Pre-Construction, Construction, and Post-Construction Monitoring Report for Greenland Meadows for July 2007- October 2010

Prepared by
The University of New Hampshire Stormwater Center
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Pre-Construction, Construction, and Post-Construction Monitoring Report for Greenland Meadows for July 2007- October 2010

New England Development, RT 33, Greenland, NH

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Pre-Construction, Construction, and Post-Construction Monitoring Report for Greenland Meadows for July 2007- October 2010

Executive Summary

Wet weather flow monitoring has been conducted at the Greenland Meadows location since July of 2007 through October 2010. This has included to date three phases of sampling including pre-construction, construction, and 1 year post-construction monitoring. A 4th phase of 5 years long-term monitoring has begun. The results to date indicate that the stormwater management systems are operating well and providing a high level of water quality treatment for the runoff from a high contaminant load commercial site and provide significant protection to the impaired receiving waters of Pickering Brook. Water quality results indicate that effluent pollutant levels as they leave the site at the gravel wetland are typically at or below ambient stream concentrations across a wide range of contaminants. In addition, the baseflow benefits, while not yet quantified, are observed to provide a nearly continuous source of cool clean baseflow from the site, discharging in a manner similar to shallow groundwater discharge.

Site Description

Greenland Meadows is a retail shopping center built in 2008 by Newton, Mass.-based New England Development along Route 33 in Greenland, New Hampshire that features the largest porous asphalt installation in the Northeast. The development is located on a 56-acre parcel and includes three, one-story retail buildings (Lowe's Home Improvement, Target, and a proposed supermarket), paved parking areas consisting of porous asphalt and non-porous pavements, landscaping areas, a large gravel wetland, as well as other advanced stormwater management systems. The total impervious area of the development – mainly from rooftops and non-porous parking areas – is approximately 26 acres, considerably more as compared to pre-development conditions. Prior to development, the project site contained an abandoned Sylvania light bulb factory with a majority of the property vegetated with grass and trees.

The site is located on Pickering Brook, an impaired stream as listed by NHDES. Pickering Brook drains significant portions of Route 33 and Interstate 95.

Framingham, Mass.-based Tetra Tech Rizzo provided site drainage engineering. The University of New Hampshire Stormwater Center provided design guidance and oversight with advanced stormwater management systems. The project was completed in cooperation with the Conservation Law Foundation of Concord, NH.

Project Overview

The project objective is to monitor and assess water quality impacts from stormwater runoff from the Greenland Meadows Site owned and operated by New England Development upon Pickering Brook from pre-construction to 5 years post-construction. Wet weather flow monitoring will be conducted to assess stormwater quality in 4 phases. The 4 phases of monitoring (see Table 1) will establish water quality for background conditions (phase 1), during construction activities (phase 2), the immediate post-construction performance of the stormwater management systems (phase 3), and the long-term performance of the

systems (phase 4). The first 3 phases have been completed and phase 4 is underway. Sampling will assess both background conditions for Pickering Brook, evaluate stormwater quality runoff from the site, and resultant water quality to Pickering Brook downstream of Greenland Meadows.

Table 1: Methods and Sampling Calendar

Period	Method, Site, Sampling Interval	Year
Phase 1: Pre-Construction Monitoring	Automated Sampler: 5 events, 1 site Grab samples; 3 events, 1 site	1
Phase 2: Construction Monitoring	Automated Sampler: 5 events, 1 site	1
Phase 3: Yr 1 Post-Construction Monitoring	Automated Sampler: 8 events, 2 site	2
Phase 4: Yrs 2-5 Post-Construction Monitoring	Automated Sampler: 4 events, 2 site	3-6

Methods and Sampling

Automated samplers (Figure 1) are being used to monitor water quality and BMP performance and will be used to assess treatment system performance and overall site runoff water quality. Composite sampling over the hydrograph of various rainfall events is used to assess overall water quality, stormwater management performance, and wash-off characteristics as it relates to street sweeping. System performance is examined with respect to effluent concentrations (pre and post construction) and upstream receiving water conditions. Removal efficiencies are not calculated because no true influent monitoring occurs to examine quality of runoff prior to treatment.

