

WATER QUALITY IN LOANTAKA BROOK HEADWATERS

2005–2006 Monitoring Results

Prepared By:

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This report summarizes the results of work carried out with the support of members of GSWA's Corporate Council through the Association's Adopt-a-Stream program. The authors wish to thank Stream Team volunteers Gene Fox, Ellen Drury, Terry Dyben and Al Pawlowski for their important contributions to this work. The report was submitted to the New Jersey Department of Environmental Protection on April 23, 2007.

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1. Introduction

The Great Swamp Watershed Association (GSWA), under its Adopt-a-Stream program¹, is conducting water quality monitoring at several sites in the headwaters of Loantaka Brook. The monitoring was initiated in 2003 in response to observations of high levels of dissolved solids in the stream, and expanded in 2005 to allow for a more comprehensive evaluation of dissolved solids. In addition, the levels of nitrogen- and phosphorus-bearing nutrients were measured at the same sites since it was known, from the stream monitoring performed further downstream since 1999 by the Ten Towns Great Swamp Watershed Management Committee (TTC) and GSWA, that concentrations of these nutrients in Loantaka Brook are significantly higher than found in the other watershed streams. Background information pertaining to this study and the data obtained through December 2005 from the headwaters monitoring were summarized in a February 2006 report². Additional data obtained during 2006, combined with the 2005 data previously reported to the Department, are discussed in the following sections.

2. 2005–2006 Headwaters Monitoring Results

Loantaka Brook rises in Morris Township, NJ, near the southern border of Morristown, and flows southward for approximately 5 miles to Green Village, where it joins Great Brook in the Great Swamp National Wildlife Refuge. Monitoring has been regularly conducted at four headwaters sites designated, in upstream-to-downstream order, LB6 (in Turtle Basin, a residential area), LB5 (where Loantaka Brook flows under Woodland Avenue), LB4 (about 200 yards downstream from the outlet of the Woodland Water Pollution Control Utility (WPCU), and LB2 (just below the outlet from Kitchell Pond). In addition, during 2006, two other sites were sampled one time each. In August 2006, samples were collected at LB5A, located approximately 125 yards upstream from LB5. In November 2006, the WPCU effluent was sampled directly prior to entering the stream. This site was designated LB4P. Figure 1 illustrates the location of these various sampling sites.

Sampling was performed quarterly, under baseflow conditions only. The samples were analyzed by Environmental Compliance Monitoring, Inc., to determine the concentrations of the following parameters: total dissolved solids (TDS), calcium, magnesium, sodium, potassium, chloride, sulfate, nitrate, nitrite, alkalinity, Kjeldahl nitrogen, soluble reactive phosphate, total phosphorus, and total suspended solids (TSS). The carbonate component of TDS³ was derived from the alkalinity measurement. Beginning in November 2005, a hand-held conductivity meter was utilized for on-site TDS assessments, in addition to the laboratory measurements. Unless otherwise stated, references made to TDS results in this report refer to the laboratory measurement, also termed “TDS (residue)”. Comparing the sum of the concentrations of the constituent ions with the measured TDS (residue) concentration can provide a degree of

¹ GSWA’s Adopt-a-Stream program, with the support of local corporations, is aimed at restoring some of the streams flowing into the Great Swamp National Wildlife Refuge and improving their water quality.

² Water Quality in Loantaka Brook Headwaters, 02/06/06, submitted to NJDEP on February 9, 2006.

³ Carbonates have low solubility in most surface waters, but by reacting with dissolved carbon dioxide and water can form bicarbonate ions, which have a much higher solubility. During a TDS measurement, water is evaporated, the chemical reaction is reversed and carbonates are formed as part of the residue.

confidence that the major contributors to TDS have been accounted for. Water temperature at each sampling site has also been measured since November 2005.

