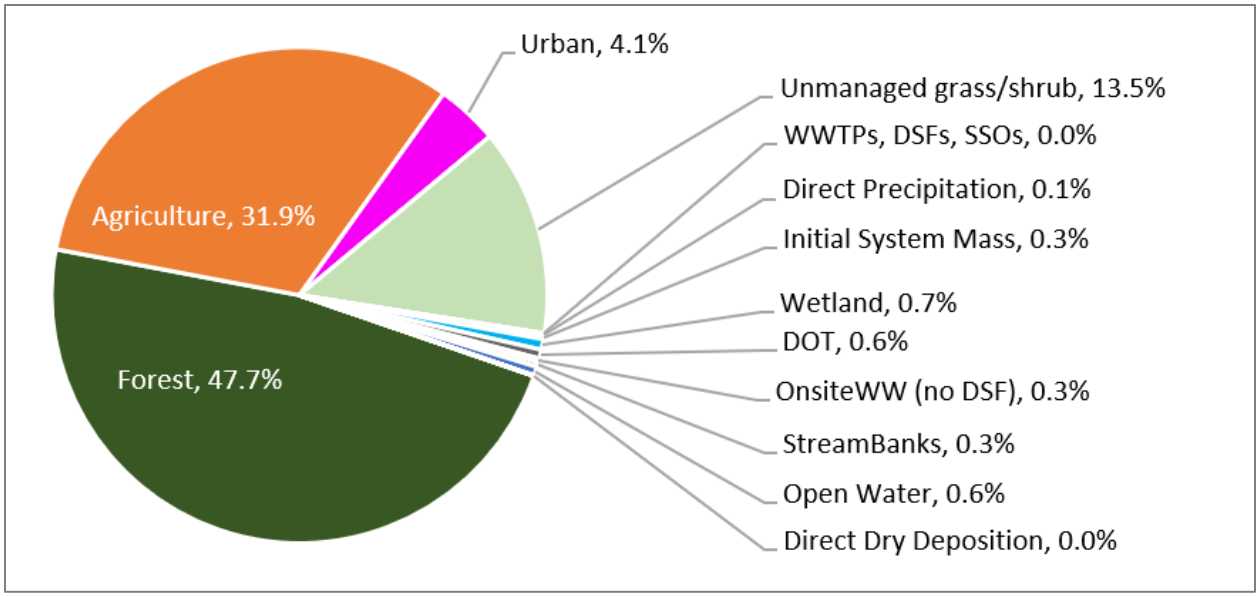

Figure I-13. Sources of Total Organic Carbon Load (~2,900,000 pounds per year) Delivered to Falls Lake from the Flat River Watershed for the UNRBA Study Period (2014 to 2018)

2.4 Little River

The Little River subwatershed represents 13.7 percent of the area draining to Falls Lake. This subwatershed includes the Little River Reservoir. Figure I-14 through Figure I-17 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this subwatershed to Falls Lake.

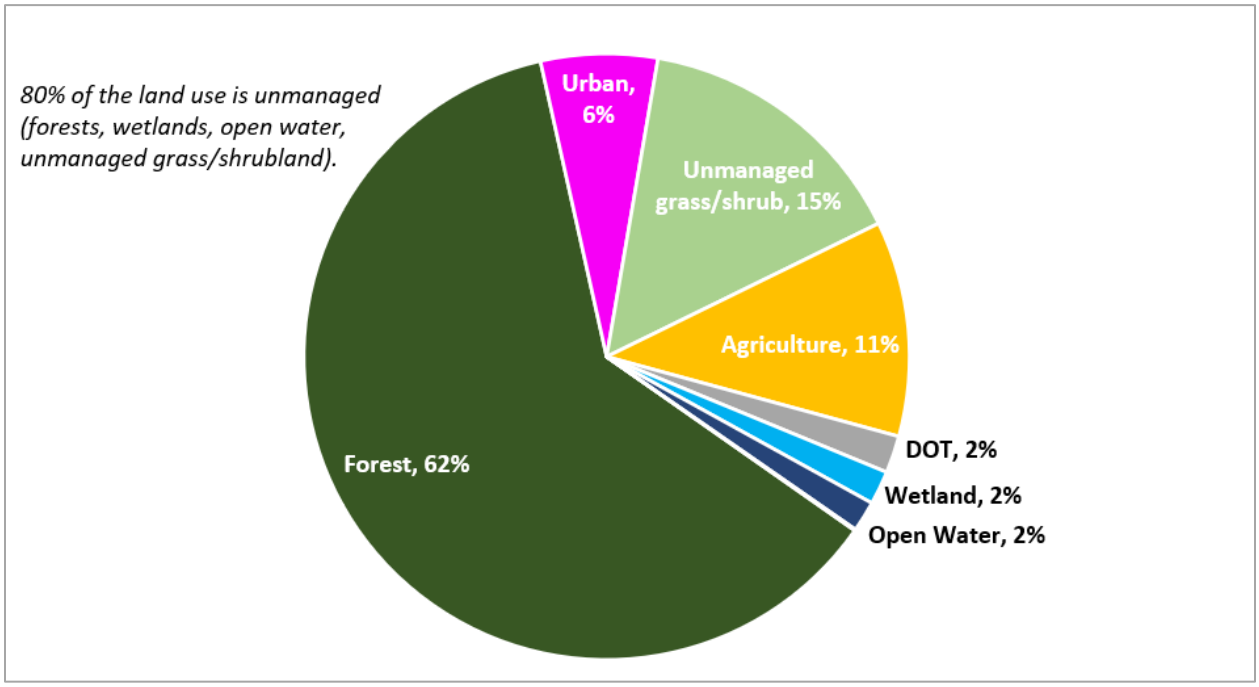

Figure I-14. Land Use Areas in the Little River Watershed (67,465 acres)

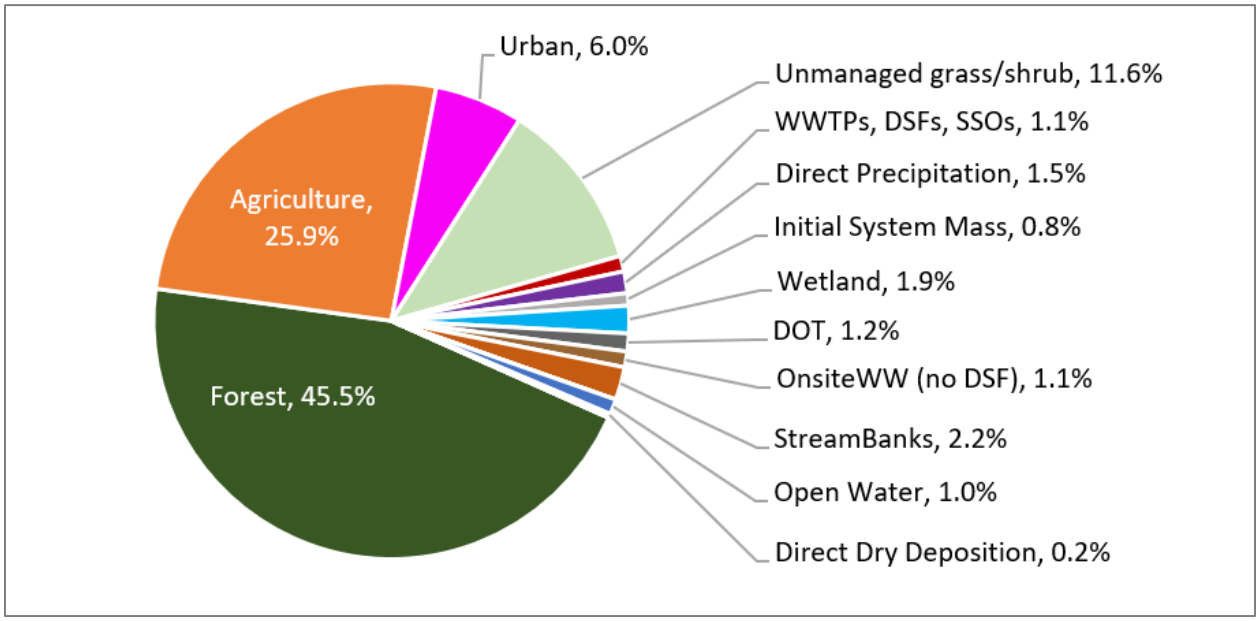

Figure I-15. Sources of Total Nitrogen Load (~145,000 pounds per year) Delivered to Falls Lake from the Little River Watershed for the UNRBA Study Period (2014 to 2018)

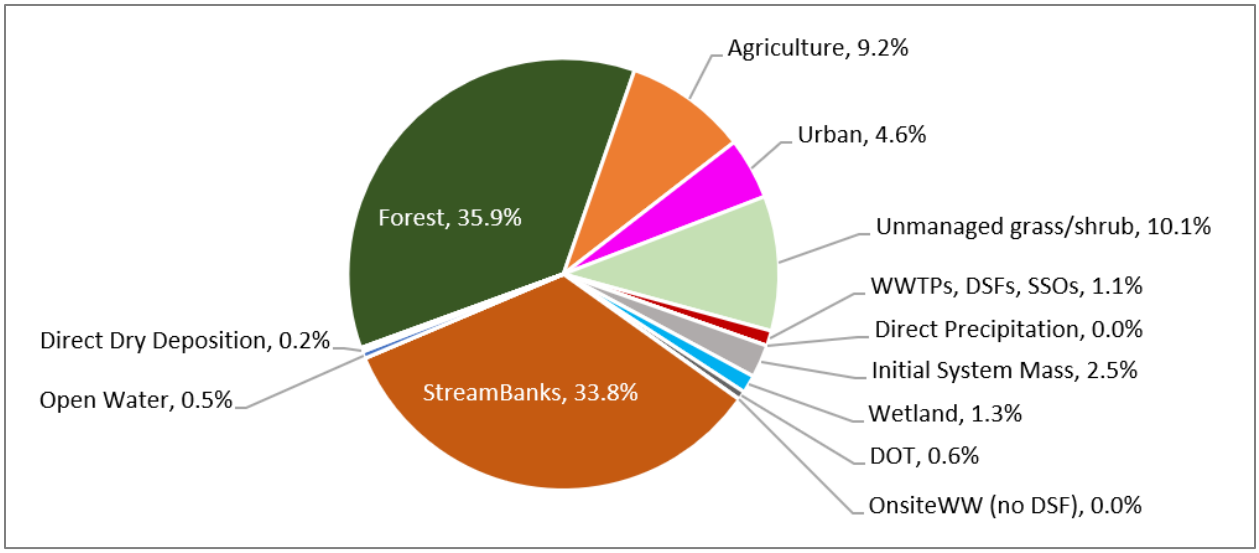

Figure I-16. Sources of Total Phosphorus Load (~15,000 pounds per year) Delivered to Falls Lake from the Little River Watershed for the UNRBA Study Period (2014 to 2018)

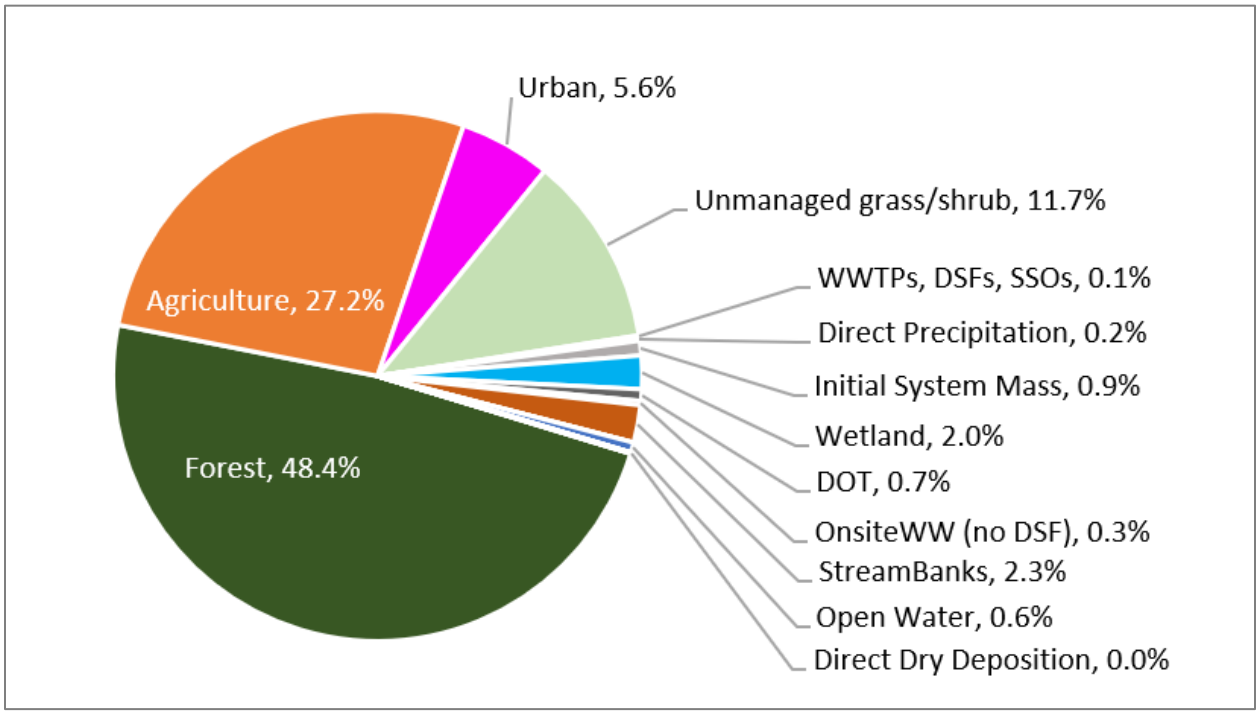

Figure I-17. Sources of Total Organic Carbon Load (~1,500,000 pounds per year) Delivered to Falls Lake from the Little River Watershed for the UNRBA Study Period (2014 to 2018)

2.5 Knap of Reeds Creek

The Knap of Reeds Creek subwatershed represents 5.8 percent of the area draining to Falls Lake. This subwatershed includes the Towns of Butner and Stem as well as the South Granville Water and Sewer Authority Wastewater Treatment Plant. Figure I-18 through Figure I-21 show the land use

composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this subwatershed to Falls Lake.

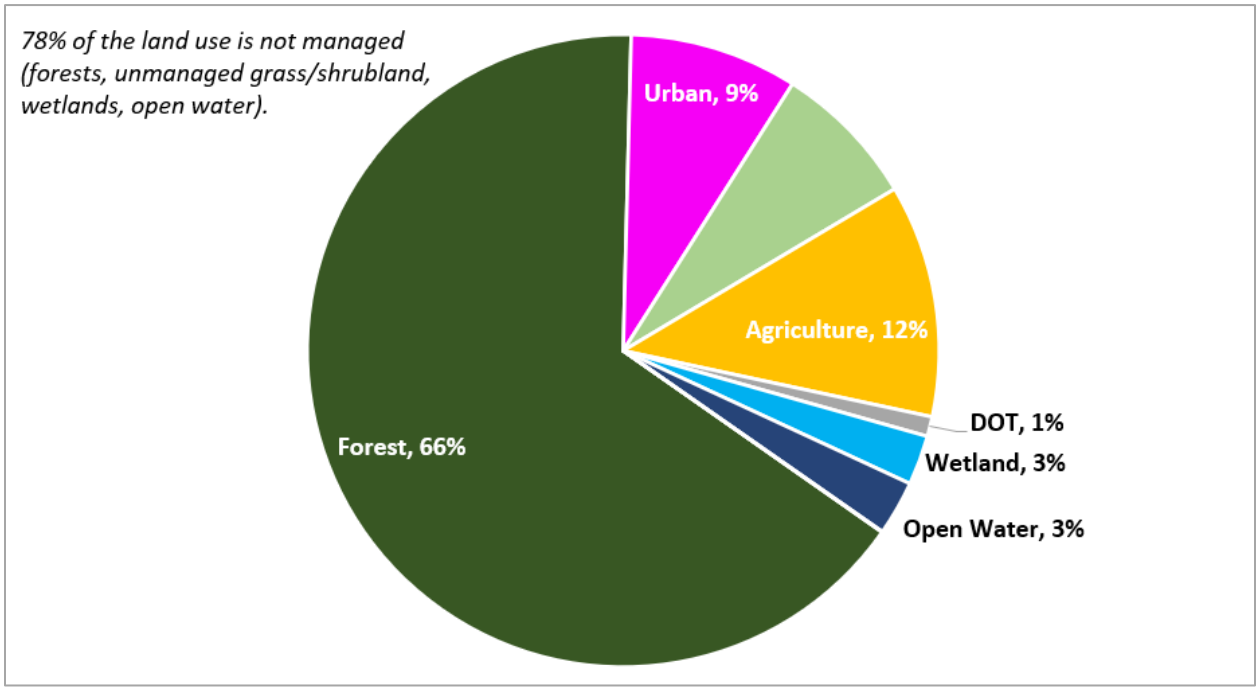

Figure I-18. Land Use Areas in the Knap of Reeds Creek Watershed (28,726 acres)

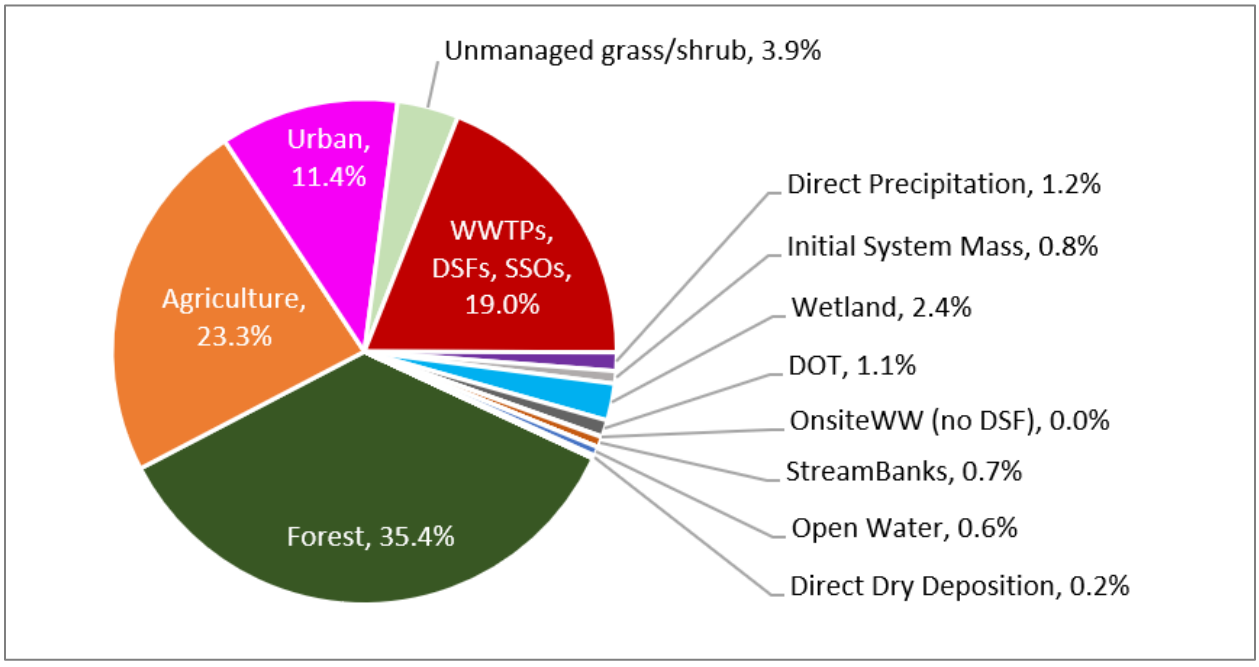

Figure I-19. Sources of Total Nitrogen Load (~107,000 pounds per year) Delivered to Falls Lake from the Knap of Reeds Creek Watershed for the UNRBA Study Period (2014 to 2018)

