when compared to organic nitrogen (1.08-16.28) and nitrate (0.28-9.97). The total masses measured into and out of the system for the 10 events with complete nitrogen speciation, as well as the corresponding removal rate for each species of nitrogen, are shown in Table 4-12.

Table 4-12 Summary of Nitrogen Speciation Masses Measured Into and Out of the Basin System and the Associated Removals for Each Species for Ten Events With Complete Nitrogen Speciation Data

	Volume	TSS	Total N	Organic N	Nitrate	Ammonium
Mass In*(kg)	$24x10^6$ L	20,000	151	77	61	14
Mass Out (kg)	$11x10^6$ L	6,000	53	36	18	2.5
Removal	54%	68%	65%	54%	70%	82%

*Mass In includes drainage area correction factor of 112/90 (See Section 1.3.2)

The removal of Organic N is equal to the volume reduction of 54% (Table 4-8); therefore, it can be assumed that the volume reduction caused by the basins is the primary mechanism for removal of Organic N. The removal of nitrate is significantly higher than the volume reduction (~15%); this possibly indicates some other treatment of nitrate is occurring within the basins, such as denitrification by microorganisms or uptake by plants between storm events. However, a definite conclusion as to which mechanism is taking place cannot be drawn from the data collected in the scope of this project.

Ammonium shows a much higher removal than any other contaminant or even the volume of runoff (~30% higher than volume reduction). The high removal rate of ammonium could be an indication of biological activity converting the ammonium to other species of nitrogen between storm events, such as nitrate which is then consequently removed from the runoff either through denitrification or leaching. It is worth noting, however, that the mass of ammonium measured during these ten events is only about 10% of the total ammonium mass

DIP makes up the majority of DP (80%), and exhibits the highest removal of all the types of phosphorus. As previously stated, DIP represents the form of phosphorus that is most bioavailable, and therefore that which is most readily taken up by plants and microorganisms. This species of dissolved phosphorus could be taken up by the plant life existing in the basins

Table 4-8. Reductions Based on Total Volume and Mass Measured Into and Out of the Basin System and Including the Drainage Area Ratio

	Volume (L)	TSS (kg)	TP (g)	PP (g)	DP (g)	DIP (g)	DOP (g)
Total Volume/Mass in	40.7×10^6	21,800	64,800	43,100	17,300	14,200	3,500
Total Volume/Mass Out	17.9×10^6	7,700	25,900	18,300	6,300	4,800	1,600
Reduction	56%	65%	60%	57%	63%	66%	54%

between storm events. During some summer months, algae was noted growing within the basins. Algae growth would utilize significant portions of the inorganic phosphorus entering the basins and therefore would also lead to some removal of the dissolved phosphorus entering the basins (Norton, 2014). Other microorganisms such as bacteria and fungi can also take up dissolved phosphorus similar to algae and contribute to the removal (Norton, 2014). Dissolved phosphorus could also be removed through adsorption onto particles followed by sedimentation. Conclusions cannot be drawn at this point as to which mechanisms, in addition to volume reduction and sedimentation, are having the most effect on the reduction of phosphorus, although it is safe to assume some other processes are taking place given the difference between volume and TSS reduction and P reduction values.

Table 4-15. Summary of Concentrations, Masses, and Removals for Storm Events Classified as Summer (April-September) or Winter (October-March) at the Hambleton Creek Study Site

	Summer										
	TP	TKN	TSS	PP	DP	DIP	DOP	NH4	NO3	ORG N	TN
Mean EMC In (mg/L)	2.84	5.70	1150	1.92	0.91	0.80	0.11	0.95	3.26	4.91	8.14
Mean EMC Out (mg/L)	2.05	4.86	850	1.47	0.58	0.37	0.20	0.96	3.51	4.37	7.78
Mass In (mg)	$37x10^6$	$83x10^6$	$15x10^9$	$26x10^6$	$10x10^6$	$8.2x10^6$	$2.3x10^6$	$7.3x10^6$	$33x10^6$	$75x10^6$	$116x10^6$
Mass Out (mg)	$21x10^6$	$42x10^6$	$6.5x10^9$	$15x10^6$	$5.2x10^6$	$4.0x10^6$	$1.3x10^6$	$2.3x10^6$	$20x10^6$	$39x10^6$	$62x10^6$
Total Mass Removal	44%	49%	57%	41%	49%	51%	45%	69%	40%	48%	46%
*Difference From Vol. Red.	14%	19%	27%	11%	19%	21%	15%	39%	10%	18%	16%
	Winter										
	TP	TKN	TSS	PP	DP	DIP	DOP	NH4	NO3	ORG N	TN
Mean EMC In (mg/L)	1.02	3.05	150	0.79	0.23	0.20	0.13	0.52	0.28	2.64	3.07
Mean EMC Out (mg/L)	0.82	2.77	157	0.61	0.21	0.18	0.04	1.08	0.18	1.69	2.80
Mass In (mg)	$16x10^6$	$46x10^6$	$2.5x10^9$	$12x10^6$	$3.6x10^6$	$3.0x10^6$	$2.7x10^6$	$6.6x10^6$	$0.32x10^6$	$39x10^6$	$46x10^6$
Mass Out (mg)	$6.1x10^6$	$14x10^6$	$1.2x10^9$	$5.0x10^6$	$1.1x10^6$	$0.9x10^6$	$0.23x10^6$	$5.0x10^6$	$0.34x10^6$	$9.4x10^6$	$15x10^6$
Total Mass Removal	61%	69%	53%	59%	69%	70%	91%	25%	-6%	76%	68%
**Difference From Vol. Red.	1%	9%	-7%	-1%	9%	10%	31%	-35%	-66%	16%	8%

*Row approximates the portion of mass removal that can be attributed to treatment by subtracting the volume reduction of 30% from the total mass removal

**Row approximates the portion of mass removal that can be attributed to treatment by subtracting the volume reduction of 60% from the total mass removal