2.1 TDS and Constituents

Table I summarizes the TDS and constituent ion data acquired during 2005–2006. The following points may be noted:

- TDS values are consistently high. Upstream of the Woodland WPCU, TDS concentrations range from about 600 to 1300 mg/l. Downstream from the plant discharge, the levels are somewhat lower, 500 to 750 mg/l.
- On 11/07/2006 the TDS and constituents' concentrations in samples taken directly from the Woodland WPCU effluent (at LB4P) agreed closely with those found at LB4, approximately 200 yards downstream from the discharge. These data, together with the appreciably different values seen at the upstream sites, suggest that there was very little dilution of the effluent by the flow from upstream on that day.
- Sodium and chloride ions have consistently been identified as the dominant contributors to TDS in these studies, accounting for 50% to 75% of the Sum of Constituents. High concentrations of TDS, sodium and chloride such as those seen upstream of the plant discharge (at LB5, LB5A and LB6) are often associated with road salt. At the plant discharge, our single sampling of the plant effluent on 11/07/2006 showed substantial sodium and chloride content, albeit of smaller concentration than observed at the upstream sites. Salt contamination is discussed further in Section 4 below.
- The rightmost column of Table I shows the Sum of Constituents to be within 20% of TDS (residue) in most cases, indicating that there are unlikely to be any unmonitored contributors to TDS at significant concentrations.
- Comparing the TDS (meter) and TDS (residue) results shows some quantitative discrepancies, but in general the correlation between the two measurements appears to be adequate for the conductivity meter to be used for low-cost approximate assessments of TDS.

2.2 Nutrients and TSS

The 2005–2006 nitrogen- and phosphorus-bearing nutrient and TSS concentrations are given in Table II.

- Nitrate and total nitrogen concentrations downstream from the Woodland WPCU discharge (and in the plant effluent on 11/07/2006) are consistently high. The somewhat reduced levels at LB2 compared with those at LB4 could be the result of dilution by water draining into the stream between LB4 and LB2. The levels of nitrate and total nitrogen nutrients upstream from the plant discharge are significantly lower.

- Phosphate and total-phosphorus concentrations are highly variable at all sampling sites. Higher levels are generally seen downstream from the plant discharge when compared to upstream, although unusually low phosphorus values were measured on 11/07/2006. Some seasonal variability is evident in the higher August 2005 and August 2006 concentrations.
- Water temperature measurements show that in the cooler months (February and November) the temperature at LB4 (and LB4P in November 2006) was higher than at the other sites, indicating the Woodland WPCU effluent to be significantly warmer than the flow from upstream.
- TSS values vary widely from levels below the detectable threshold (less than 2 mg/l) to over 40 mg/l. On 11/07/2006 the high value of 26 mg/l observed at LB5 was consistent with the observation made during the sample collection that the water at that site had an unusually milky appearance.

3. Recently reported USGS monitoring of Loantaka Brook

The United States Geological Survey (USGS) publishes results of its chemical sampling of numerous New Jersey water bodies in annual Water Data Reports. Beginning in October 2004, in collaboration with NJDEP, USGS conducted quarterly sampling of Loantaka Brook at a site near the northeast end of Blue Stone Terrace in Morris Township. This site, designated AN0220 as one of NJDEP's Ambient Biomonitoring Network locations, is approximately 700 yards downstream from the Woodland plant discharge and about 500 yards downstream from GSWA's LB4 location. Data from samples collected between October 2004 and September 2005 were published⁴ in May 2006. A portion of these data, pertaining to the TDS, constituent ions, N- and P- nutrients and TSS being monitored by GSWA, are reproduced in Tables III and IV.

Although a rigorous comparison of the USGS and GSWA chemical results cannot be made, since the two sets of samples were collected on different dates and at different locations, examination of the USGS Table III data shows the concentrations of TDS and ionic constituents to generally agree with GSWA's measurements at LB4 (Table I). Similar high values of TDS are seen, with sodium and chloride being the major constituents.