Figure 1: ISCO 6712FR Automated Sampler

To date, monitoring has occurred at two primary locations (Figure 2). Background conditions were established at a monitoring location in Pickering Brook over the span of seven months prior to any on-site construction activity. The second monitoring location was established after the construction of the primary sedimentation basin and located in the brook just downstream of the outlet. Sampling is performed using automated 6712 ISCO samplers. Each sampler is outfitted with a water quality sonde and flow meter. The water quality sonde is YSI Model 600XL multi-parameter sonde, recording: pH, temperature, dissolved oxygen and conductivity at regular intervals. Automated sampling was triggered based on preset rainfall conditions. The sampling program for each device during the background and

construction activity conditions was based on anticipated storm conditions and covered the resultant hydrographs from all rainfall events.

Table 2: Monitoring Location Coordinates

Station ID	Latitude	Longitude
Pre-Construction Monitoring	43° 2'52.08"N	70°49'16.12"W
Construction and Post-Construction Monitoring	43° 2'54.84"N	70°49'18.68"W

Runoff constituent analyses routinely included; total suspended solids (TSS), total petroleum hydrocarbons- diesel (TPH-D), total nitrogen (NO3, NO2, NH4, TKN), and total metals (Zn). Additional analytes such as total phosphorus and ortho-phosphate have been added due to their relative importance in stormwater effluent characteristics. All sample analyses listed in Table 3 are performed at a state-certified laboratory for drinking water and wastewater. UNHSC operates under a detailed quality assurance project plan, which is modeled after EPA protocols.

Figure 2: Pre-Construction, Construction, and Post-Construction Monitoring Locations for Pickering Brook