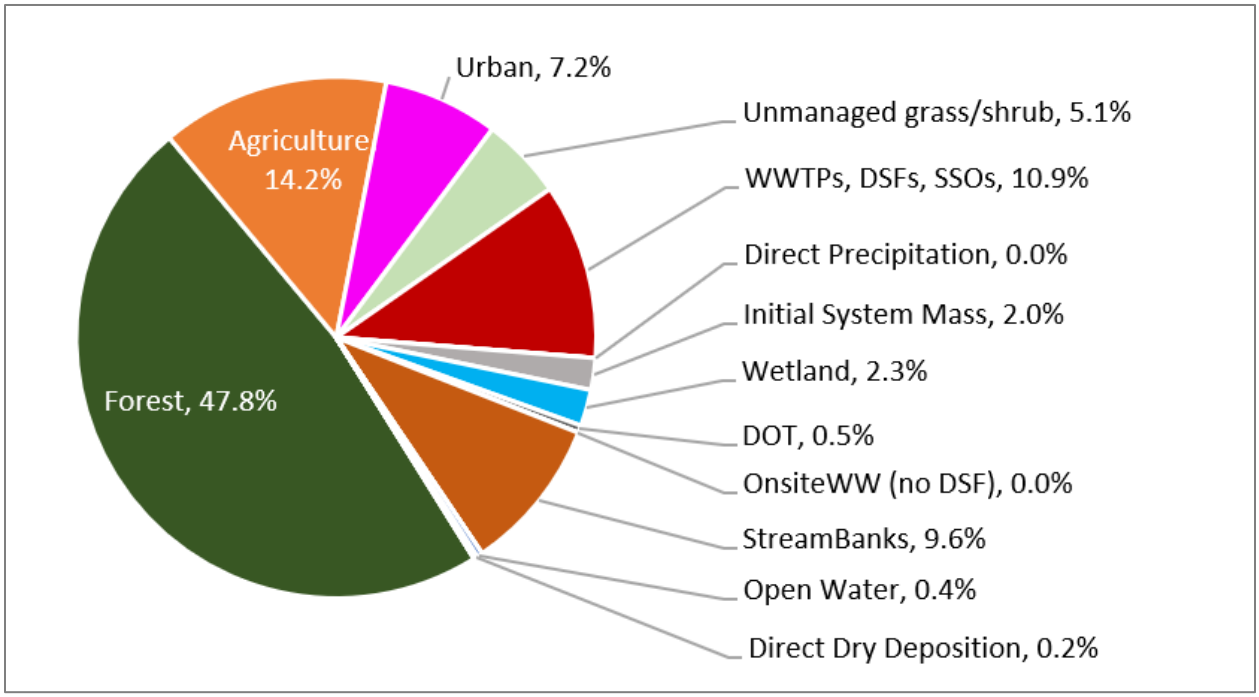

Figure I-20. Sources of Total Phosphorus Load (~14,400 pounds per year) Delivered to Falls Lake from the Knap of Reeds Creek Watershed for the UNRBA Study Period (2014 to 2018)

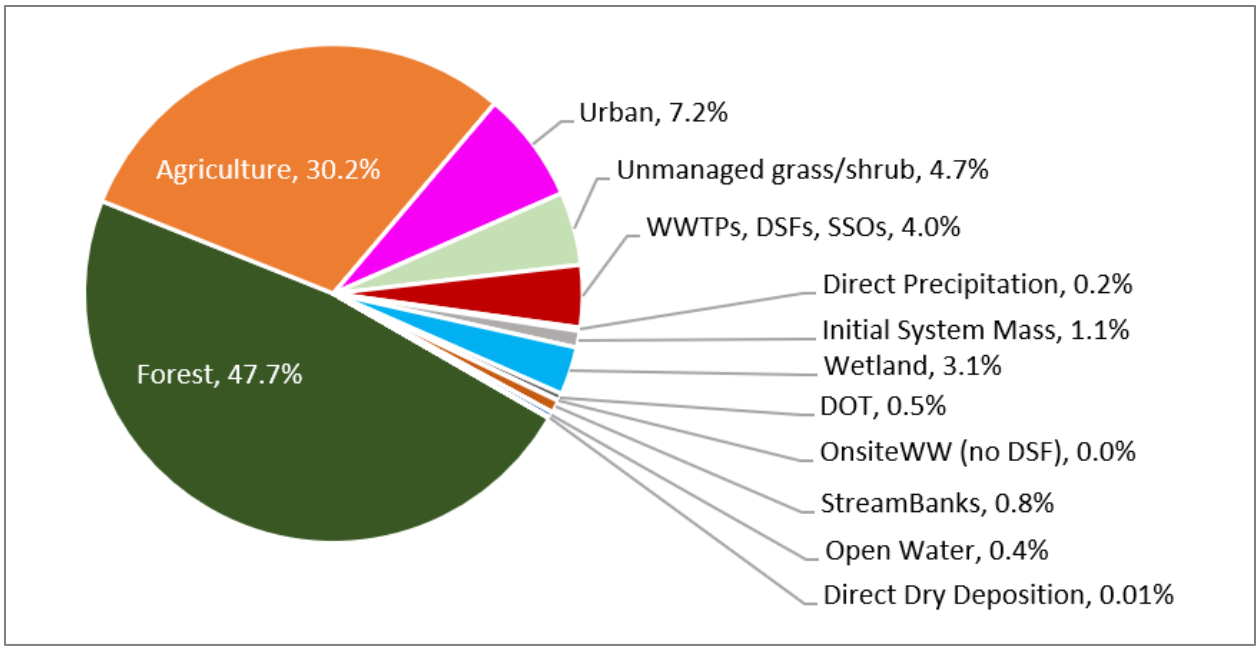

Figure I-21. Sources of Total Organic Carbon Load (~885,000 pounds per year) Delivered to Falls Lake from the Knap of Reeds Creek Watershed for the UNRBA Study Period (2014 to 2018)

2.6 Other Tributaries

Twenty-two other tributaries that drain to Falls Lake comprise 22.7 percent of the watershed area, similar to the percentage of the largest tributary to Falls Lake, the Flat River. Figure I-22 through Figure I-25 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from these areas to Falls Lake.

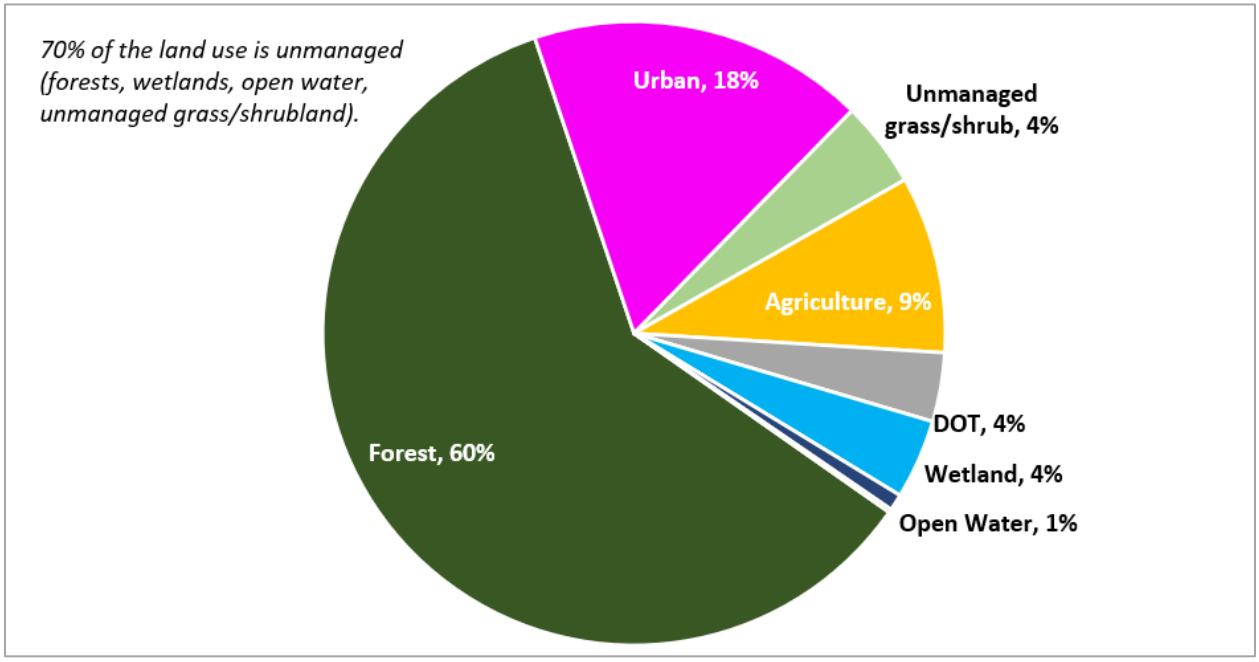

Figure I-22. Land Use Areas (111,235 acres) in the Other Tributaries to Falls Lake (Excluding Eno, Little, Flat Rivers and Ellerbe and Knap of Reeds Creek)

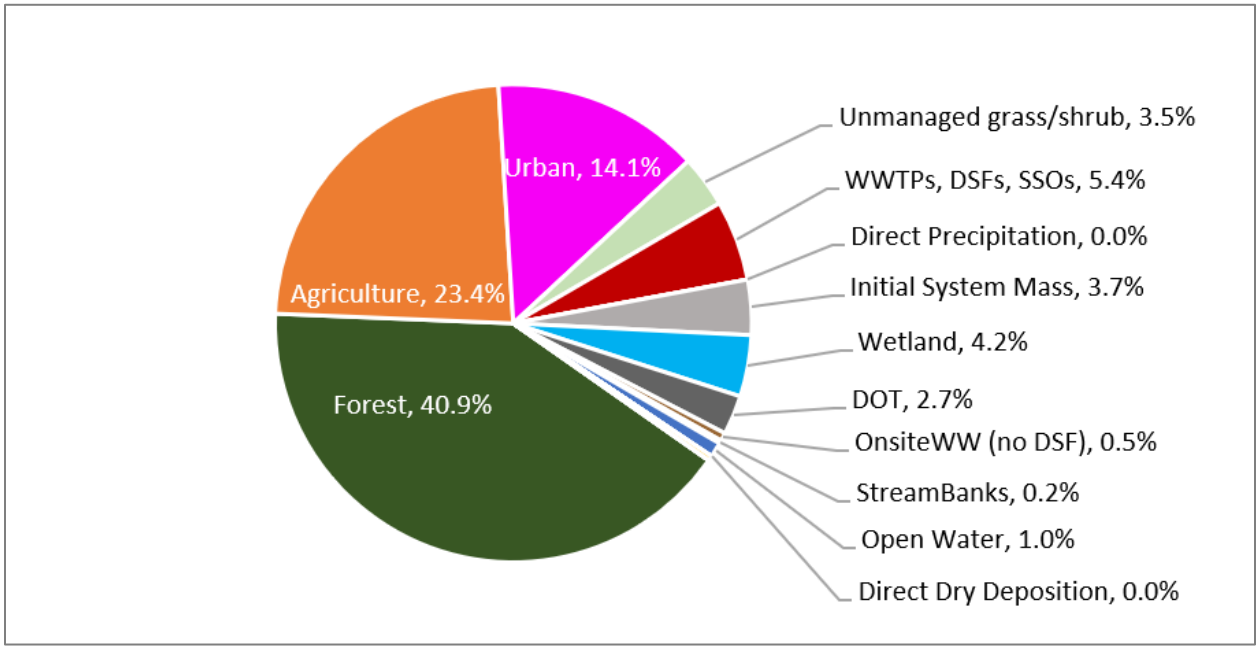

Figure I-23. Sources of Total Nitrogen Load (~350,000 pounds per year) Delivered to Falls Lake from the Other Tributaries (Excluding Eno, Little, Flat Rivers and Ellerbe and Knap of Reeds Creek) for the UNRBA Study Period (2014 to 2018)

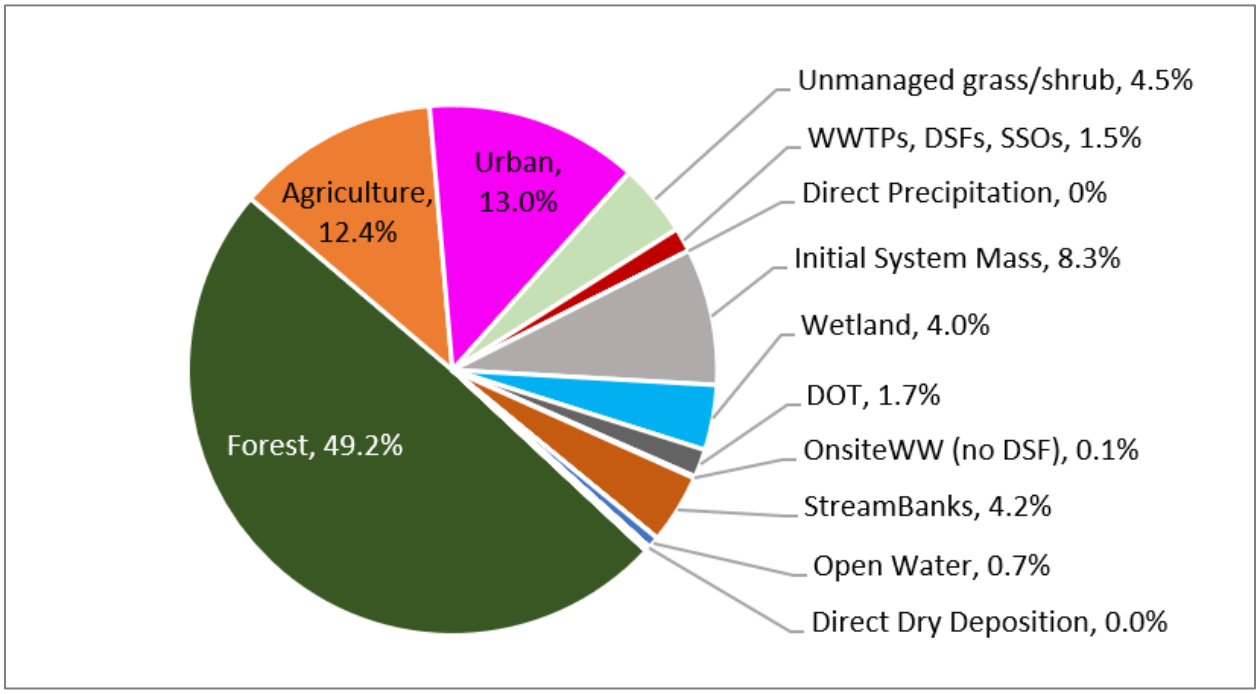

Figure I-24. Sources of Total Phosphorus Load (~42,000 pounds per year) Delivered to Falls Lake from the Other Tributaries (Excluding Eno, Little, Flat Rivers and Ellerbe and Knap of Reeds Creek) for the UNRBA Study Period (2014 to 2018)

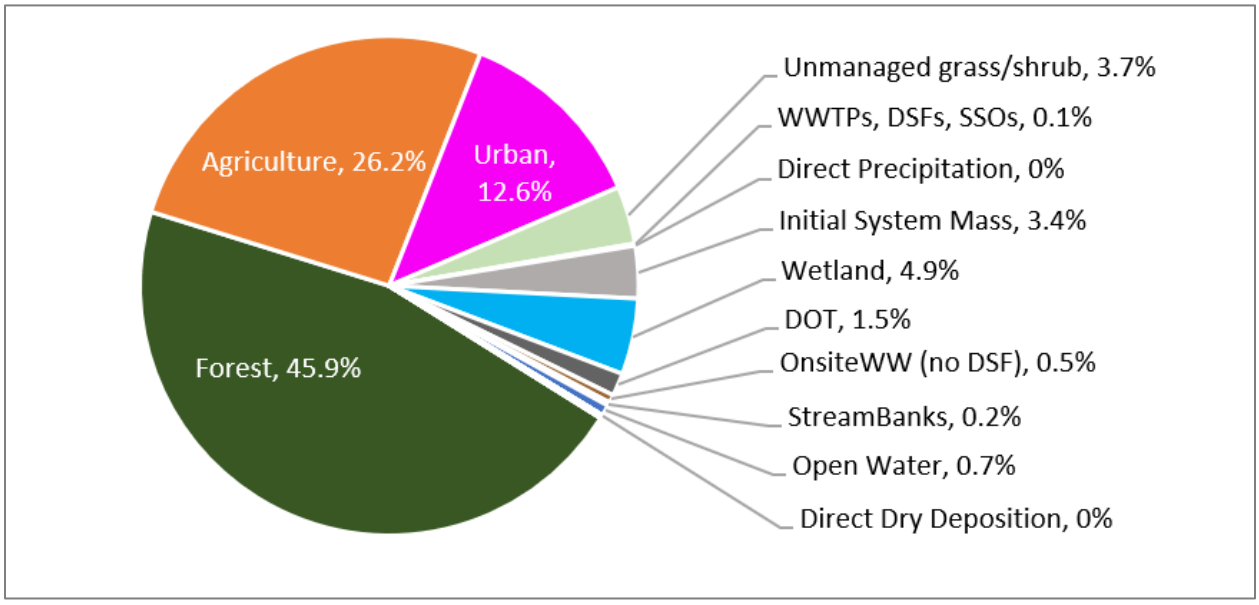

Figure I-25. Sources of Total Organic Carbon Load (~3,000,000 pounds per year) Delivered to Falls Lake from the Other Tributaries (Excluding Eno, Little, Flat Rivers and Ellerbe and Knap of Reeds Creek) for the UNRBA Study Period (2014 to 2018)

2.7 Near Lake Area and Direct Deposition to Falls Lake

The near lake drainage areas and surface of Falls Lake comprise 13.1 percent of the watershed area. Figure I-26 through Figure I-29 show the land use composition and sources of delivered total nitrogen, total phosphorus, and total organic carbon from this area to Falls Lake (including direct deposition to the lake surface).