With respect to nutrients, the data in Tables II and IV exhibit less variability in the USGS data than in GSWA's LB4 results. Nitrates and total nitrogen concentrations reported by USGS and GSWA are generally comparable in magnitude. In the case of phosphates and total phosphorus, the unusually high concentrations found by GSWA in the August 2005 sample were not seen by USGS, but the other quarterly USGS samplings yielded consistently higher levels of the P-nutrients (0.3 to 0.5 mg/l) than those obtained by GSWA.

⁴ USGS Water Resources Data, New Jersey, Water-Data Report NJ-05-3

4. Discussion

Except during and after storms, Loantaka Brook is a low-volume, slow-moving stream, especially in the headwaters; such characteristics mean that any contaminated water entering the stream will not be diluted or flushed downstream as effectively as would occur in a larger, faster-flowing stream. The stream's sources are located close to Madison Avenue (Route 124) and South Street; nearby are a number of office buildings and apartment complexes. Deicing salts deposited on roads and parking lots in the area are likely to be washed into the soils surrounding the headwaters and into the brook, contributing most of the sodium and chloride components of the high TDS. The lack of a strong seasonal fluctuation in the sodium and chloride concentrations is consistent with some of the salt washed off local roads remaining in the soil and slowly leaching into the stream throughout the year. As was mentioned in GSWA's February 2006 report on Loantaka Brook, the upper reaches of two watershed streams, that are less exposed to road salts and that have higher flow volumes (Primrose Brook and Upper Passaic River), contain much smaller amounts of TDS, sodium and chloride.

Below the Woodland WPCU discharge, road salt may be only one of several contributors. Our single sampling of the plant effluent on 11/07/2006 shows substantial sodium and chloride content, albeit of smaller concentration than at the upstream sites. Potential origins could include road salt if any storm water inadvertently infiltrates the plant influent, or there could be other sources such as brine flushed from water softeners, laundry detergent, bleaches, and other household cleansing materials.

The levels of N- and P-nutrients do not meet several pertinent water quality standards and reference values. Table V lists the relevant New Jersey Surface Water Quality Standards for FW2-NT streams, the US EPA reference levels for the Northern Piedmont Ecoregion, and the Ten Towns Committee 2002 baseflow water quality standard objectives for Loantaka Brook. The measured nutrient concentrations listed in Tables II and IV for sites downstream from the Woodland WPCU discharge often fail to meet all the applicable standards.

The Woodland WPCU publishes its own data on the water quality of the plant effluent. Average nitrate concentrations during the period August 2003 through July 2005 ranged from 9.6 to 15.7 mg/l with a mean value of 12.5 mg/l. Both the GSWA and USGS results for samples at and below the plant discharge are in general agreement with the plant data. The Woodland WPCU has published total phosphorus concentrations in the effluent for a number of years. The plant's reported average phosphorus concentrations in 2006 were somewhat lower than in 2005, so we consider the two years separately. In 2005, the Woodland WPCU reported a total phosphorus monthly average range of 0.44 to 0.75 mg/l with a mean of 0.60 mg/l. The USGS sampling yielded data consistent with these results, but GSWA's measurements, except for the 08/09/05 result (see Table II), were somewhat lower. The corresponding plant-reported numbers for 2006 had a range of 0.05 to 0.94 mg/l and a mean of 0.37 mg/l. USGS has not yet published its 2006 data; GSWA's 2006 phosphorus levels remain somewhat lower than the plant figures.

Stronger flows during and after storms can provide better flushing and dilution, but in periods of drought or low rainfall the stream is more vulnerable than usual and higher pollutant

concentrations can result. Some of the fluctuations in concentrations in the upper reaches of the stream may be partially attributable to variations in flow rates.

The Woodland WPCU currently has no imposed permit limit on the temperature of their discharge. As stated earlier, our measurements show that significant warming of the stream water occurs immediately downstream from the discharge during cool seasons. The NJ Surface Water Quality Standards for FW2-NT streams requires “no thermal alterations which would cause temperatures to deviate more than 2.8°C at any time from ambient temperatures.” This criterion also requires that temperatures must be measured outside the heat dissipation area, or mixing zone, where the discharge merges with the stream. If the LB4 sampling site, approximately 200 yards downstream from the discharge, is considered to fall outside the mixing zone, this criterion was not being met at the time of our sampling during the months of November 2005, February 2006 and November 2006.