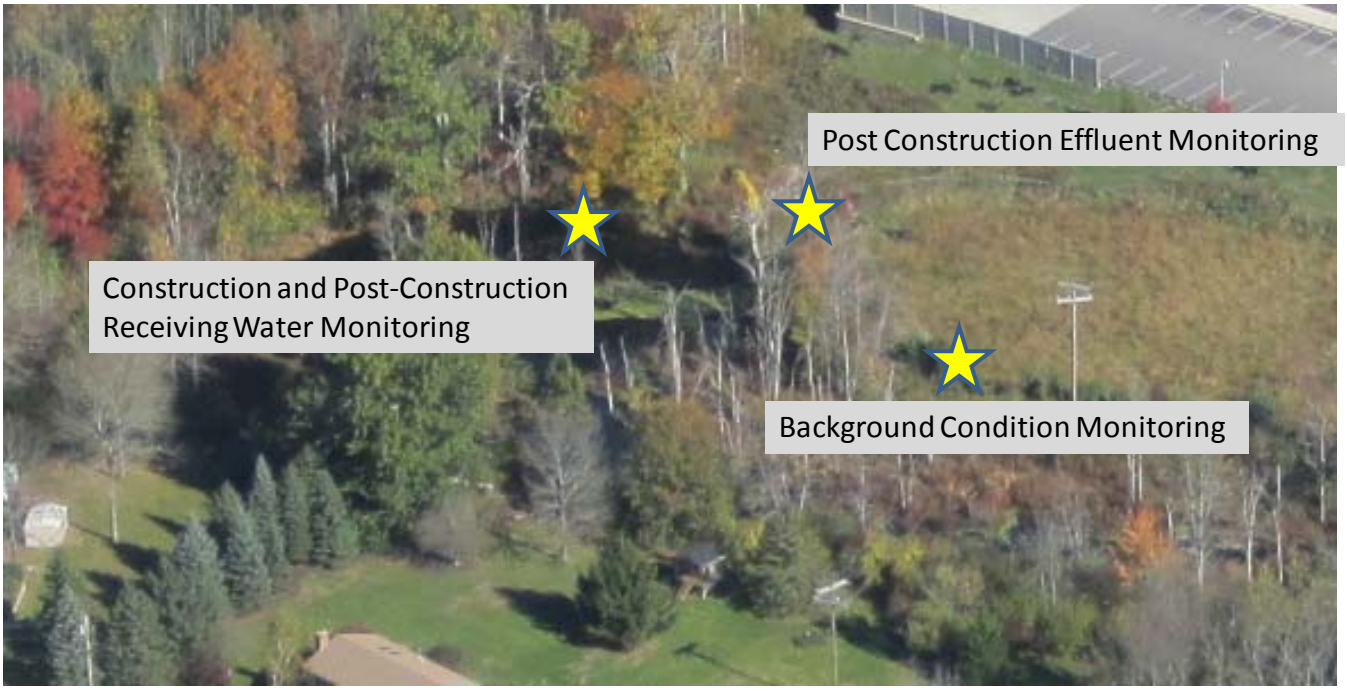


Table 3: Laboratory Analytical Methods and Detection Limits for Each Analyte

Analyte	Analytical Method	Sample Detection Limit (mg/L)	Method Detection Limit (mg/L)[a]
Nitrate/Nitrite in water	EPA 300.0A	0.1	0.008
TKN	ASTMD359002A	Variable	0.5
Ammonia (NH3)	SM4500NH3-D	Variable	0.5
Total Nitrogen		Variable	0.4
Total Suspended Solids	SM 2540 D	Variable, 1-10	
Suspended Sediment Concentration	ASTM D-3977	Variable, 1-2	1
Total Phosphorus	EPA 365.3	0.01	0.008
Ortho-Phosphate	EPA 300.0A	0.031	0.05
Zinc in water	EPA 200.7	0.05	0.001-0.05
Total Petroleum Hydrocarbons –Diesel Range	SW 3510C 8015B	Variable ≤ 3.5	0.1-3.0

[a]Method detection limit is different than sample detection limit which will be often be higher as they are based on sample volume available for analyses.

Phase 1: Pre-Construction Monitoring (Completed)

A total of 12 events have been sampled including 9 rain events and 3 dry weather grab samples. Rainfall event details are included for pre-construction and post construction monitoring in Table 4. Water quality results are presented in Table 5. Background sampling occurred over the span of seven months and three seasons. Many laboratory analyses were returned below detection limits (BDL) for a variety of pollutants. In such cases, for this study 0.5 of the median detection limit value was applied for all BDL results. This is a common approach for treatment of BDL values.

Phase 2: Construction Monitoring (Completed)

During site construction activities eight sample events were collected over the course of four months and two seasons. Results are presented in Table 6. Rainfall event details are included for pre-construction and post construction monitoring in Table 4. Results indicate that minor elevations in sediment, nitrogen, and phosphorus were observed. It should be noted that the average concentrations of both nutrients are below any EPA action limits. Nutrient concentrations would be expected to be elevated during construction as this is a period of non-vegetation during which no plant uptake of nutrients is occurring. Once vegetation and permanent stormwater management systems are in place nutrient concentrations would be expected to decline with the stormwater management strategies employed for this site.

Phase 3: Yr 1 Post-Construction Monitoring (Completed)

Post-Construction monitoring coincided with the opening of Target in summer 2009. Wet weather monitoring of the site for runoff water quality and receiving waters was planned for 8 wet weather events for year 1 with 4 events minimum planned for subsequent years. Monitoring is being conducted in two locations; the effluent from the gravel wetland and in Pickering Brook downstream of the zone of mixing of the gravel wetland outfall. The results are listed in Table 8 and Table 9 and plotted in Figures 3 and 4. Results indicate that effluent pollutant levels are typically at or below ambient stream concentrations across the range of contaminants. Receiving stream water quality is not monitored during the winter months due to freezing of Pickering Brook. No evaluation of winter water quality for Pickering Brook is available for this reason. The gravel wetland effluent is monitored year round and treatment and quality is monitored. Based on the storms observed thus far the water discharging the Greenland Meadows site is typically lower in contaminant concentration than receiving water concentrations in Pickering Brook. It is suspected that the water quality for nutrients in Pickering Brook is worse than reported here because the 3 winter months are not included and these months are typically the period of time when highest nitrogen concentrations are observed. A summary of monitored water quality for Phase 1 through Phase 3 is presented in Table 10.

Phase 4: Yrs 2-5 Post-Construction Monitoring (Yet to be completed)

For the years 2-5 of post-construction monitoring, sample events will be performed at the pace of a minimum of 4 wet weather events per year with automated samplers. Sample locations are same as listed above. This will total 5 years of post construction monitoring. At the end of monitoring period the cumulative yearly data will be compiled and a summary report produced to evaluate system performance and water quality as it relates to Pickering Brook.