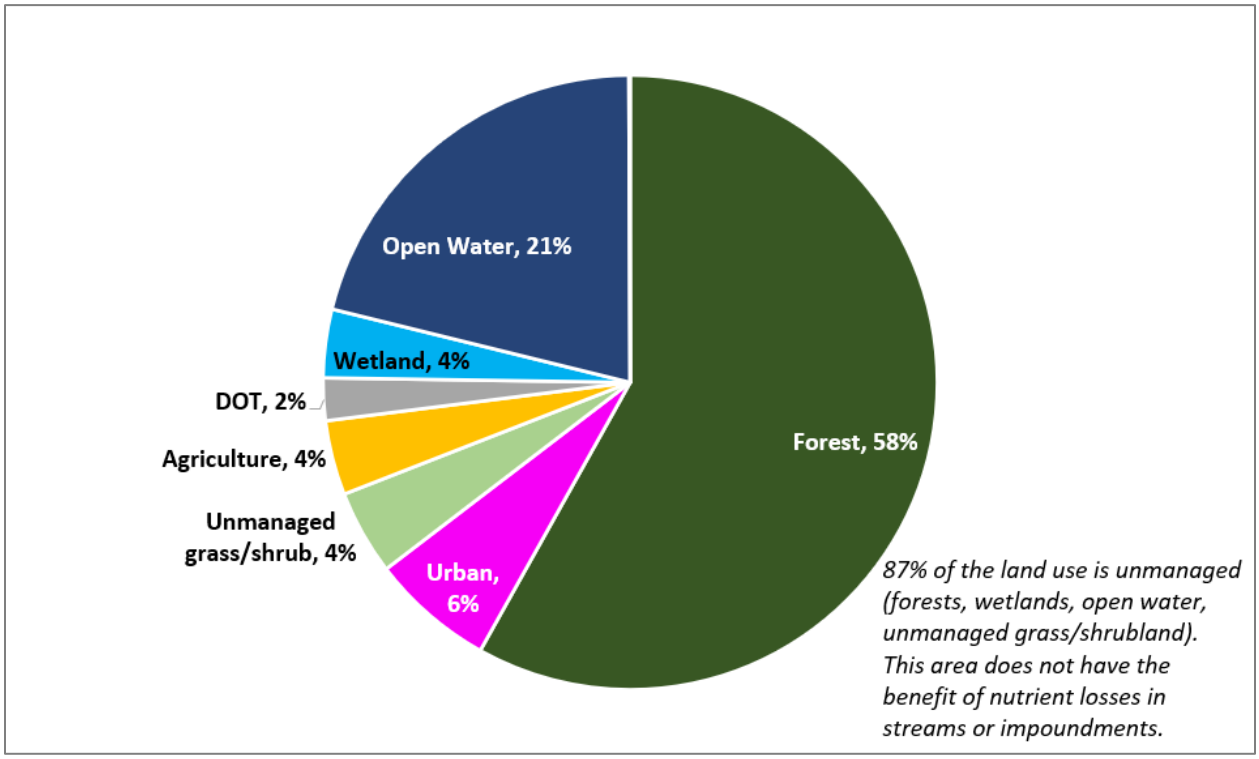

Figure I-26. Land Use (64,646 acres) in the Near Lake and Lake Area (directly draining to Falls Lake, and Falls Lake surface)

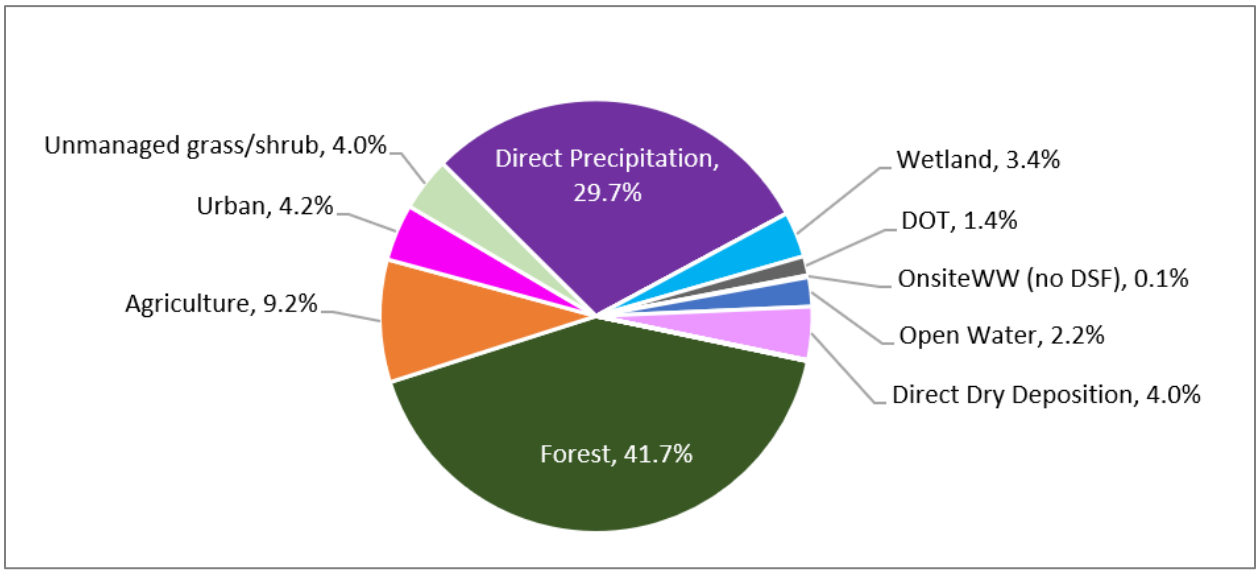

Figure I-27. Sources of Total Nitrogen Load (~260,000 pounds per year) Delivered to Falls Lake from the Near Lake Area (downstream of UNRBA Monitoring Stations) for the UNRBA Study Period (2014 to 2018)

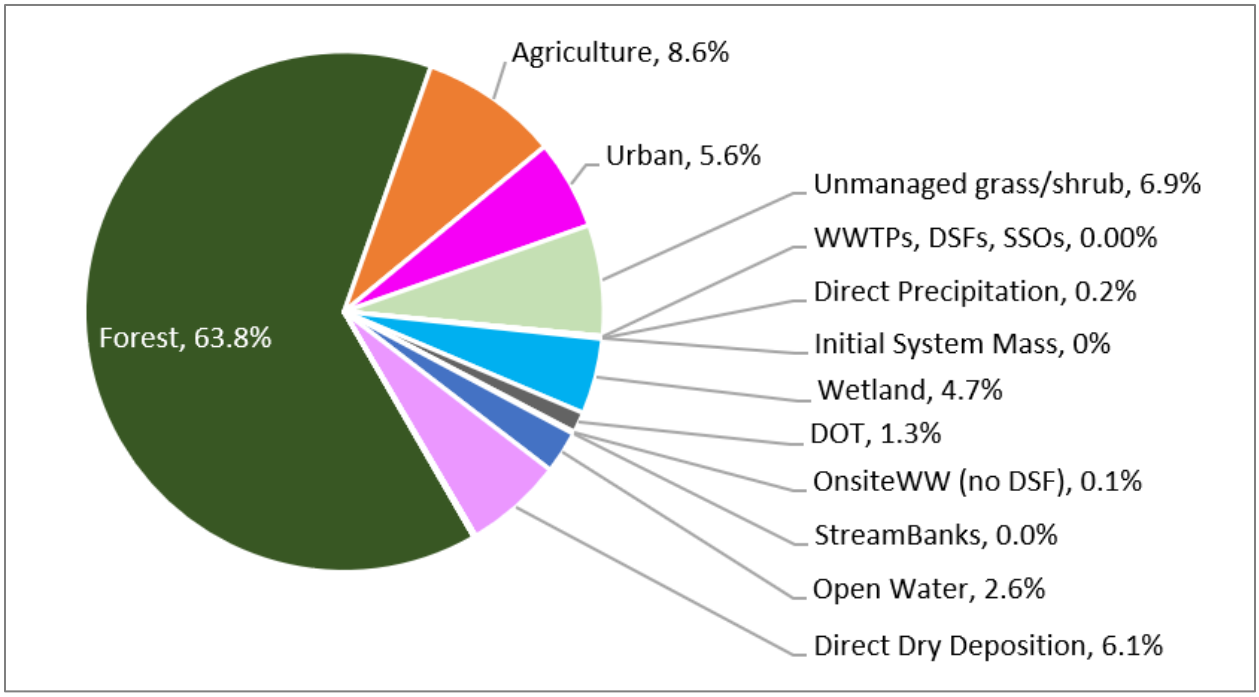

Figure I-28. Sources of Total Phosphorus Load (~33,000 pounds per year) Delivered to Falls Lake from the Near Lake Area (downstream of UNRBA Monitoring Stations) for the UNRBA Study Period (2014 to 2018)

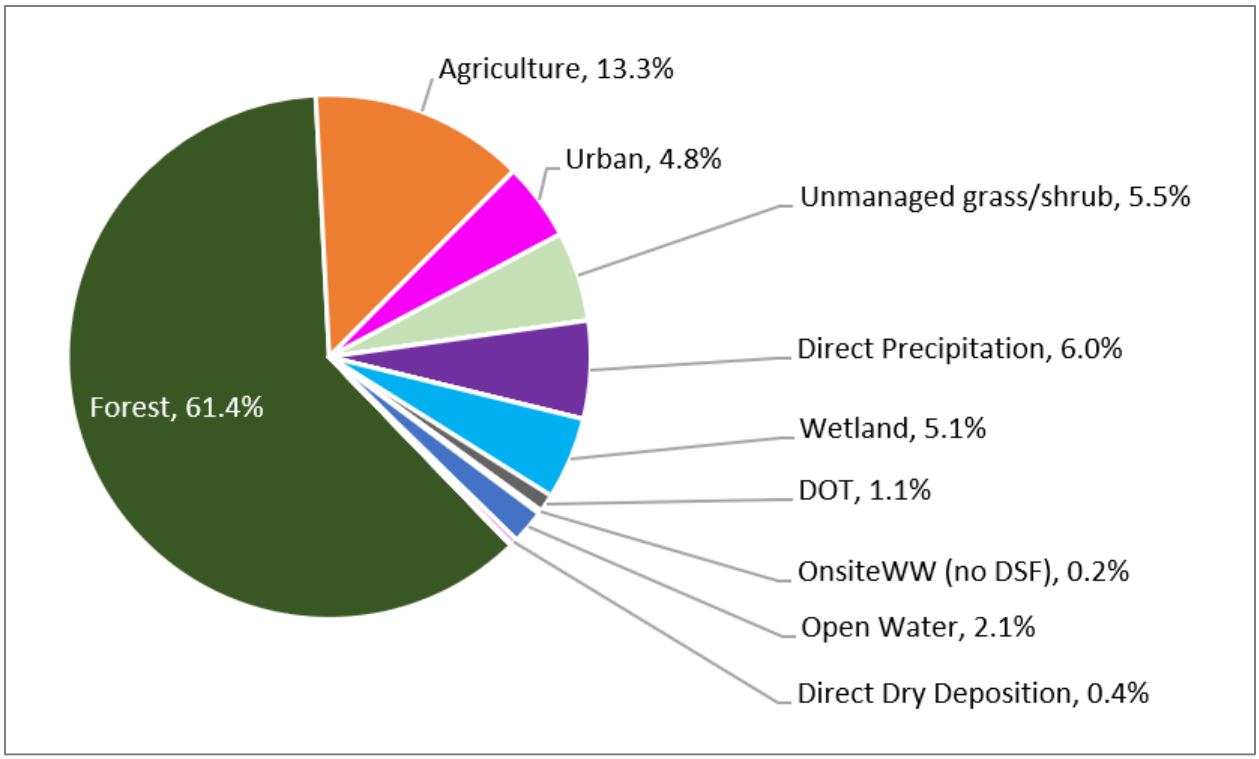

Figure I-29. Sources of Total Organic Carbon Load (~1,800,000 pounds per year) Delivered to Falls Lake from the Near Lake Area (downstream of UNRBA Monitoring Stations) for the UNRBA Study Period (2014 to 2018)

Section 3: Estimation of Jurisdictional Loads

The WARMF model internally tracks applied/released nutrients in the watershed as well as physical and biogeochemical processes in the catchments, streams, and impoundments; and calculates loads delivered to Falls Lake for each tributary and source category. While the Falls Lake watershed model was developed with catchments delineated to county lines where possible, these divisions are not exact and do not provide for separating out loads for the municipalities.

To provide as accurate as possible estimates of jurisdictional loads (municipalities, counties, and permittees), a two-step process was used:

1. Determine the contribution of loading at the county level using the simulated nutrient and carbon loads crossing the county lines and reaching Falls Lake
2. Use the model input information (acreages of land uses, numbers of onsite wastewater treatment systems, etc.) to allocate the county-level loads among the jurisdictions within each county.

Sections 3.1 and 3.2 describe these steps in more detail.

3.1 Step 1 - Total Loads by County (Including Municipal Areas)

In order to apportion loads by jurisdiction, estimates of delivered loading rates by county were developed using a scenario developed to estimate loading if all developed or agricultural land was converted to mixed forest. Mixed forest areas were labeled by county to track the amount of load crossing the county line and the amount reaching Falls Lake. The ratio of delivered load from mixed forest to the load crossing the county line was then applied to the land uses included in the calibrated model. This approach was needed because the number of land uses in the calibrated model, five-year study period, 6-hr time step, and separation of soils beneath each land use would overwhelm the model if all land uses were distinguished by county. This approach was approved by the Modeling and Regulatory Support Workgroup (MRSW) on May 3, 2022, with an understanding that more refined results may be provided following updates to the WARMF model graphical user interface. The subject matter experts concurred that using an alternative approach would not likely generate significantly different allocations.

Table I-3 summarizes the modeled drainage areas based on the catchment assignments for each simulated land use in each county (including the municipalities). Table I-4 through Table I-6 summarize the estimated total nitrogen, total phosphorus, and total organic carbon loads delivered to Falls Lake for each land use and county.

Table I-3. Simulated County Land Use Areas Based on Modeling Catchment Assignments for the UNRBA Study Period Used to Estimate Loading Rates by Land Use (not used to assign jurisdictional loads)

Land Use	Durham	Wake	Granville	Orange	Person	Franklin	Total
Conventional Grain Corn	2	37	96	32	2	-	169
Double-cropped Soybeans	35	241	499	553	1,897	126	3,350
Fescue (Pasture)	3,267	1,442	7,864	7,946	5,523	282	26,324
Fescue (Hay)	782	305	937	1,892	648	-	4,564
Flue-Cured Tobacco	180	34	519	391	1,581	30	2,736
Full Season Soybeans	462	1,054	782	1,160	2,402	1	5,861
No-Till Grain Corn	356	56	404	1,034	777	-	2,627
Wheat	431	29	42	174	143	-	820

Table I-3. Simulated County Land Use Areas Based on Modeling Catchment Assignments for the UNRBA Study Period Used to Estimate Loading Rates by Land Use (not used to assign jurisdictional loads)

Land Use	Durham	Wake	Granville	Orange	Person	Franklin	Total
DOT Roads, Connected	1,382	275	626	354	240	11	2,888
DOT Roads, Unconnected	2,237	2,432	1,094	2,718	1,325	169	9,976
Existing Development (ExDev), High Intensity	815	28	269	211	205	25	1,554
ExDev, Medium Intensity	2,608	228	673	542	347	50	4,449
ExDev, Low Intensity	6,764	1,393	1,751	1,592	989	121	12,610
Developed Open Space	17,131	8,902	4,654	7,772	4,064	458	42,981
Interim Development (IntDev), High Intensity	63	-	-	1	-	-	64
IntDev, Medium Intensity	327	-	-	3	-	-	330
IntDev, Low Intensity	250	-	-	2	-	-	252
New Development (NewDev), High Intensity	29	7	30	5	2	-	72
NewDev, Medium Intensity	194	40	38	21	4	2	298
NewDev, Low Intensity	172	99	43	10	9	5	339
Deciduous Forest	34,169	9,531	16,420	52,569	32,925	972	146,587
Coniferous Forest	17,310	17,558	18,983	8,658	4,867	1,126	68,503
Mixed Forest	19,671	15,948	16,253	13,626	9,525	894	75,917
Shrub / Scrub	1,259	403	1,289	1,837	2,533	47	7,368
Unmanaged Grassland	10,988	1,612	2,356	14,492	11,972	64	41,484
Barren	212	19	174	47	18	1	471
Emergent Herbaceous Wetland	128	17	234	12	13	2	406
Woody Wetland	4,180	818	3,456	439	492	110	9,495
Waterfowl Impoundment	661	-	178	-	-	-	839
Open Water[1]	2,287	1,061	1,390	1,207	570	8	18,933
Total	128,352	63,569	81,054	119,300	83,073	4,504	492,267

[1] Falls Lake adds 12,410 acres to the open water category, as reflected in the totals. This acreage represents 2.5 percent of the total watershed area.