5. Future monitoring

Loantaka Brook is the most impaired stream in the Great Swamp Watershed, and continued quarterly monitoring of its water quality is essential for meeting our objective of improving the overall health of this stream. The data gathered over an extended period will be important in supporting efforts to mitigate the environmental impact of road salt, wastewater treatment plant effluent and any other pollutant sources which might be identified in the future. In addition, as stream restoration programs are implemented, any effects on water quality can be evaluated.

With the dominant contributors to TDS identified as sodium and chloride, GSWA proposes to discontinue monitoring some of the other ionic constituents of TDS. Chemical monitoring of Loantaka Brook during 2007 will include TDS, sodium and chloride together with the N- and P-nutrients and TSS. Additional parameters may include pH, dissolved oxygen and turbidity. One or more additional sampling sites will be evaluated for developing a broader chemical assessment of the stream.

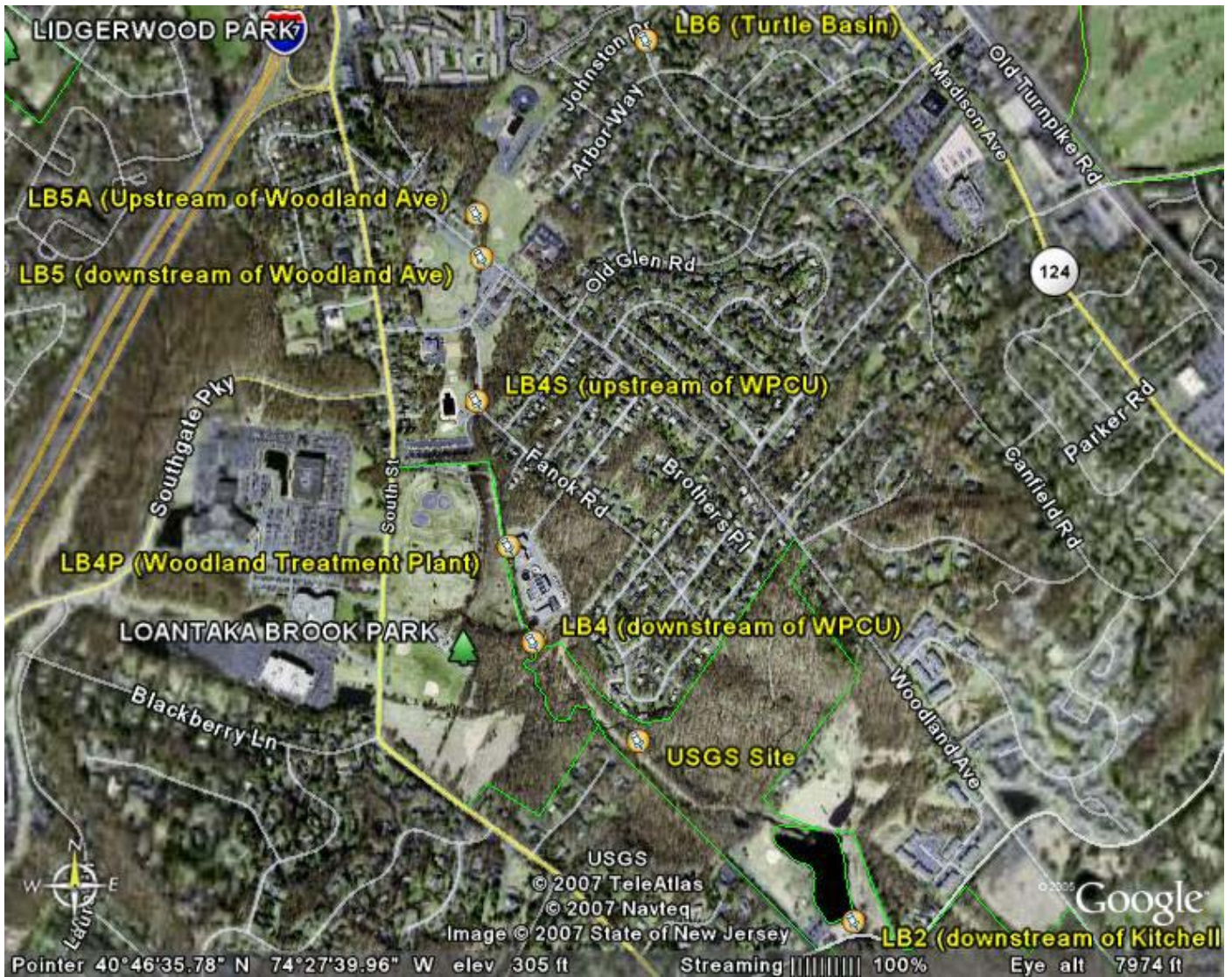
6. Summary

Two years of quarterly monitoring of Loantaka Brook headwaters have demonstrated that water quality is impacted by a high level of Total Dissolved Solids (dominated by sodium and chloride ions), and by high levels of nitrogen- and phosphorus-bearing nutrients. TDS concentrations are highest in the upper reaches of the headwaters, upstream from the Woodland WPCU discharge. In this region near its sources, the low-velocity, low-flow brook is vulnerable to contamination by deicing salts deposited on nearby roads and parking lots. The Woodland plant contributes a large volume of treated wastewater to the stream with the degree of dilution being very limited. The plant effluent contains a relatively high content of TDS, sodium and chloride, although at concentrations somewhat lower than found upstream from the plant discharge. Salt may enter the influent to the plant in several ways, such as inadvertent infiltration of stormwater containing deicing agents, discharge from water softeners, household detergents and cleaning agents. Excessive sodium and chloride in surface waters is of growing concern in many northern US