Monitoring Summary

The wet weather flow monitoring conducted at the Greenland Meadows since July of 2007 through October 2010 has concluded to date three phases of sampling including pre-construction, construction, and 1 year post-construction monitoring. A 4^{th} phase of 5 years long-term monitoring has begun. The median TSS concentrations for the post-construction treated runoff (3 mg/L TSS) are below pre-construction monitoring (5 mg/L TSS), and significantly below the receiving waters of Pickering Brook (53 mg/L TSS). The median TN concentrations for the post-construction treated runoff (0.50 mg/L TN) are below pre-construction monitoring (0.55 mg/L TN), and significantly below the receiving waters of Pickering Brook (1.35 mg/L TN). The median TP concentrations for the post-construction treated runoff (0.005 mg/L TP) are below pre-construction monitoring (0.05 mg/L TP), and significantly below the receiving waters of Pickering Brook (.145 mg/L TP). The results to date indicate that the stormwater management systems are operating well and providing a high level of water quality treatment for the

runoff from a high contaminant load commercial site and provide significant protection to the impaired receiving waters of Pickering Brook. In addition, the baseflow benefits, while not yet quantified, are observed to provide a nearly continuous source of cool clean baseflow from the site, discharging in a manner similar to shallow groundwater discharge.

Table 4: Rainfall Characteristics for Background, Construction, and Post-Construction Sampling Events

Monitoring Period	Rainfall Event	Total Depth (in)	Peak Intensity (in/hr)	Duration (min)	Season
Background (Pre-development) Monitoring	7/6/2007	0.71	3.42	110	Summer
	7/12/2007	0.43	1.20	50	Summer
	7/19/2007	0.41	0.54	180	Summer
	7/28/2007	1.12	2.22	80	Summer
	9/27/2007	0.24	0.78	70	Fall
	11/6/2007	0.67	0.48	520	Winter
	11/13/2007	0.18	0.18	200	Winter
	11/26/2007	0.12	0.12	270	Winter
	1/10/2008	0.60	0.36	340	Winter
Construction Phase Monitoring	3/28/2008	0.16	0.12	180	Winter
	3/31/2008	0.24	0.12	550	Winter
	4/12/2008	0.15	0.12	170	Spring
	4/28/2008	1.84	0.30	1330	Spring
	5/27/2008	0.13	0.66	30	Spring
	6/4/2008	0.48	1.80	360	Spring
	6/6/2008	0.35	0.24	390	Spring
	6/14/2008	1.28	0.60	680	Spring
Post-Construction Monitoring	8/28/2009	2.17	0.72	1330	Summer
	9/12/2009	0.68	1.08	465	Summer
	10/7/2009	0.96	0.84	4390	Fall
	10/18/2009	0.58	0.12	5225	Fall
	12/2/2009	1.03	0.60	5075	Fall
	12/27/2009	0.92	0.36	6765	Winter
	1/17/2010	0.44	0.12	5650	Winter
	1/24/2010	0.96	0.36	7650	Winter
	2/24/2010	0.52	1.20	2500	Winter
	3/11/2010	0.90	0.24	12045	Winter
	5/8/2010	0.57	1.08	7545	Spring
	5/14/2010	0.20	0.48	6540	Spring
	6/3/2010	1.25	2.76	2505	Spring
	6/10/2010	0.63	0.60	6665	Spring
	6/23/2010	0.28	0.36	3535	Summer
	7/10/2010	0.43	1.56	4525	Summer
	7/13/2010	2.09	3.00	8420	Summer
	8/9/2010	2.16	3.72	5815	Summer
	8/22/2010	3.30	1.80	5925	Summer
	10/6/2010	0.91	0.24	6040	Fall
	10/14/2010	2.53	1.32	5090	Fall