Table I-4. Estimated Total Nitrogen Loads Delivered to Falls Lake by County and Land Use for the UNRBA Study Period (Including Municipal Areas)

Source	Durham	Wake	Granville	Orange	Person	Franklin	Falls Lake	Total
Conventional Grain Corn	24	211	318	50	4	-	-	607
Double-cropped Soybeans	831	559	1,137	758	3,225	152	-	6,663
Fescue (Pasture)	39,451	16,985	81,554	36,220	61,595	2,569	-	238,374
Fescue (Hay)	2,768	1,130	2,762	3,054	1,759	-	-	11,474
Flue-Cured Tobacco	1,370	163	4,113	2,820	7,854	202	-	16,521
Full Season Soybeans	1,197	2,423	1,908	1,621	5,137	2	-	12,288
No-Till Grain Corn	1,229	323	1,286	1,685	1,967	-	-	6,491
Wheat	1,589	134	157	370	540	-	-	2,791

Table I-4. Estimated Total Nitrogen Loads Delivered to Falls Lake by County and Land Use for the UNRBA Study Period (Including Municipal Areas)

Source	Durham	Wake	Granville	Orange	Person	Franklin	Falls Lake	Total
DOT Roads, Connected	8,477	657	2,428	1,761	515	16	-	13,853
DOT Roads, Unconnected	5,794	5,155	2,935	11,991	2,642	258	-	28,775
ExDev, High Intensity	5,084	32	1,014	644	275	29	-	7,078
ExDev, Medium Intensity	18,039	367	3,338	2,835	519	66	-	25,163
ExDev, Low Intensity	42,199	3,192	8,065	9,166	2,850	181	-	65,652
Developed Open Space	67,695	19,124	13,981	29,068	9,495	732	-	140,095
IntDev, High Intensity	236	-	-	2	-	-	-	238
IntDev, Medium Intensity	1,141	-	-	12	-	-	-	1,154
IntDev, Low Intensity	879	-	-	15	-	-	-	894
NewDev, High Intensity	86	6	75	7	1	-	-	176
NewDev, Medium Intensity	506	49	106	60	6	2	-	729
NewDev, Low Intensity	506	181	92	38	17	7	-	841
Deciduous Forest	81,199	19,718	35,526	93,185	73,564	1,157	-	304,350
Coniferous Forest	47,418	42,366	48,307	14,758	9,932	1,292	-	164,073
Mixed Forest	49,980	33,043	37,248	23,539	19,339	971	-	164,120
Shrub / Scrub	3,337	1,461	2,658	3,259	5,252	50	-	16,017
Unmanaged Grassland	29,749	4,041	6,017	26,989	27,832	87	-	94,717
Barren	1,133	74	1,103	290	69	3	-	2,672
Emerg Herbaceous Wetland	333	35	744	8	24	2	-	1,146
Woody Wetland	15,269	2,224	12,247	698	1,056	187	-	31,682
Waterfowl Impoundment	1,641	-	576	-	-	-	-	2,216
Water	5,770	4,511	3,214	3,697	2,155	18	-	19,366
General Nonpoint Sources	6,860	2,132	7,394	2,498	565	108	-	19,557
Stream Bank Erosion	8,647	564	1,003	3,452	8	1	-	13,674
Direct Precipitation	5,777	-	1,271	-	-	-	78,132	85,180
Direct Dry Deposition	723	-	166	-	-	-	10,433	11,322
Onsite WWT (excluding DSF)	4,647	1,172	902	12,347	1,322	120	-	20,512
Point Sources (including DSF)	80,482	15,984	20,305	4,396	185	-	-	121,352
Total	542,070	178,019	303,951	291,292	239,706	8,209	88,565	1,651,813

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.
DSF=discharging sand filter

Table I-5. Estimated Total Phosphorus Loads Delivered to Falls Lake by County and Land Use for the UNRBA Study Period (Including Municipal Areas)

Land Use	Durham	Wake	Granville	Orange	Person	Franklin	Falls Lake	Total
Conventional Grain Corn	4	41	68	5	1	-	-	120
Double-cropped Soybeans	37	143	217	66	641	29	-	1,134
Fescue (Pasture)	1,486	1,132	4,526	1,201	2,261	89	-	10,695
Fescue (Hay)	340	205	405	242	248	-	-	1,440
Flue-Cured Tobacco	185	88	460	76	886	11	-	1,706
Full Season Soybeans	211	640	364	150	832	-	-	2,199
No-Till Grain Corn	220	75	247	141	311	-	-	994
Wheat	230	26	17	19	60	-	-	352
DOT Roads, Connected	498	58	144	28	28	1	-	759
DOT Roads, Unconnected	451	469	211	193	156	16	-	1,496
ExDev, High Intensity	131	1	21	8	7	-	-	168
ExDev, Medium Intensity	813	37	156	33	25	4	-	1,069
ExDev, Low Intensity	3,702	648	916	210	251	20	-	5,746
Developed Open Space	6,538	2,324	1,434	850	826	61	-	12,033
IntDev, High Intensity	9	-	-	-	-	-	-	9
IntDev, Medium Intensity	74	-	-	-	-	-	-	75
IntDev, Low Intensity	87	-	-	-	-	-	-	87
NewDev, High Intensity	4	-	3	-	-	-	-	8
NewDev, Medium Intensity	41	7	10	1	-	-	-	59
NewDev, Low Intensity	57	45	12	1	2	1	-	118
Deciduous Forest	7,764	2,470	5,139	6,988	8,942	152	-	31,455
Coniferous Forest	7,311	8,844	7,663	1,101	1,327	206	-	26,452
Mixed Forest	6,511	5,820	5,693	1,790	2,528	148	-	22,491
Shrub / Scrub	414	293	397	167	697	7	-	1,975
Unmanaged Grassland	4,007	802	962	1,770	4,051	12	-	11,603
Barren	220	12	100	11	11	-	-	355
Emerg Herbaceous Wetland	62	10	93	-	3	-	-	168
Woody Wetland	2,268	349	1,384	32	107	20	-	4,159
Waterfowl Impoundment	186	-	82	-	-	-	-	268
Water	528	578	271	67	157	1	-	1,602
General Nonpoint Sources	2,630	598	1,853	814	253	15	-	6,164
Stream Bank Erosion	17,920	325	1,718	6,789	23	2	-	26,776
Direct Precipitation	3	-	1	-	-	-	55	59
Direct Dry Deposition	104	-	25	-	-	-	1,995	2,124
Onsite WWT (excluding DSF)	23	63	15	3	5	-	-	109
Point Sources (including DSF)	4,411	286	1,574	1,127	17	-	-	7,414
Total	69,480	26,391	36,184	23,885	24,658	795	2,051	183,444

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.
DSF=discharging sand filter

Table I-6. Estimated Total Organic Carbon Loads Delivered to Falls Lake by County and Land Use for the UNRBA Study Period (Including Municipal Areas)

Land Use	Durham	Wake	Granville	Orange	Person	Franklin	Falls Lake	Total
Conventional Grain Corn	176	808	2,300	406	37	-	-	3,728
Double-cropped Soybeans	9,343	5,247	11,178	7,702	29,991	960	-	64,421
Fescue (Pasture)	467,800	177,554	847,022	390,347	637,033	21,210	-	2,540,966
Fescue (Hay)	22,693	6,883	22,955	27,356	13,928	3	-	93,817
Flue-Cured Tobacco	4,567	1,008	12,150	5,388	30,619	220	-	53,952
Full Season Soybeans	14,178	22,304	18,937	16,469	47,680	11	-	119,580
No-Till Grain Corn	10,325	1,393	9,637	14,714	15,582	-	-	51,651
Wheat	9,933	593	1,038	2,471	3,129	-	-	17,164
DOT Roads, Connected	27,596	3,012	10,141	4,024	2,206	46	-	47,026
DOT Roads, Unconnected	30,354	22,681	13,818	25,519	11,988	807	-	105,167
ExDev, High Intensity	8,931	77	1,521	971	419	37	-	11,957
ExDev, Medium Intensity	50,463	1,631	10,503	5,860	2,091	241	-	70,790
ExDev, Low Intensity	202,298	20,609	47,942	30,264	18,397	1,047	-	320,556
Developed Open Space	491,598	145,173	108,014	136,098	77,261	4,169	-	962,313
IntDev, High Intensity	593	-	-	3	-	-	-	596
IntDev, Medium Intensity	5,181	-	-	29	-	-	-	5,209
IntDev, Low Intensity	5,736	-	-	46	-	-	-	5,781
NewDev, High Intensity	309	23	234	14	2	1	-	582
NewDev, Medium Intensity	3,312	335	704	224	31	9	-	4,614
NewDev, Low Intensity	4,261	1,519	801	202	152	46	-	6,981
Deciduous Forest	857,585	184,370	358,885	968,404	695,417	7,470	-	3,072,132
Coniferous Forest	500,674	424,405	494,905	158,410	100,745	9,605	-	1,688,743
Mixed Forest	531,034	326,756	380,725	253,562	195,846	7,137	-	1,695,059
Shrub / Scrub	36,256	14,414	27,144	27,486	51,443	345	-	157,087
Unmanaged Grassland	304,544	35,651	56,594	224,474	260,522	542	-	882,328
Barren	5,603	428	5,771	903	382	9	-	13,097
Emerg Herbaceous Wetland	3,530	351	7,516	83	240	12	-	11,732
Woody Wetland	161,071	22,278	125,957	7,404	10,717	1,527	-	328,955
Waterfowl Impoundment	16,893	-	6,121	-	-	-	-	23,014
Water	35,357	26,936	19,762	10,388	11,554	57	-	104,053
General Nonpoint Sources	52,901	16,941	59,723	24,474	5,105	827	-	159,971
Stream Bank Erosion	84,246	6,069	10,021	31,844	74	4	-	132,257
Direct Precipitation	8,446	-	1,948	-	-	-	111,015	121,409
Direct Dry Deposition	539	-	130	-	-	-	7,553	8,221
Onsite WWT (excluding DSF)	5,510	9,797	7,576	6,852	5,778	948	-	36,463
Point Sources (including DSF)	186,556	1,706	35,500	5,247	113	-	-	229,123
Total	4,160,392	1,480,952	2,717,172	2,387,639	2,228,484	57,290	118,567	13,150,496

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.
DSF=discharging sand filter

3.2 Step 2 - Loads by Jurisdiction

Because the modeling catchments could not be delineated to match county boundary lines exactly or to account for municipal boundaries (Figure I-30), a separate geospatial intersection of jurisdictional boundaries (based on NC Department of Transportation 2018 boundaries to correspond to the end of the UNRBA Study Period) and 2016 NLCD land use was conducted. These areas by jurisdiction are more accurate for assigning jurisdiction loads associated with land uses. However, not all of the land uses simulated in WARMF are represented by the NLCD, so scaling the county-level estimated loads was not always feasible. The following assumptions were used to apportion jurisdictional loads:

- Loads associated with agricultural use are assigned to the county. County level crop data was integrated into the catchment data using the NLCD data, but the specific agricultural uses are not available spatially. For most cases, the NLCD data did not have sufficient acreage of agricultural land use specified, so a portion of herbaceous cover was reduced to account for these acreages. Thus, spatial evaluation of NLCD data cannot be used to allocate any agricultural load to municipalities. However, the amount of agriculture in municipalities is small and this approach should not introduce significant error into the estimated jurisdictional loads.
- Low, medium, and high intensity development were estimated using the corresponding NLCD development classes and information from each local government. Acreages and loads associated with new development (709 acres) and interim development (376 acres) are assigned to the municipality that comprises the majority of the catchment that includes these land uses or to the county if the catchment does not intersect a municipal boundary. Note that these land uses comprise a small area and a small fraction of the total load during the UNRBA Study Period. For example, interim and new development contribute 4,000 pounds per year of total nitrogen out of the 1.65 million that reach Falls Lake or approximately 0.2 percent of the annual load. Thus, errors in this approach will not significantly affect jurisdictional load allocations.
- Loads associated with NC Department of Transportation (DOT) rights of way were not assigned to a county or a municipality but allocated to DOT.
- In order to account for the county-level agricultural data provided by the NC Department of Agriculture, some NLCD unmanaged land uses were adjusted. To assign the loads from unmanaged land uses to jurisdictions, the load estimated from the entire county (including the municipalities) was allocated based on the area of the land use within each jurisdiction.
- Waterfowl impoundments are assigned to the counties because they do not intersect municipal boundaries.
- Initial system mass and stream bank erosion are allocated based on the length of simulated stream reaches in each jurisdiction. In the summary tables below, initial system mass was added to the unmanaged lands category but loads from stream bank erosion are grouped separately.
- Direction deposition to lakes (other than Falls Lake) are assigned to the counties because each reservoir is within the county's jurisdictional boundary. These loads were also grouped with unmanaged lands. Falls Lake is treated separately because it crosses multiple county lines.
- WARMF tracks delivered loads from all point sources (major and minor wastewater treatment systems, sanitary sewer overflows, and discharging sand filter systems) in a group called "General Point Sources." In order to allocate the loads among the point sources in a county, the delivered load was apportioned based on the proportion of nutrient load input to the system and the location of the discharge.

- Loads from other onsite wastewater treatment systems (excluding DSF) were allocated based on the number and type located in each jurisdiction.

Table I-7 and Table I-8 summarize the jurisdictional and permitted total nitrogen loads to Falls Lake as loads (pounds per acre per year) and as percentages, respectively. Table I-9 and Table I-10 provide this information for total phosphorus, and Table I-11 and Table I-12 summary the loads for total organic carbon.

Figure I-31 shows the **total** delivered load to Falls Lake from all jurisdictions, NC Department of Transportation (DOT), and permitted facilities. Figure I-32 through Figure I-45 show the **non-point source** loads delivered to Falls Lake by jurisdiction. The non-point source figures do not show the load from DOT rights of way (ROW) because those loads are not under the jurisdiction of the local governments, nor do they show the permitted discharges because not all of those are under the jurisdiction of the local governments either. Refer to Table I-7 and Table I-9 for the permitted and point source loads including DOT. If a small load is present in the jurisdiction, the percentage of the load is displayed by increasing the number of decimal places. If no load is present in the jurisdiction, then the percentage is displayed with no decimal places as “0%.”

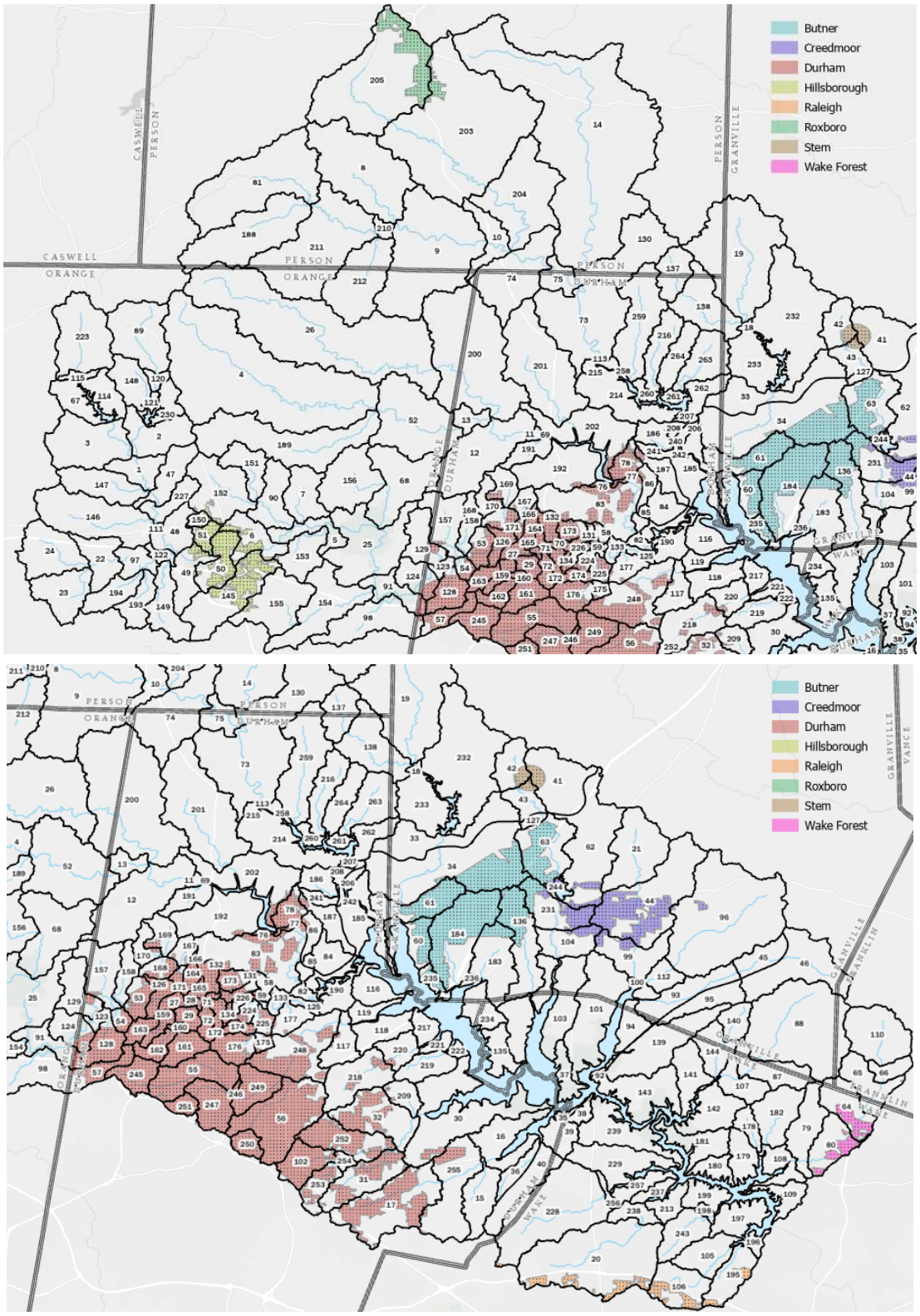

Figure I-30. Intersection of WARMF Modeling Catchments and 2018 Jurisdictional Boundaries

Table I-7. Estimated Jurisdictional or Permittee Delivered Total Nitrogen Loads (lb/yr) to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	13,367	-	3,455	6,497	290	-	0	See facilities	23,610
Creedmoor	5,408	-	1,122	1,932	271	-	0	See facilities	8,735
Durham County	216,308	48,538	27,308	14,198	3,166	4,464	4,095	See facilities	318,077
City of Durham	32,151	-	40,497	54,619	5,496	976	560	See facilities	134,299
Falls Lake (Direct Deposition)	88,709	-	-	-	-	-	-	See facilities	88,709
Franklin	3,877	2,929	733	286	1	-	120	See facilities	7,945
Granville	136,094	93,387	9,272	4,150	381	19	902	See facilities	244,205
Hillsborough	3,337	-	3,452	3,700	540	-	24	See facilities	11,052
Orange	165,567	46,653	25,664	9,071	2,917	321	12,343	See facilities	262,536
Person	138,560	82,215	8,956	2,442	6	185	1,270	See facilities	233,636
Raleigh	1,252	-	679	553	250	-	3	See facilities	2,736
Roxboro	1,385	-	554	1,232	1	-	54	See facilities	3,227
Stem	751	-	154	131	62	-	-	See facilities	1,099
Wake	107,752	21,965	17,785	3,024	247	11	1,171	See facilities	151,955
Wake Forest	707	-	690	256	68	-	2	See facilities	1,723
NC DOT	NA	NA	NA	NA	NA	NA	NA	42,697	42,697
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	74,942	74,942
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	3,982	3,982
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	20,319	20,319
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	85	85
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	8,255	8,255
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	231	231
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	7,733	7,733
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	15	15
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	Inactive	-
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	11	11
Total	915,226	295,687	140,322	102,091	13,697	5,977	20,546	158,269	1,651,813