states because of deleterious effects on aquatic plant and animal life, and infiltration into groundwater with potential contamination of drinking water.

N- and P-nutrients are found at higher levels downstream from the Woodland WPCU discharge than upstream. Total nitrogen and phosphorus concentrations significantly exceed the Ten Towns water quality objectives. Immediately below the plant discharge, nitrate concentrations often exceed the much less stringent human-health based NJ Surface Water Quality Standard of 10.0 mg/l. High nutrient levels can cause excessive aquatic plant growth and accelerated eutrophication downstream. GSWA's TDS and nutrient measurements on samples taken immediately downstream from the plant are strongly supported by recently published monitoring data obtained by the USGS at a nearby site.

Quarterly monitoring of Loantaka Brook will be continued with some changes in the set of parameters to be measured. Data will continue to be gathered on the key parameters discussed in this report, particularly TDS, sodium, chloride and the nitrogen- and phosphorus-bearing nutrients. Adding one or more monitoring sites will enable a better assessment to be made of the downstream impact of the headwaters contaminant sources.



Geographic Coordinates for Sampling Sites on Loantaka Brook

Source: Google Earth software

Site	Description	Latitude	Longitude
LB2	Downstream of Kitchell Pond	40°46'5.01"	74°27'17.60"
LB4	Downstream of WPCU	40°46'25.06"	74°27'47.91"
LB4P	Woodland Water Pollution Control Utility (WPCU)	40°46'31.91"	74°27'50.23"
LB5	Woodland Ave (downstream)	40°46'52.50"	74°27'52.79"
LB5A	Woodland Ave (upstream)	40°46'55.61"	74°27'54.07"
LB6	Turtle Basin	40°47'7.97"	74°27'37.24"
AN0220	USGS/NJDEP AMNET site	40°46'18"	74°27'38"

Figure 1

Aerial Photo of Loantaka Brook Showing Sampling Sites

I. Total Dissolved Solids and Constituent Ions, Loantaka Brook

Concentrations in mg/liter

Site	Sampling Date	TDS (meter)	TDS (residue)	Calcium Ca	Magnesium Mg	Sodium Na	Potassium K	Chloride Cl	Sulfate SO ₄	Carbonate*** CO ₃	Nitrate as NO ₃	Nitrite as NO ₂	Sum of Constituents	Percent of TDS(res)
LB6 (Turtle Basin)	02/07/05		1270	90	26	360	6.1	549	30.1	80.3	2.88	0.05	1144	90.1%
	05/09/05		1110	93	26	260	5.6	577	24.0	127.1	1.20	0.05	1114	100.4%
	08/09/05		1289	121	33.7	241	6.11	441	1.2	149.9	15.05	0.07	1009	78.3%
	11/08/05	1090	945	99.8	27.4	198	5.96	480	9.0	127.7	2.12	0.01	950	100.5%
	02/07/06	566	631	57	16	131	2.88	251	13.0	69.5	8.41	0.02	549	87.0%
	05/03/06	925	1000	100	28	220	7.5	448	20.5	103.1	2.12	0.06	929	92.9%
	08/07/06	924	842	115	31.6	214	4.73	470	7.0	95.9	0.53	0.01	939	111.5%
	11/07/06	933	956	96.4	27.8	192	4.1	365	20.4	94.1	1.24	0.15	801	83.8%
LB5A*	08/07/06	1330	1150	121	38	219	6.47	490	41.0	96.5	11.51	0.11	1024	89.0%
LB5 (Woodland Ave)	02/07/05		1200	96	27	290	4.4	559	36.0	80.9	9.30	0.05	1103	91.9%
	05/09/05		888	89	28	210	4.0	404	38.0	90.5	7.97	0.11	872	98.2%
	08/09/05		1095	100	31.6	212	4.73	280	46.0	110.3	6.20	0.09	791	72.2%
	11/08/05	996	873	97.2	27.8	171	4.73	420	42.0	109.7	5.31	0.11	878	100.6%
	02/07/06	560	632	66.2	17.8	112	2.81	235	33.0	86.9	10.18	0.04	564	89.2%
	05/03/06	1289	977	100	29	190	6.7	425	33.4	98.3	8.41	0.09	891	91.2%
	08/07/06	886	1010	115	35.7	205	6.3	445	39.0	88.7	11.51	0.10	946	93.7%
	11/07/06	806	756	86.2	25.2	145	3.3	361	27.8	95.9	9.30	0.03	754	99.7%
LB4P**	11/07/06	621	594	56.8	20.5	127	10.8	178	65.2	61.8	59.76	0.04	580	97.6%
LB4 (Below Plant Outlet)	02/07/05		750	62	21	170	9.2	343	68.0	67.8	23.02	0.42	764	101.9%
	05/09/05		608	58	22	140	11	221	78.0	74.9	14.17	0.15	619	101.9%
	08/09/05		677	62.6	23.4	141	11.7	195	79.0	87.5	61.09	0.14	661	97.7%
	11/08/05	655	547	51.2	16.5	121	10.5	220	70.0	52.2	44.71	0.09	586	107.2%
	02/07/06	564	579	57.7	21.1	112	7.66	196	64.0	70.7	39.84	0.08	569	98.3%
	05/03/06	692	713	65	23	140	14	243	82.8	68.4	36.74	0.32	673	94.4%
	08/07/06	644	734	72.1	25.5	159	10.8	226	86.0	77.9	38.96	0.06	696	94.9%
	11/07/06	632	586	57.3	19.7	120	9.0	188	58.4	66.0	50.47	0.05	569	97.1%
LB2 (Below Kitchell Pond)	02/07/05		750	63	21	200	7.5	412	55.8	64.2	19.92	0.23	844	112.5%
	05/09/05		622	48	18	110	7.4	288	72.0	70.1	13.28	0.23	627	100.8%
	08/09/05		707	56.4	20.6	134	10.2	169	78.0	83.9	15.49	0.53	568	80.4%
	11/08/05	271	525	49.2	15.9	104	7.98	200	60.0	67.2	23.46	0.18	528	100.5%
	02/07/06	415	521	48.5	16.9	91.5	4.69	167	46.0	64.2	23.02	0.08	462	88.6%
	05/03/06	630	659	60	23	130	11	240	65.6	69.5	16.38	0.22	616	93.4%
	08/07/06	563	622	64.1	23	117	9.73	220	73.0	83.9	5.31	0.72	597	95.9%
	11/07/06	573	636	58.5	19.5	116	7.0	179	51.8	73.1	30.54	0.15	536	84.2%