Table I-8. Estimated Percent Contributions for Jurisdictional or Permittee Delivered Total Nitrogen Loads to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	0.8%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	See facilities	1.4%
Creedmoor	0.3%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	See facilities	0.5%
Durham County	13.1%	2.9%	1.7%	0.9%	0.2%	0.3%	0.2%	See facilities	19.3%
City of Durham	1.9%	0.0%	2.5%	3.3%	0.3%	0.1%	0.0%	See facilities	8.1%
Falls Lake (Direct Deposition)	5.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	5.4%
Franklin	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.5%
Granville	8.2%	5.7%	0.6%	0.3%	0.0%	0.0%	0.1%	See facilities	14.8%
Hillsborough	0.2%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	See facilities	0.7%
Orange	10.0%	2.8%	1.6%	0.5%	0.2%	0.0%	0.7%	See facilities	15.9%
Person	8.4%	5.0%	0.5%	0.1%	0.0%	0.0%	0.1%	See facilities	14.1%
Raleigh	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.2%
Roxboro	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	See facilities	0.2%
Stem	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.1%
Wake	6.5%	1.3%	1.1%	0.2%	0.0%	0.0%	0.1%	See facilities	9.2%
Wake Forest	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.1%
NC DOT	NA	NA	NA	NA	NA	NA	NA	2.6%	2.6%
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	4.5%	4.5%
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	0.2%	0.2%
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	1.2%	1.2%
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	0.5%	0.5%
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	0.5%	0.5%
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	NA	0.0%
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Total	55.4%	17.9%	8.5%	6.2%	0.8%	0.4%	1.2%	9.6%	100.0%

Percentages are presented to the tenth of a percentage for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

Table I-9. Estimated Jurisdictional or Permittee Delivered Total Phosphorus Loads (lb/yr) to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	2,055	-	355	529	497	-	0	See facilities	3,435
Creedmoor	821	-	115	179	465	-	0	See facilities	1,580
Durham County	27,311	2,718	2,638	1,067	6,562	723	20	See facilities	41,040
City of Durham	4,539	-	3,913	3,862	11,393	158	3	See facilities	23,866
Falls Lake (Direct Deposition)	2,055	-	-	-	-	-	-	See facilities	2,055
Franklin	562	130	61	25	2	-	0	See facilities	780
Granville	20,616	6,317	951	400	652	2	15	See facilities	28,954
Hillsborough	251	-	101	68	1,063	-	0	See facilities	1,484
Orange	12,502	1,905	751	185	5,739	52	3	See facilities	21,136
Person	17,924	5,250	779	203	19	17	5	See facilities	24,197
Raleigh	228	-	83	103	144	-	0	See facilities	558
Roxboro	177	-	48	84	4	-	0	See facilities	314
Stem	118	-	16	13	107	-	-	See facilities	254
Wake	19,449	2,357	2,162	588	142	1	63	See facilities	24,762
Wake Forest	124	-	84	49	39	-	0	See facilities	296
NC DOT	NA	NA	NA	NA	NA	NA	NA	2,259	2,259
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	3,527	3,527
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	1,057	1,057
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	1,575	1,575
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	17	17
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	171	171
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	11	11
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	114	114
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	4	4
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	Inactive	-
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	0	0
Total	108,732	18,676	12,056	7,354	26,828	953	110	8,734	183,444

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

Table I-10. Estimated Percent Contributions for Jurisdictional or Permittee Delivered Total Phosphorus Loads to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	1.1%	0.0%	0.2%	0.3%	0.3%	0.0%	0.0%	See facilities	1.9%
Creedmoor	0.4%	0.0%	0.1%	0.1%	0.3%	0.0%	0.0%	See facilities	0.9%
Durham County	14.9%	1.5%	1.4%	0.6%	3.6%	0.4%	0.0%	See facilities	22.4%
City of Durham	2.5%	0.0%	2.1%	2.1%	6.2%	0.1%	0.0%	See facilities	13.0%
Falls Lake (Direct Deposition)	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	1.1%
Franklin	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.4%
Granville	11.2%	3.4%	0.5%	0.2%	0.4%	0.0%	0.0%	See facilities	15.8%
Hillsborough	0.1%	0.0%	0.1%	0.0%	0.6%	0.0%	0.0%	See facilities	0.8%
Orange	6.8%	1.0%	0.4%	0.1%	3.1%	0.0%	0.0%	See facilities	11.5%
Person	9.8%	2.9%	0.4%	0.1%	0.0%	0.0%	0.0%	See facilities	13.2%
Raleigh	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	See facilities	0.3%
Roxboro	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.2%
Stem	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	See facilities	0.1%
Wake	10.6%	1.3%	1.2%	0.3%	0.1%	0.0%	0.0%	See facilities	13.5%
Wake Forest	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.2%
NC DOT	NA	NA	NA	NA	NA	NA	0.0%	1.2%	1.2%
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	1.9%	1.9%
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	0.6%	0.6%
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	0.9%	0.9%
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	0.1%	0.1%
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	0.1%	0.1%
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	NA	0.0%
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Total	59.3%	10.2%	6.6%	4.0%	14.6%	0.5%	0.1%	4.8%	100.0%

Percentages are presented to the tenth of a percentage for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

Table I-11. Estimated Jurisdictional or Permittee Delivered Total Organic Carbon Loads (lb/yr) to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	133,400	-	26,678	29,577	2,898	-	2	See facilities	192,556
Creedmoor	53,668	-	8,667	9,744	2,709	-	3	See facilities	74,791
Durham County	2,182,033	539,552	198,183	59,637	30,822	10,341	4,881	See facilities	3,025,450
City of Durham	329,299	-	293,905	221,802	53,508	2,260	636	See facilities	901,410
Falls Lake (Direct Deposition)	118,686	-	-	-	-	-	-	See facilities	118,686
Franklin	27,549	22,427	4,173	1,382	4	-	949	See facilities	56,484
Granville	1,346,420	926,139	71,587	21,720	3,800	33	7,578	See facilities	2,377,278
Hillsborough	31,594	-	16,151	10,244	4,981	-	13	See facilities	62,983
Orange	1,644,761	465,317	120,082	27,329	26,894	383	6,846	See facilities	2,291,614
Person	1,319,639	778,775	72,835	14,911	60	114	5,550	See facilities	2,191,882
Raleigh	11,629	-	5,151	3,466	2,684	-	22	See facilities	22,952
Roxboro	13,277	-	4,504	6,204	14	-	234	See facilities	24,233
Stem	7,456	-	1,190	725	623	-	-	See facilities	9,994
Wake	1,034,928	216,006	134,930	19,154	2,656	1	9,769	See facilities	1,417,444
Wake Forest	6,594	-	5,236	1,597	735	-	16	See facilities	14,178
NC DOT	NA	NA	NA	NA	NA	NA	NA	152,344	152,344
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	173,605	173,605
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	4,750	4,750
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	35,502	35,502
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	101	101
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	881	881
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	536	536
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	825	825
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	18	18
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	Inactive	-
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	1	1
Total	8,260,931	2,948,215	963,272	427,493	132,389	13,133	36,500	368,563	13,150,496

Loads are presented to the single pound for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

Table I-12. Estimated Percent Contributions for Jurisdictional or Permittee Delivered Total Organic Carbon Loads to Falls Lake for the UNRBA Study Period									
Jurisdiction or Permitted Facility	Unmanaged Land, Direct Deposition to Lakes, and Initial System Mass	Agriculture	Developed Open Space, Non-DOT Rights of Way	Development	Streambank Erosion	DSF	Other OWWS	Permitted	Total
Butner	1.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	See facilities	1.5%
Creedmoor	0.4%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	See facilities	0.6%
Durham County	16.6%	4.1%	1.5%	0.5%	0.2%	0.1%	0.0%	See facilities	23.0%
City of Durham	2.5%	0.0%	2.2%	1.7%	0.4%	0.0%	0.0%	See facilities	6.9%
Falls Lake (Direct Deposition)	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.9%
Franklin	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.4%
Granville	10.2%	7.0%	0.5%	0.2%	0.0%	0.0%	0.1%	See facilities	18.1%
Hillsborough	0.2%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	See facilities	0.5%
Orange	12.5%	3.5%	0.9%	0.2%	0.2%	0.0%	0.1%	See facilities	17.4%
Person	10.0%	5.9%	0.6%	0.1%	0.0%	0.0%	0.0%	See facilities	16.7%
Raleigh	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.2%
Roxboro	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.2%
Stem	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.1%
Wake	7.9%	1.6%	1.0%	0.1%	0.0%	0.0%	0.1%	See facilities	10.8%
Wake Forest	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	See facilities	0.1%
NC DOT	NA	NA	NA	NA	NA	NA	0.0%	1.2%	1.2%
North Durham Water Reclamation Facility (WRF)	NA	NA	NA	NA	NA	NA	NA	1.3%	1.3%
Hillsborough Wastewater Treatment Plant (WWTP)	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
South Granville Water and Sewer Authority (SGWASA) WWTP	NA	NA	NA	NA	NA	NA	NA	0.3%	0.3%
Arbor Hills MHP WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Hawthorne Subdivision WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Lake Ridge Aero Park WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Wildwood Green WWTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Orange-Alamance Water System Water Treatment Plant (WTP)	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Heather Glen WTP	NA	NA	NA	NA	NA	NA	NA	NA	0.0%
Waterfall Plantation WTP	NA	NA	NA	NA	NA	NA	NA	0.0%	0.0%
Total	62.8%	22.4%	7.3%	3.3%	1.0%	0.1%	0.3%	2.8%	100.0%

Percentages are presented to the tenth of a percentage for comparisons across the model report and appendices that present the data in various categories. This reporting is not to infer precision in the modeling results.

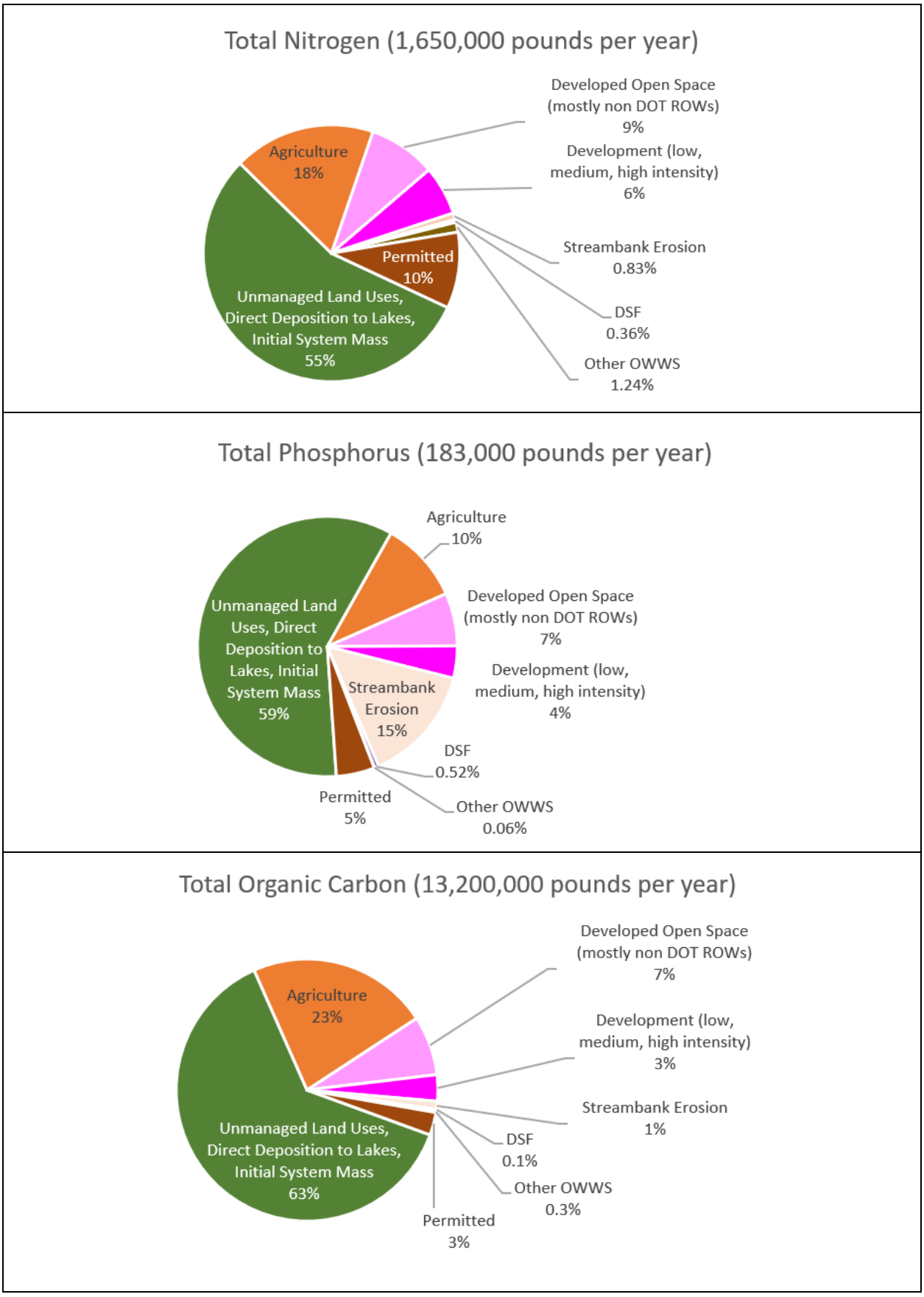

Figure I-31. Total Delivered Point and Non-point Source Loads to Falls Lake

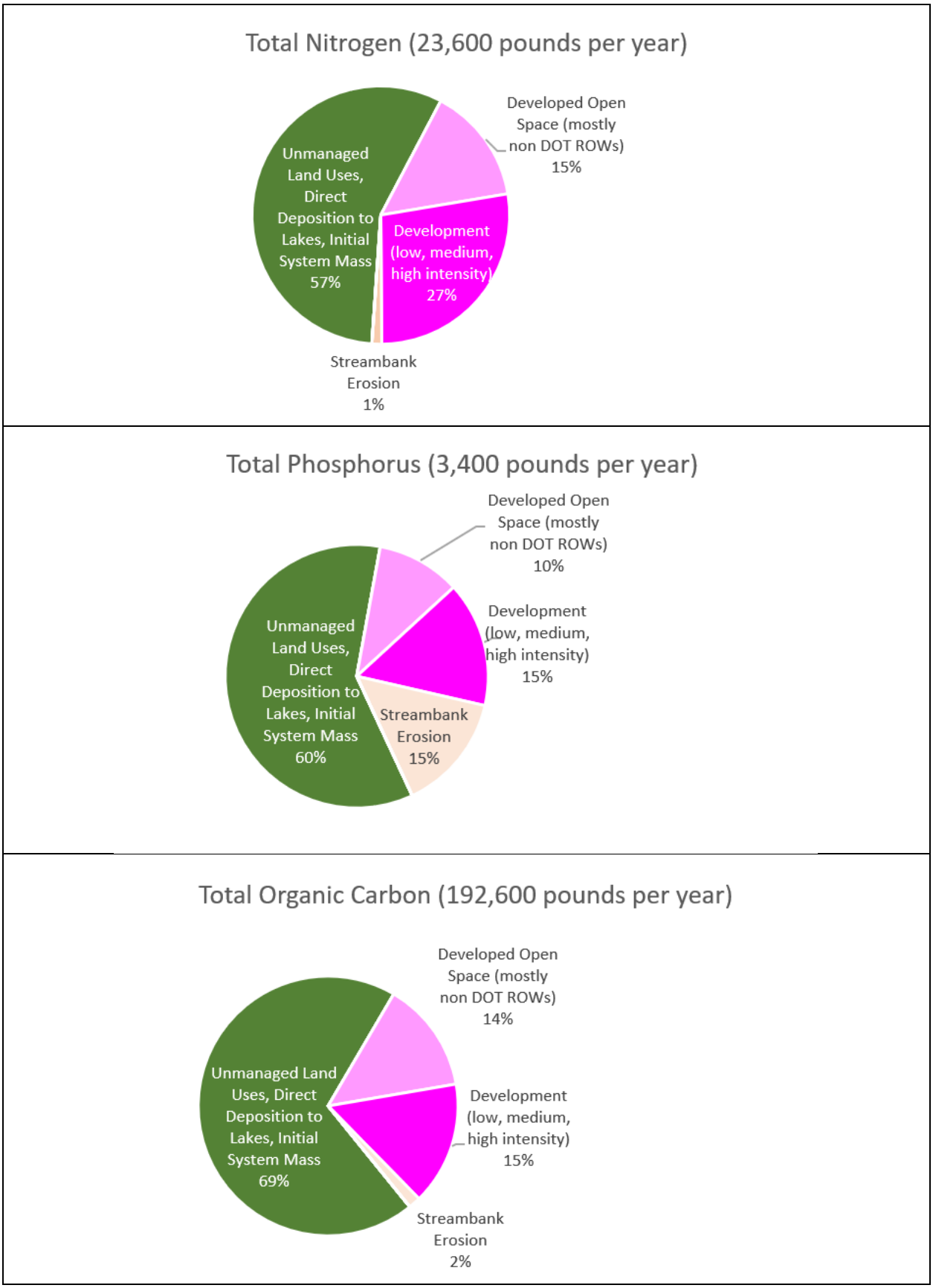

Figure I-32. Delivered Non-point Source Loads from Town of Butner to Falls Lake

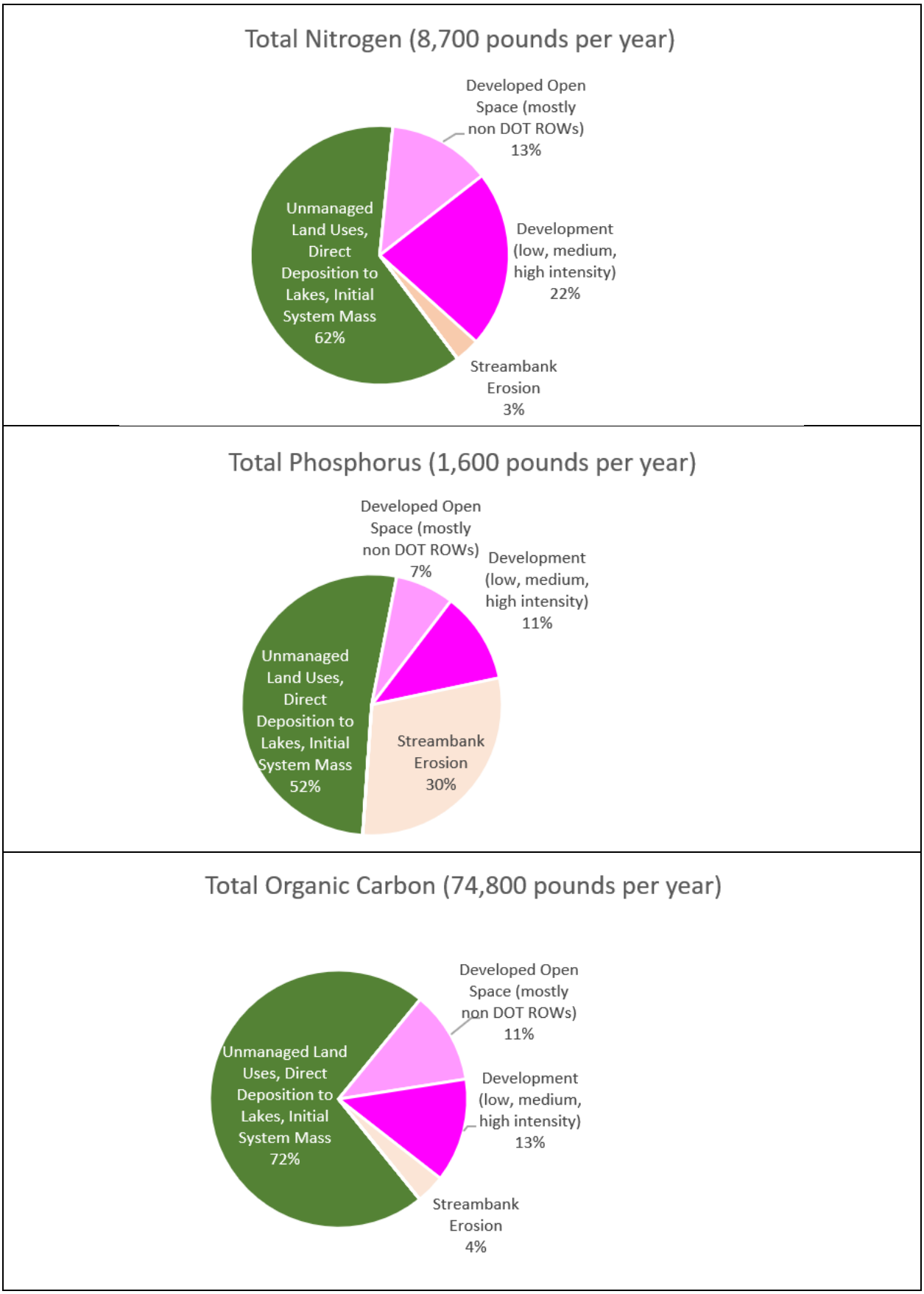

Figure I-33. Delivered Non-point Source Loads from City of Creedmoor to Falls Lake

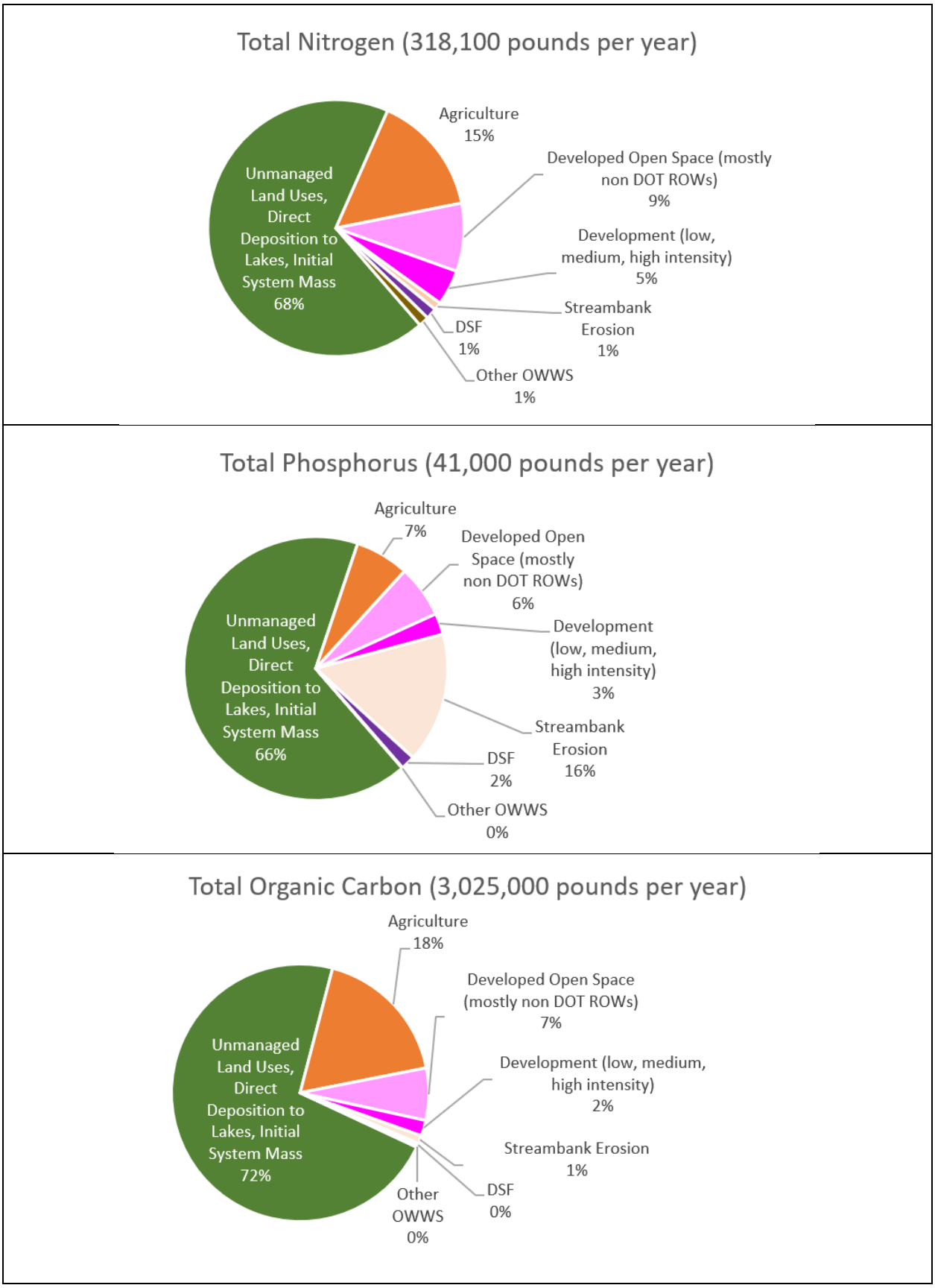

Figure I-34. Delivered Non-point Source Loads from Durham County to Falls Lake

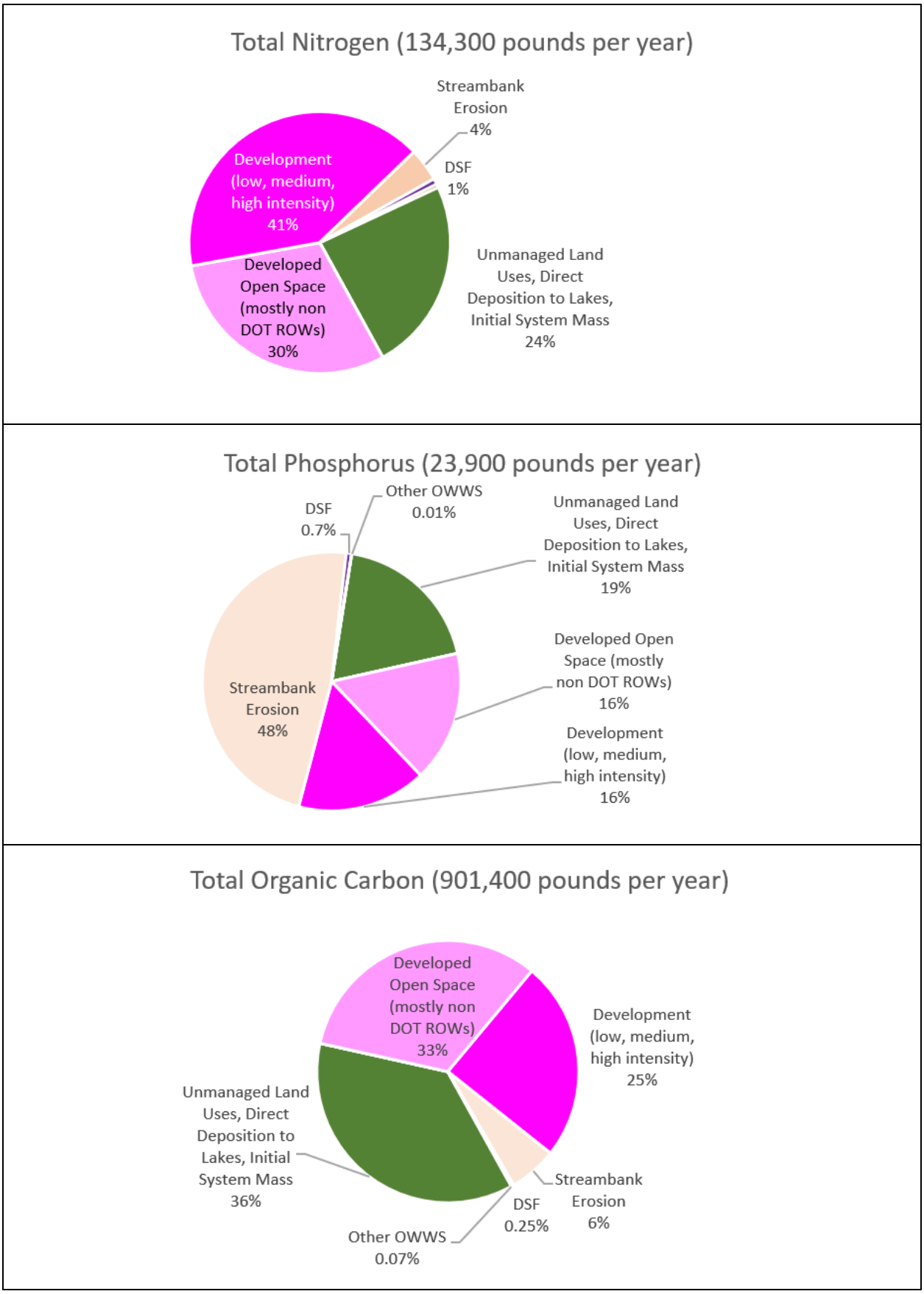

Figure I-35. Delivered Non-point Source Loads from City of Durham to Falls Lake

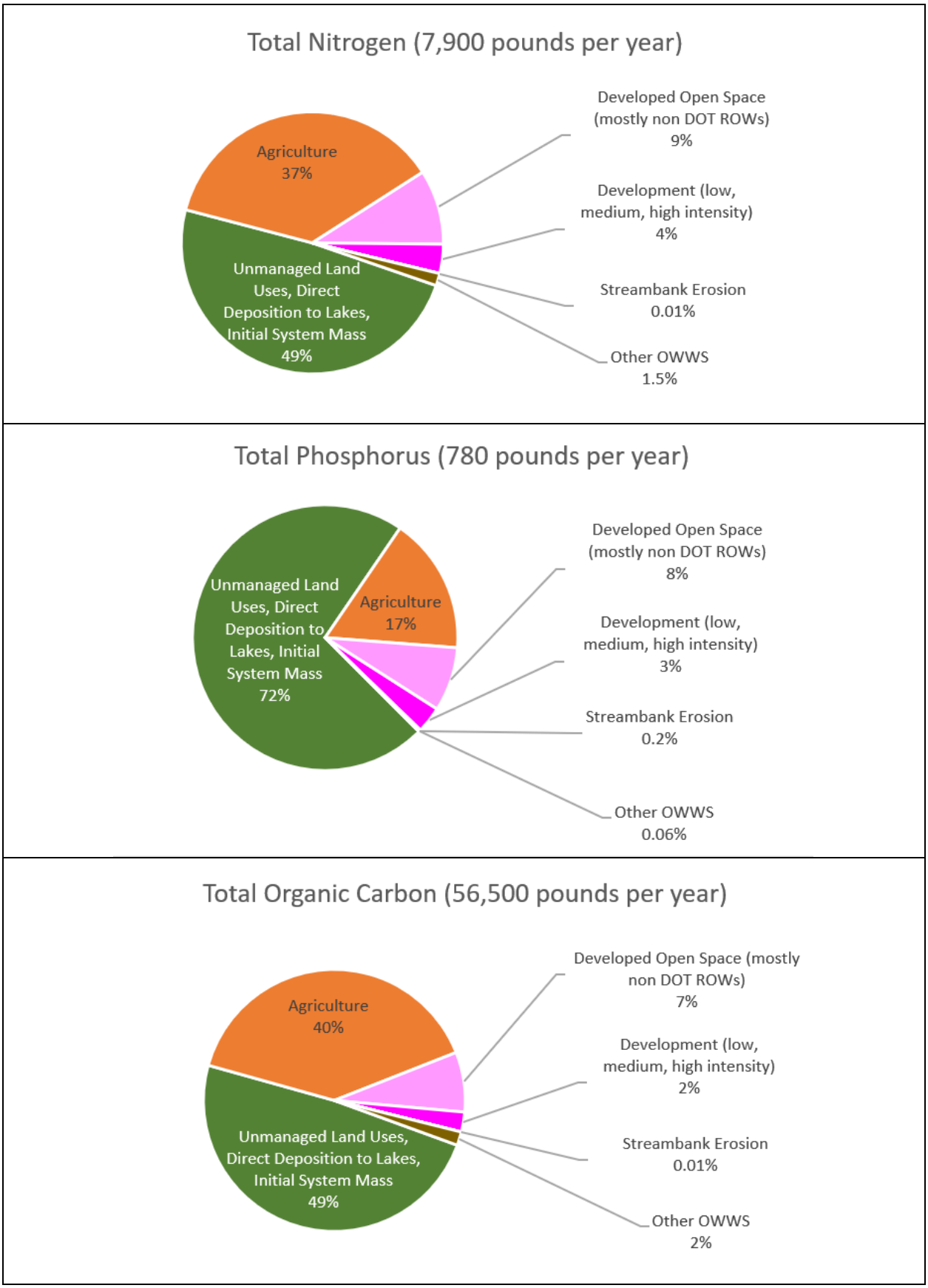

Figure I-36. Delivered Non-point Source Loads from Franklin County to Falls Lake

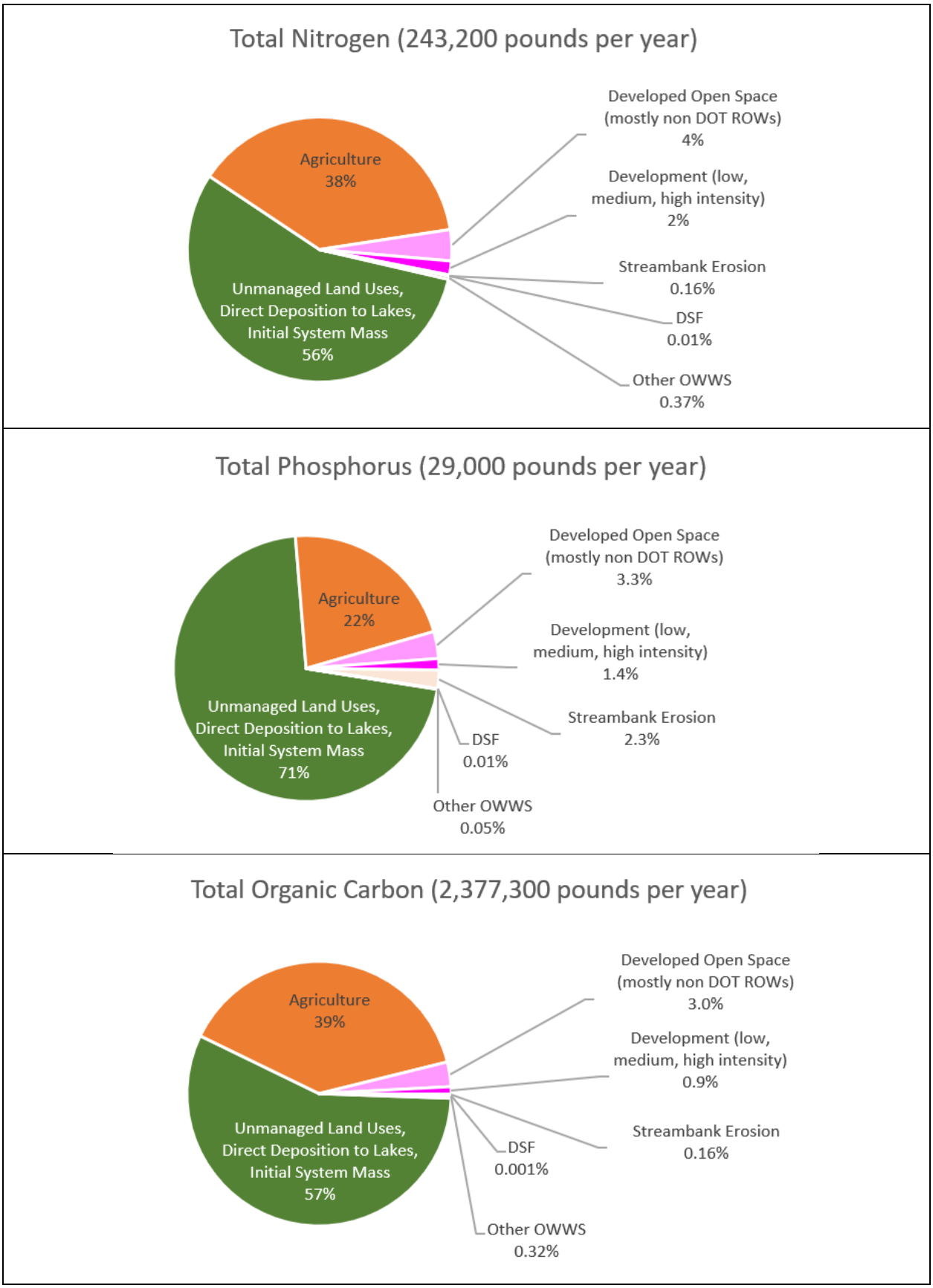

Figure I-37. Delivered Non-point Source Loads from Granville County to Falls Lake