* LB5A is on the opposite (upstream) side of Woodland Ave from LB5

*** Carbonate estimated from measured alkalinity

** LB4P is at the plant outlet and the effluent was sampled directly

II. N- and P-Bearing Nutrients, Loantaka Brook

Concentrations in mg/liter

Sampling Site	Sampling Date	Water Temperature		Total Kjeldahl Nitrogen "as N"	Nitrate "as N"	Nitrite "as N"	Total Nitrogen "as N"	Soluble Reactive Phosphate "as P"	Total Phosphorus "as P"	Total Suspended Solids
		°F	°C							
LB6 (Turtle Basin)	02/07/05			0.28	0.65	0.015	0.95	< 0.003	0.06	< 3
	05/09/05			0.47	0.27	0.015	0.76	< 0.003	0.06	4
	08/09/05			1.40	3.4	0.021	4.82	0.006	0.38	21
	11/06/05	52.5	11.4	0.26	0.48	0.003	0.74	<0.002	0.19	7
	02/07/06	40.1	4.5	1.40	1.9	0.005	3.31	0.008	0.02	< 2
	05/03/06	53.5	11.9	0.55	0.48	0.018	1.05	<0.002	0.22	41
	08/07/06	71.4	21.9	0.42	0.12	0.003	0.54	0.006	0.1	19
	11/07/06	50.0	10.0	0.64	0.28	0.047	0.97	<.002	0.02	< 2
LB5A*	08/07/06			0.49	2.6	0.032	3.12	0.01	0.04	12
LB5 (Woodland Ave)	02/07/05			0.28	2.1	0.018	2.40	0.004	0.03	3
	05/09/05			0.55	1.8	0.033	2.38	0.003	< 0.01	< 3
	08/09/05			1.40	1.4	0.027	2.83	0.015	0.03	22
	11/06/05	53.9	12.2	0.47	1.2	0.035	1.71	0.008	0.01	3
	02/07/06	41.3	5.2	1.40	2.3	0.011	3.71	0.002	0.02	< 2
	05/03/06	55.1	12.8	0.46	1.9	0.028	2.39	0.002	0.07	2
	08/07/06	71.4	21.9	0.62	2.6	0.029	3.25	0.017	0.04	3
11/07/06	52.7	11.5	0.75	2.1	0.01	2.86	< .002	0.17	26	
LB4P**	11/07/06	64.5	18.1	0.64	13.5	0.011	14.15	0.004	0.06	< 2
LB4 (Below Plant Outlet)	02/07/05			0.37	5.2	0.129	5.70	0.208	0.29	4
	05/09/05			0.68	3.2	0.047	3.93	0.20	0.25	< 3
	08/09/05			1.70	13.8	0.042	15.54	1.1	1.2	7
	11/06/05	64.4	18.0	0.52	10.1	0.028	10.65	0.134	0.21	< 3
	02/07/06	51.2	10.7	0.16	9.0	0.024	9.18	0.037	0.16	< 2
	05/03/06	60.6	15.9	0.49	8.3	0.097	8.89	0.008	0.07	< 2
	08/07/06	74.0	23.3	0.67	8.8	0.017	9.49	0.21	0.25	3
11/07/06	61.5	16.4	0.64	11.4	0.018	12.06	0.004	0.04	< 2	
LB2 (Below Kitchell Pond)	02/07/05			0.47	4.5	0.07	5.04	0.085	0.18	9
	05/09/05			0.49	3.0	0.07	3.56	0.16	0.24	< 3
	08/09/05			1.70	3.5	0.162	5.36	0.2	0.28	11
	11/06/05	56.4	13.6	0.52	5.3	0.056	5.88	0.09	0.13	< 3
	02/07/06	39.3	4.1	1.40	5.2	0.024	6.62	0.03	0.12	< 2
	05/03/06	60.9	16.1	0.65	3.7	0.067	4.42	0.009	0.13	14
	08/07/06	77.0	25.0	1.40	1.2	0.22	2.82	0.170	0.29	25
11/07/06	51.6	10.9	0.64	6.9	0.047	7.59	0.015	0.07	< 2	