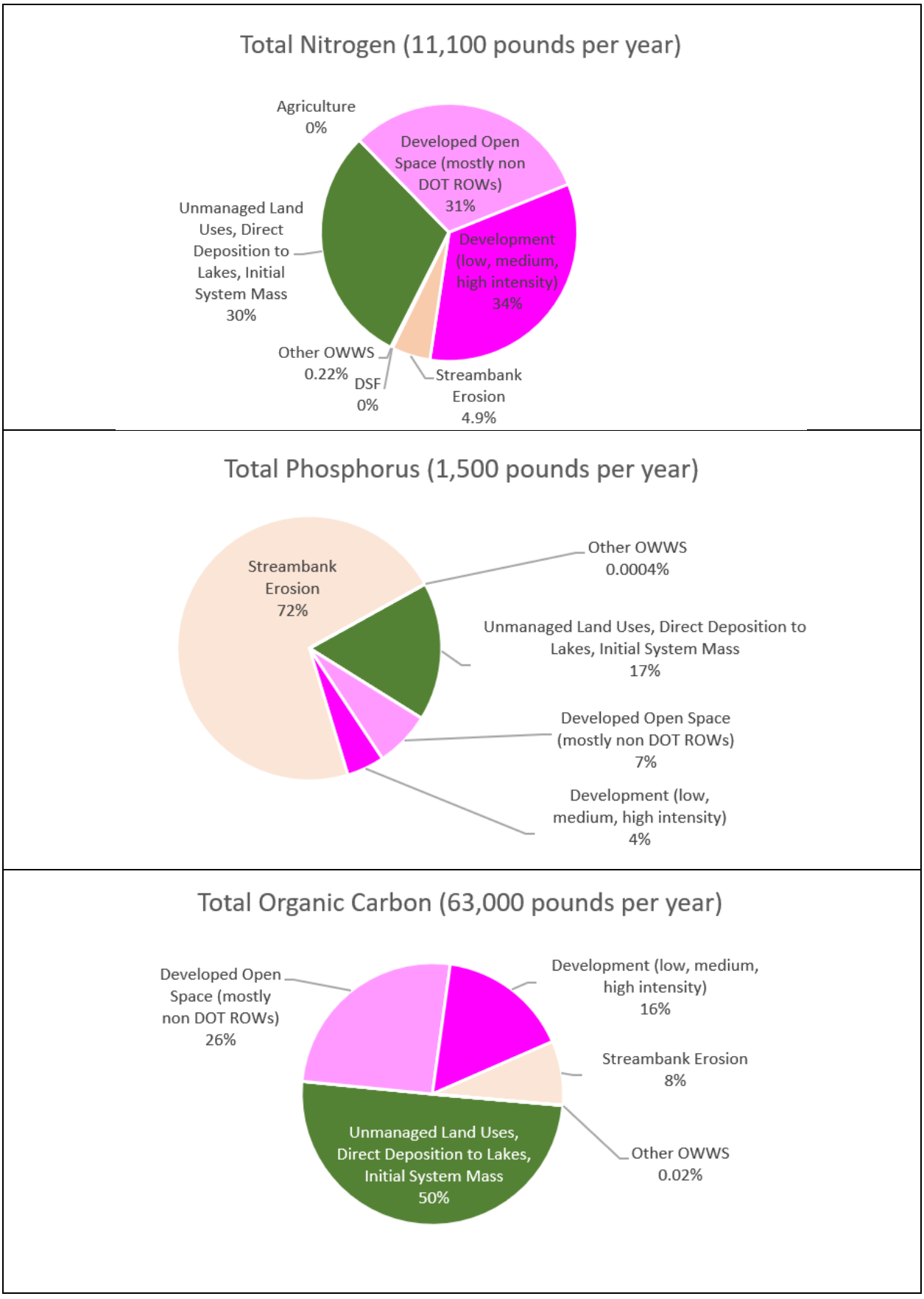

Figure I-38. Delivered Non-point Source Loads from Town of Hillsborough to Falls Lake