* LB5A is on the opposite (upstream) side of Woodland Ave from LB5

** LB4P is at the plant outlet and the effluent was sampled directly

USGS WATER QUALITY DATA FOR LOANTAKA BROOK

(All concentrations in mg/liter)

III. Total Dissolved Solids and Constituent Ions

Site	Sampling Date	TDS (residue)	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Silica	Carbonate	Nitrate	Nitrite	Sum of Constituents	Percent of TDS(res)
			Ca	Mg	Na	K	Cl	SO ₄	SiO ₂	CO ₃	as NO ₃	as NO ₂		
AN0220	10/25/04	608	56.3	19.7	129	10.4	202	69.5	14.9	58.2	49.93	0.06	611	100.5%
USGS	02/03/05	696	66.2	24.7	133	10.6	229	78.6	17.6	67.2	57.55		686	98.6%
(Approx	05/12/05	689	62.4	24.4	120	10.4	211	84.8	17.2	72.5	48.69		654	94.9%
500 yds	08/11/05	733	68.8	25.4	146	13.1	237	99.1	16.9	64.8	58.88		731	99.7%
below LB4)														
NOTES:											1	2	3	

1. USGS estimates carbonate from Acid Neutralization Capacity.
2. USGS reports only "Nitrates + Nitrites" after 10/25/04. They are listed here under "Nitrates", since nitrites are normally negligible.
3. USGS "Sum of Constituents" includes very small amounts of materials not listed here, contributing a total of 3 mg/l or less.

IV. N- and P-Bearing Nutrients

Sampling Site	Sampling Date	Total Kjeldahl Nitrogen "as N"	Nitrates + Nitrites "as N"	Total Nitrogen "as N"	Soluble Reactive Phosphate "as P"	Total Phosphorus "as P"	Total Suspended Solids
AN0220	10/25/04	0.87	11.28	12	0.495	0.55	3
USGS	02/03/05	0.91	13	14	0.329	0.59	4
(Approx	05/12/05	0.95	11	12	0.344	0.47	4
500 yds	08/11/05	0.68	13.3	14	0.32	0.34	2
below LB4)							

NOTE: USGS reports some parameters under different titles
 e.g. "Kjeldahl Nitrogen" is reported as "Ammonia + Organic Nitrogen"
 "Soluble Reactive Phosphorus" as "Orthophosphate"
 and "Total Suspended Solids" as "Residue total at 105C, suspended" or "Suspended sediment concentration"

V. Nutrient and TSS Reference Standards

Concentrations in mg/liter

Originator of Standards	Total Kjeldahl Nitrogen "as N"	Nitrate "as N"	Total Nitrogen "as N"	Soluble Reactive Phosphate "as P"	Total Phosphorus "as P"	Total Suspended Solids
NJDEP Surface Water Quality Standards (FW2)		10.0			0.10	40
EPA reference, Northern Piedmont Ecoregion	0.30	0.995	1.295		0.04	
Ten Towns 2002 Standards (Goals) for Loantaka Brook	0.40	2.0	2.4	0.02	0.05	4

ATTACHMENT A
LABORATORY DATA PACKAGES

1. February 7, 2006 Sampling Report
2. May 3, 2006 Sampling Report
3. August 7, 2006 Sampling Report
4. November 7, 2006 Sampling Report