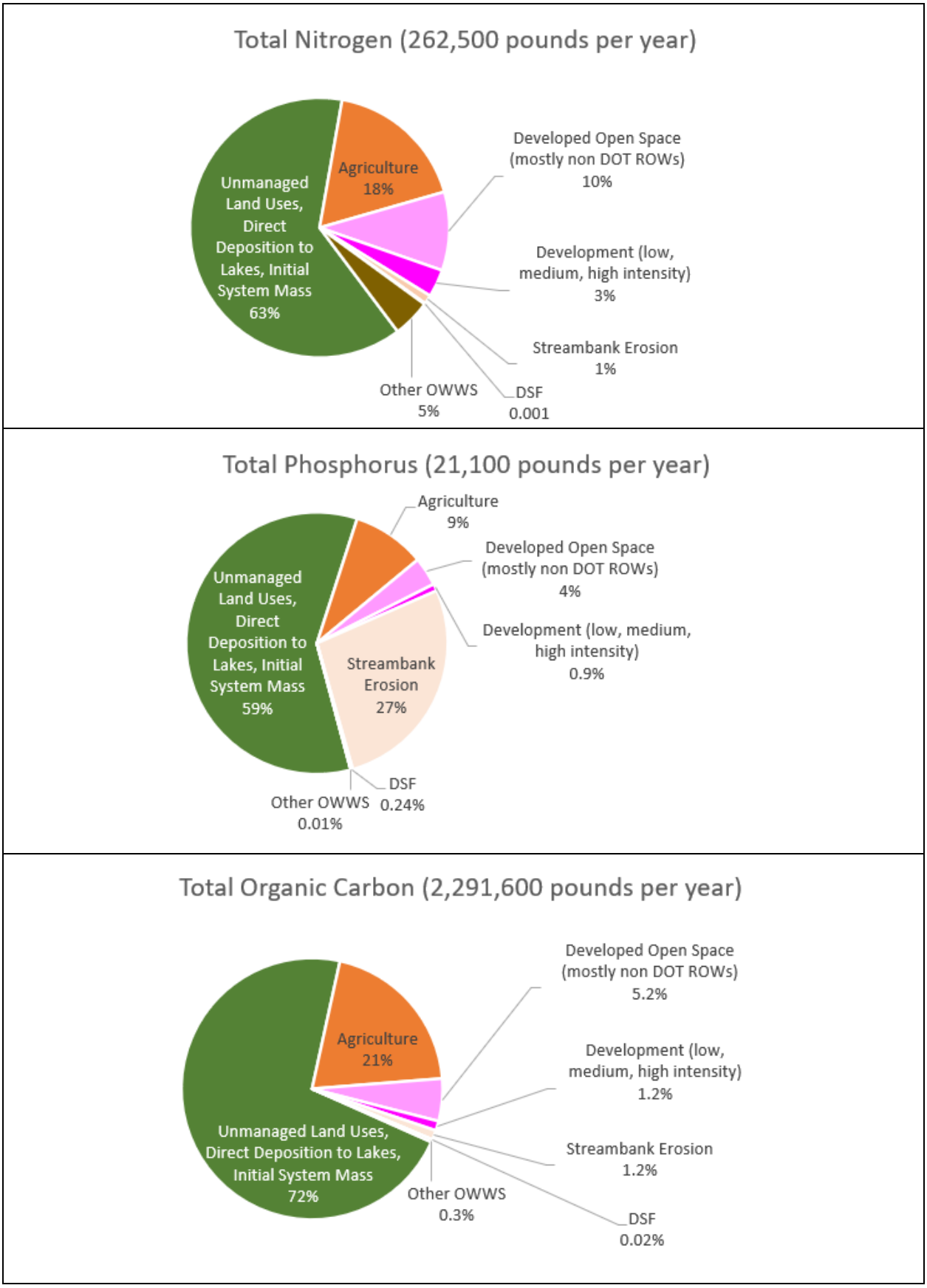

Figure I-39. Delivered Non-point Source Loads from Orange County to Falls Lake

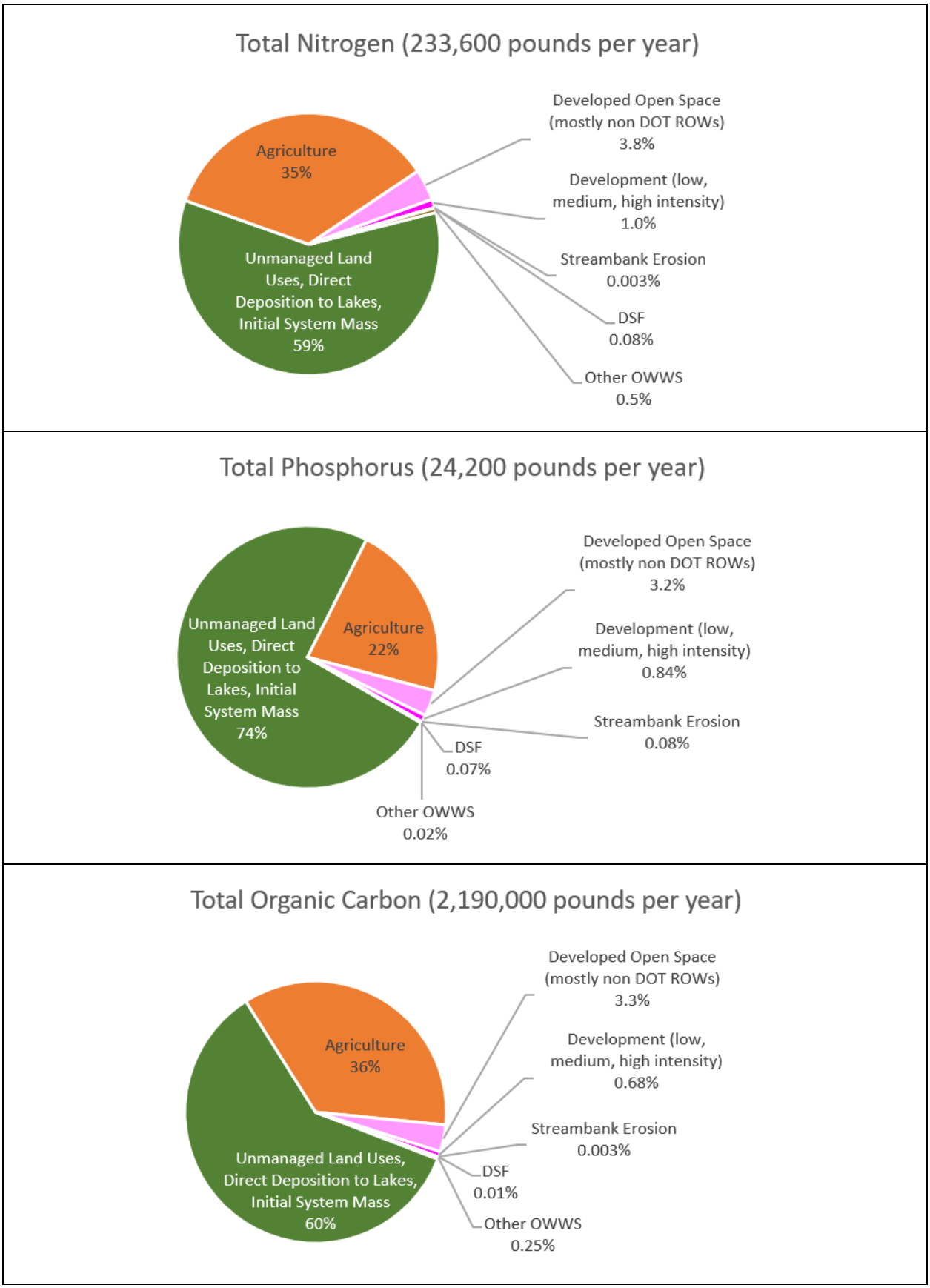

Figure I-40. Delivered Non-point Source Loads from Person County to Falls Lake

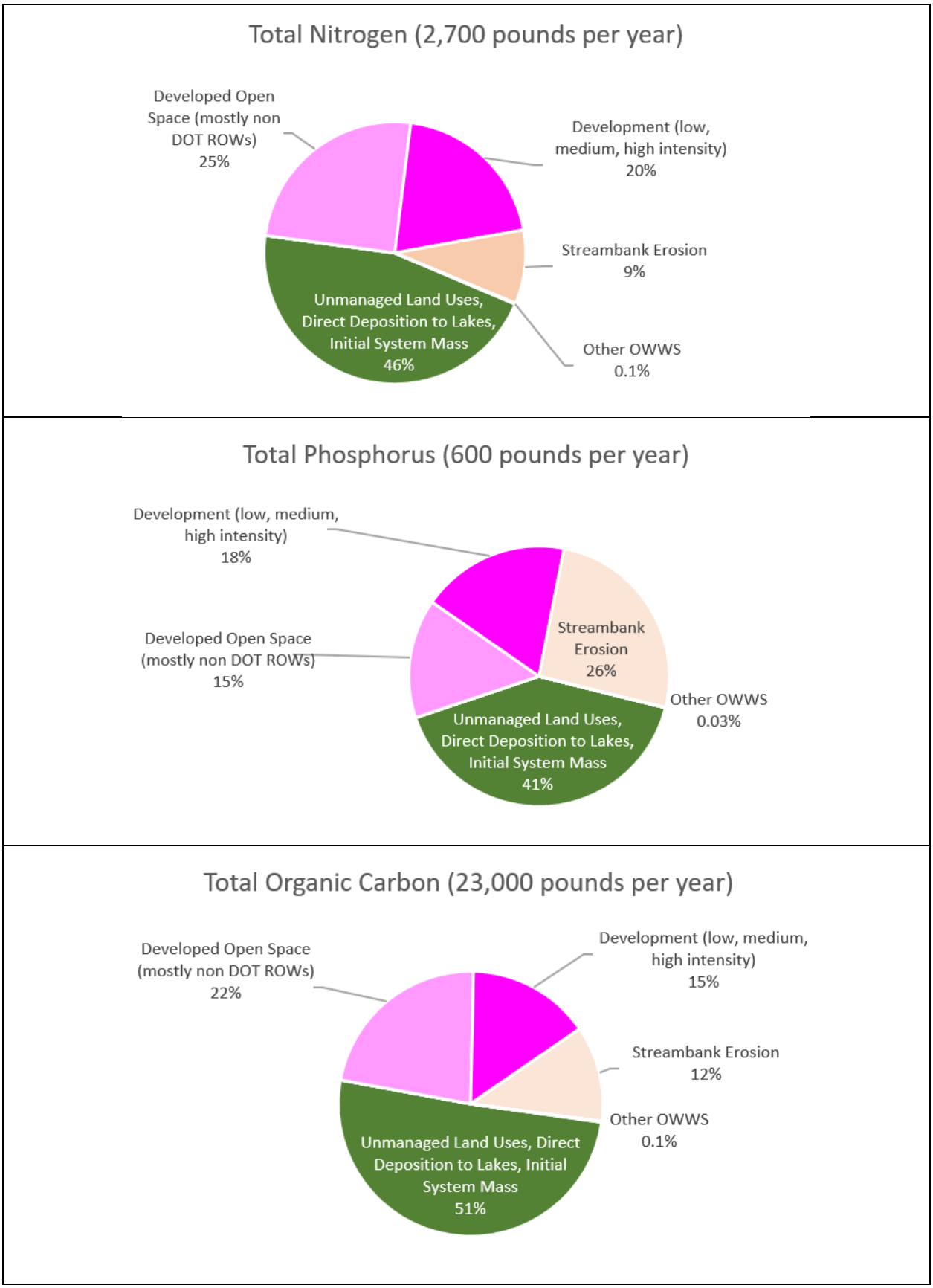

Figure I-41. Delivered Non-point Source Loads from City of Raleigh to Falls Lake

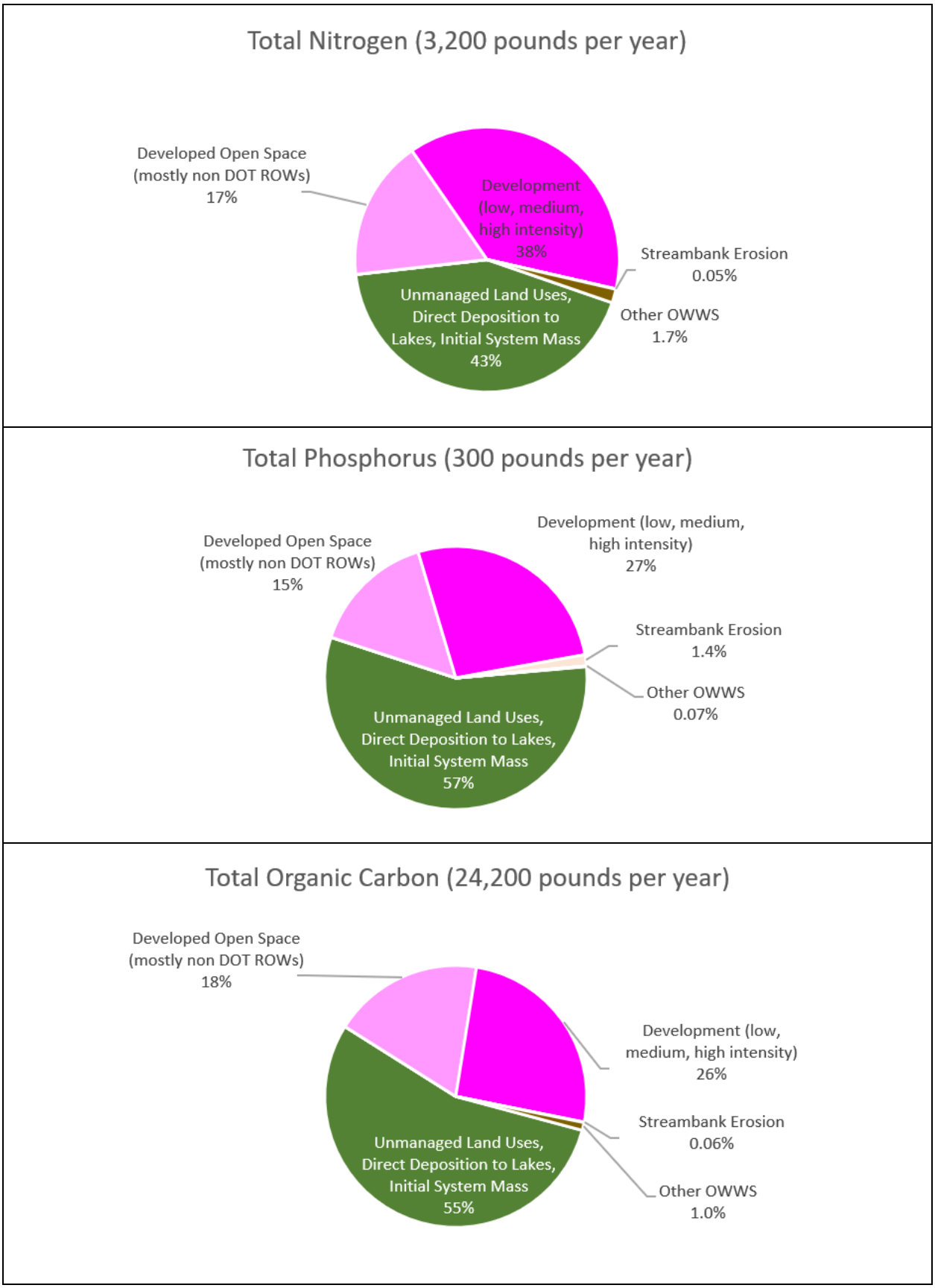

Figure I-42. Delivered Non-point Source Loads from City of Roxboro to Falls Lake

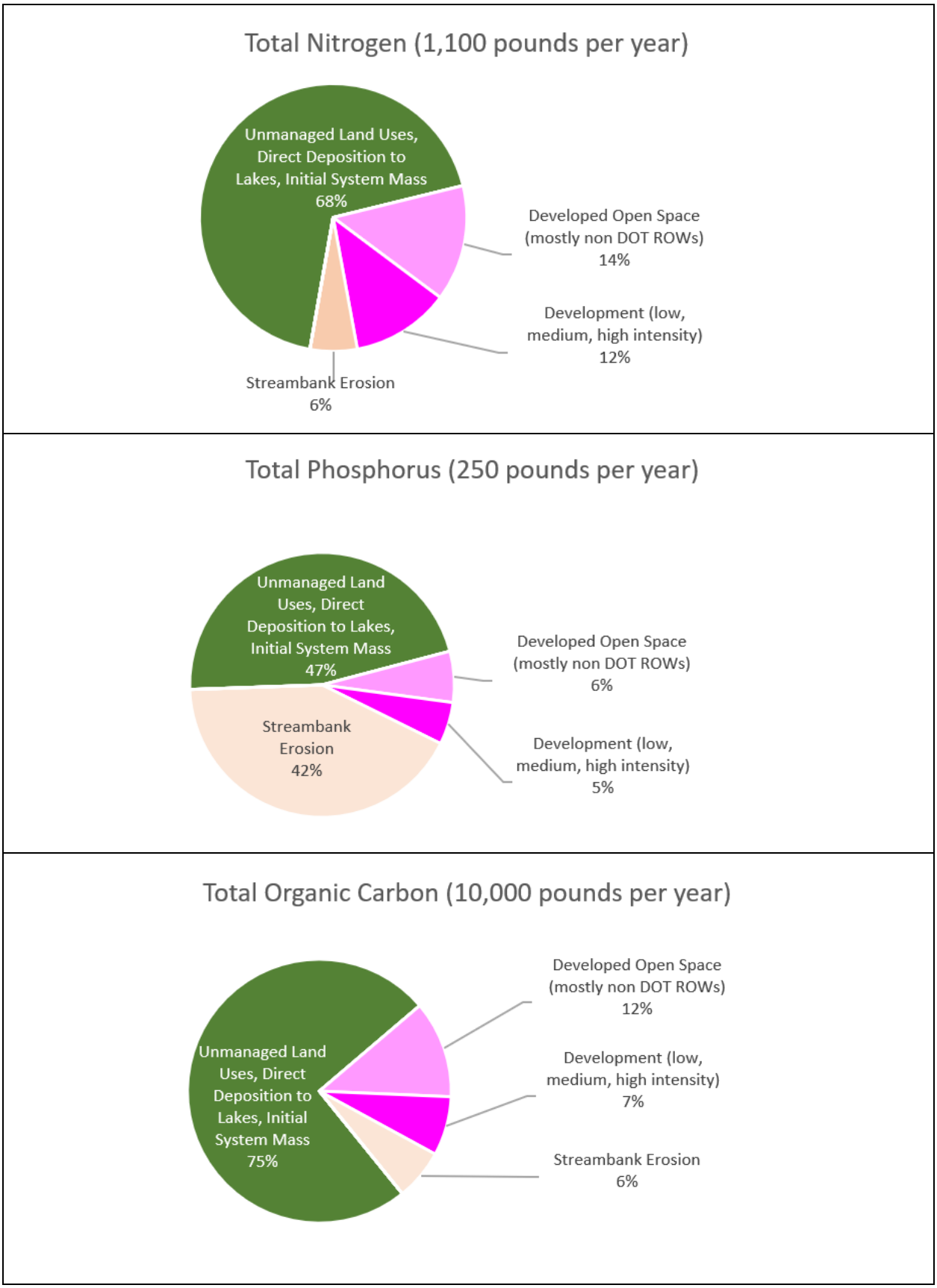

Figure I-43. Delivered Non-point Source Loads from Town of Stem to Falls Lake

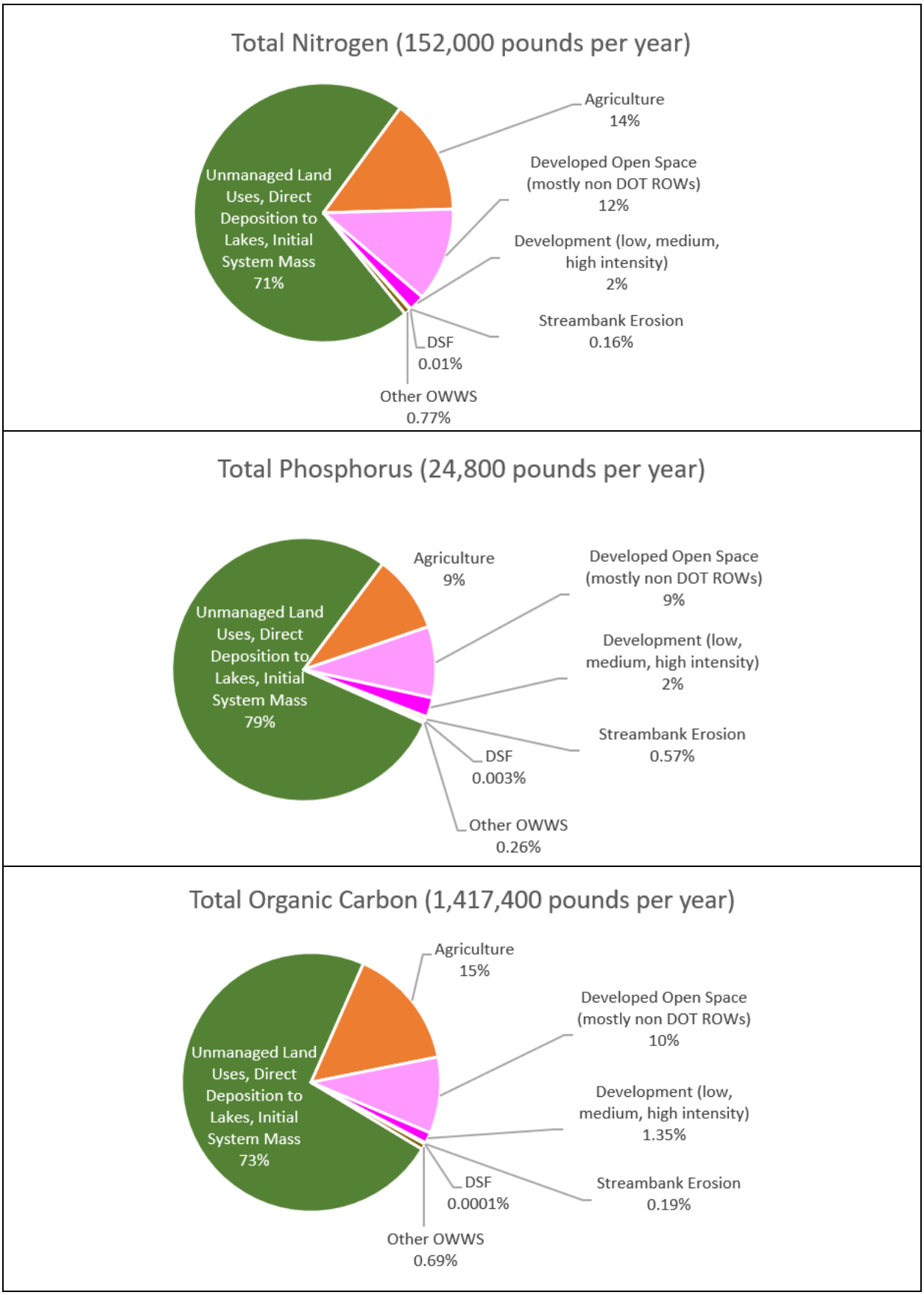

Figure I-44. Delivered Non-point Source Loads from Wake County to Falls Lake

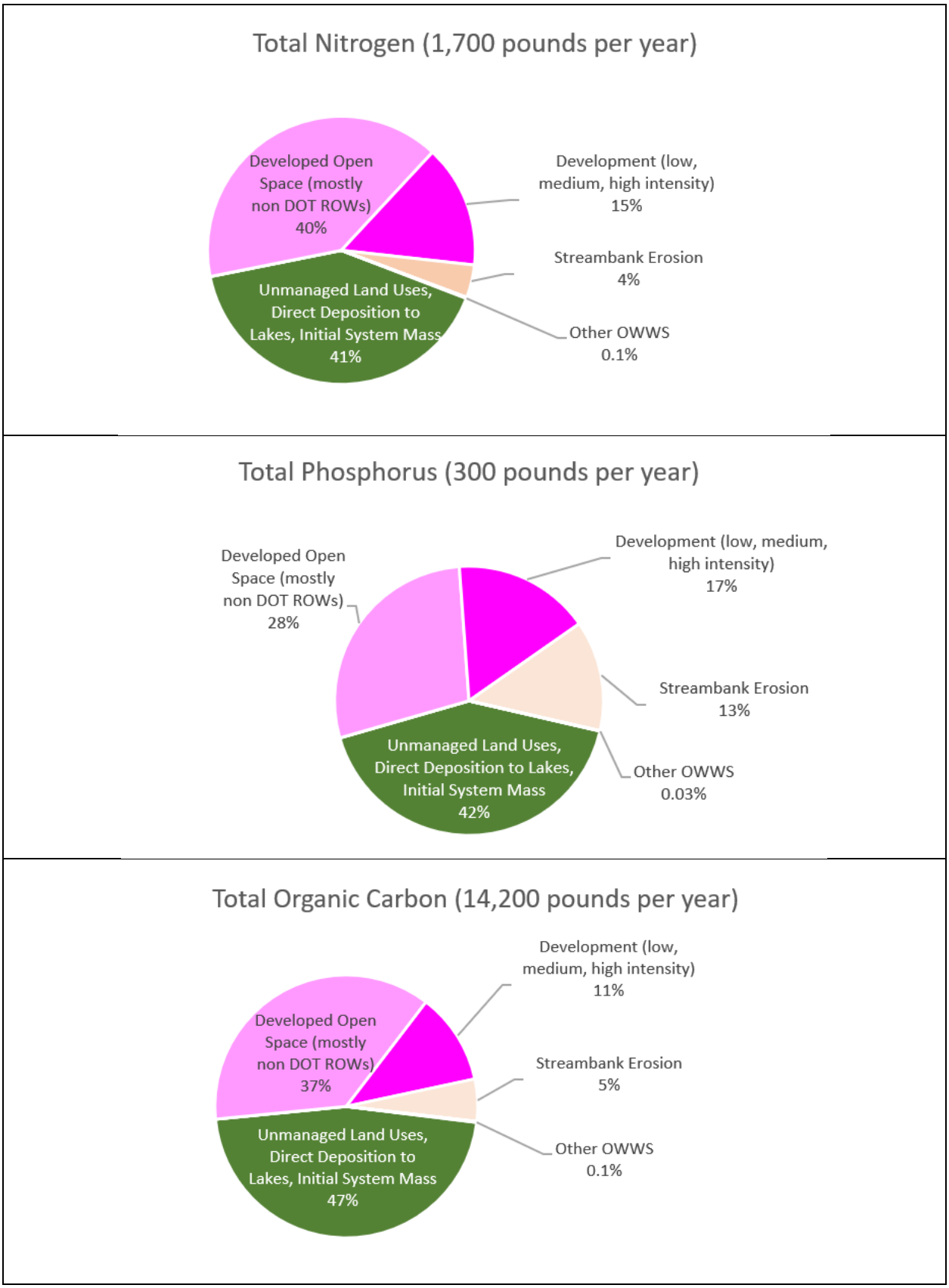

Figure I-45. Delivered Non-point Source Loads from Wake Forest to Falls Lake

Section 4: Estimation of Delivery Factors for 12-Digit HUCs

At the request of DWR, Falls Lake WARMF model output was post-processed using available information to estimate delivery factors for total nitrogen, total phosphorus, and total organic carbon (Table I-13). DWR requested delivery factors be estimated at the scale of 12-digit USGS Hydrologic Unit Codes (HUCs) and referenced previous work conducted by the modeling team as part of the nutrient credit project. The naming convention used in that project was retained for this analysis (Figure I-46). However, there are important differences in the methodology that yield different results.

For example, the previous analysis used USGS SPARROW models to approximate the delivery factors. Estimations were generated for the mid-point of each 12-digit HUC. For the WARMF model, this level of refinement is not possible without additional model runs and significant additional effort. Existing information described in Section 2 was post-processed for these estimates:

- The loads entering and exiting watershed impoundments (West Fork and East Fork Eno River Reservoirs, Lake Michie, Little River Reservoir, and Lake Butner) were used to estimate "trapping" by the impoundment
- The ratio of loads from an upstream county that cross the county line relative to the amount of load that reaches Falls Lake were used to account for transport and processing in streams of downstream counties
- For 12-digit HUCs that are in a single county and do not have an impoundment, sufficient information is not available from the model to develop delivery ratios for different parts of the county. For these HUCs, the delivery ratio is assumed 100% regardless of location in the HUC. Further refinements of these areas are possible but outside the scope of the project.

Table I-13. Estimated Delivery Ratios for USGS 12-Digit HUCs in the Falls Lake Watershed

Label	TN	TP	TOC	Notes
ENR5a	62%	31%	51%	Accounts for delivery from impoundment and downstream reaches
ENR5b	80%	41%	61%	Accounts for delivery from impoundment and downstream reaches
ENR4	93%	55%	92%	Uses Orange County forest loads at county line and delivered to Falls Lake
ENR3	93%	55%	92%	Uses Orange County forest loads at county line and delivered to Falls Lake
ENR2	93%	55%	92%	Uses Orange County forest loads at county line and delivered to Falls Lake
ENR1	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake
LTR3a	62%	40%	62%	Delivery based on what goes into and out of Little River Reservoir
LTR3b	62%	40%	62%	Delivery based on what goes into and out of Little River Reservoir
LTR2	62%	40%	62%	Delivery based on what goes into and out of Little River Reservoir
LTR1	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake
FLR2a	81%	68%	78%	Uses delivery of Person County forest loads to Falls Lake
FLR2b	81%	68%	78%	Uses delivery of Person County forest loads to Falls Lake
FLR2c	81%	68%	78%	Uses delivery of Person County forest loads to Falls Lake
FLR1	81%	68%	78%	FLR1 includes the impoundment so delivery is less than 100%
KRC2	65%	50%	68%	Uses delivery of Person County forest loads to Falls Lake
KRC1	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake
NLC (Granville County)	93%	80%	92%	Uses delivery of Granville County forest loads to Falls Lake
NLC (Wake County)	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake
HSE (Franklin County)	93%	72%	83%	Uses delivery of Franklin County forest loads to Falls Lake
HSE (Wake County)	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake
All other tributaries	100%	100%	100%	Furthest downstream HUC assumes 100% delivery; simulated loads discharge to Falls Lake

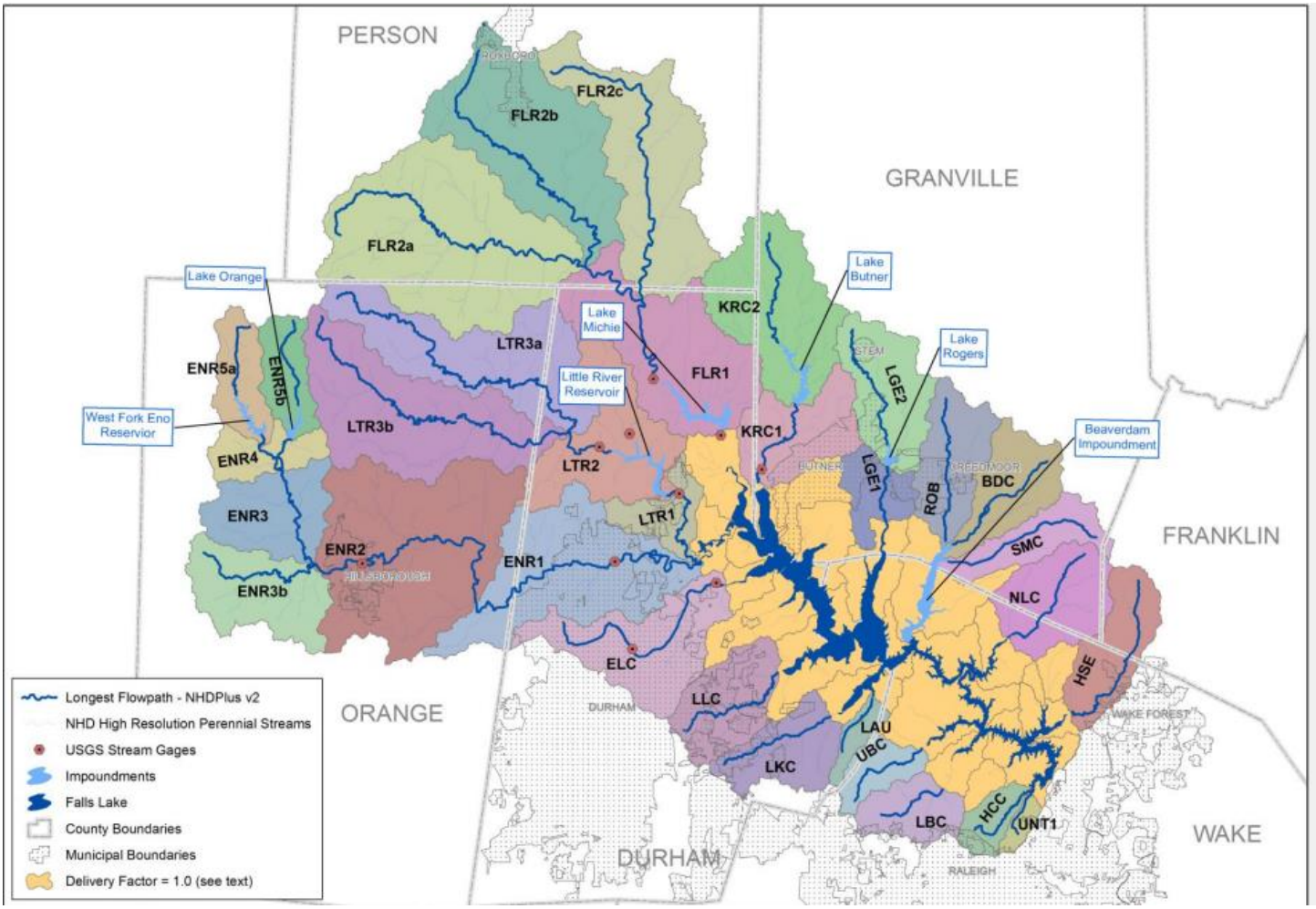

Figure I-46. Labels for 12-Digit HUCs in the Falls Lake Watershed (Copied from Cardno ENTRIX and Center for Watershed Protection 2014)[1]

[1] Cardno ENTRIX and Center for Watershed Protection. 2014. Memorandum: UNRBA Nutrient Credits Project, Task 1.1, Watershed Trapping Analysis, Date: December 15, 2014, to: Forrest Westall, UNRBA, from: Alix Matos, Cardno ENTRIX and Neely Law, Center for Watershed Protection, Inc.