Table 5 Results for Pre-Construction Background Monitoring Phase

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho- P
7/5/2007	<10	<310	<0.01	<0.1	<0.1	<0.5	0.5	0.5	0.06	NA
7/6/2007*	<10	<320	<0.01	<0.1	<0.1	<0.5	0.5	0.5	0.08	NA
7/11/2007	<10	<340	<0.01	<0.1	<0.1	<0.5	1.4	1.4	0.05	NA
7/18/2007	<10	<330	<0.01	<0.1	<0.1	<0.5	0.8	0.8	0.05	NA
7/27/2007	<10	<270	0.01	<0.1	<0.1	<0.5	1.3	1.3	0.05	NA
8/3/2007*	< 10	<350	<0.01	<0.1	<0.1	<0.5	0.6	0.6	0.05	<0.1
9/26/2007	< 10	< 570	0.02	< 0.05	< 0.1	< 0.5	0.8	0.8	0.07	NA
11/6/2007*	< 10	<380	<0.01	<0.1	<0.1	<0.5	<0.5	<0.5	0.02	<0.1
11/5/2007	< 10	<350	<0.01	<0.1	<0.1	<0.5	<0.5	<0.5	0.03	<0.1
11/10/2007*	< 10	<320	<0.01	<0.1	<0.1	<0.5	0.5	0.5	0.01	<0.1
11/25/2007	< 10	<430	<0.01	<0.1	<0.1	<0.5	<0.5	<0.5	0.02	<0.1
1/10/2008	< 10	<370	<0.01	0.1	<0.1	<0.5	0.8	0.9	0.03	<0.1

*Denotes grab sample; < denotes below detection limit (BDL)

Table 6: Results for Construction Phase Sampling Events

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho-P
3/28/2008	4	< 200	< 0.01	2.5	< 0.1	< 0.5	0.8	3.3	0.02	< 0.01
3/31/2008	2	< 210	< 0.01	1.1	< 0.1	< 0.5	0.9	2	< 0.01	< 0.01
4/12/2008	3	< 210	< 0.01	0.7	< 0.1	< 0.5	1	1.7	0.02	< 0.01
4/28/2008	22	< 230	< 0.05	2.4	< 0.1	< 0.5	2.6	5	0.01	0.02
5/27/2008	12	< 200	< 0.01	< 0.1	< 0.1	< 0.5	1.8	< 0.5	0.14	0.04
6/4/2008	28	< 370	< 0.01	< 0.1	< 0.1	< 0.5	0.9	0.9	0.12	0.03
6/6/2008	28	NA	< 0.01	0.1	< 0.1	< 0.5	1	1.1	0.12	0.01
6/14/2008	16	NA	< 0.01	0.7	< 0.1	< 0.5	1	1.7	0.13	0.04

< denotes below detection limit (BDL)

Table 7: Results for Construction Phase with 0.5 of Detection Limit

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho-P
3/28/2008	4	100	0.005	2.50	0.05	0.25	0.8	3.30	0.020	0.00
3/31/2008	2	105	0.005	1.10	0.05	0.25	0.9	2.00	0.005	0.00
4/12/2008	3	105	0.005	0.70	0.05	0.25	1.0	1.70	0.020	0.00
4/28/2008	22	115	0.025	2.40	0.05	0.25	2.6	5.00	0.010	0.02
5/27/2008	12	100	0.005	0.05	0.05	0.25	1.8	0.25	0.140	0.04
6/4/2008	28	185	0.005	0.05	0.05	0.25	0.9	0.90	0.120	0.03
6/6/2008	28		0.005	0.10	0.05	0.25	1.0	1.10	0.120	0.01
6/14/2008	16		0.005	0.70	0.05	0.25	1.0	1.70	0.130	0.04

Table 8: **Results for Post-Construction Phase Sampling Events**

EFFLUENT

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-	NH4	TKN	TN	TP	ortho-P	SSC
8/28/2009	2	< 420	< 0.05	< 0.1	< 0.1	< 0.5	4.1	4.1	0.01	0.01	3
9/12/2009	1	< 380	< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	< 0.01	< 0.01	6
10/7/2009	1	< 320	< 0.01	0.1	< 0.1	< 0.5	< 0.5	< 0.5	< 0.01	< 0.01	4
10/18/2009	2	< 330	< 0.05	0.1	< 0.1	< 0.5	0.7	0.8	0.02	< 0.01	4
12/2/2009	2		< 0.01	0.4	< 0.1	< 0.5	< 0.5	< 0.5	< 0.01	< 0.01	3
12/27/2009	13	< 360	< 0.01	1.2	< 0.1	< 0.5	< 0.5	1.2	0.01	< 0.01	1
1/17/2010	3	< 360	< 0.01	1.4	< 1.0	< 0.5	0.9	2.3	< 0.01	< 0.01	< 1.0
1/24/2010	2		< 0.01	< 1.0	< 2.0	< 0.5	0.6	< 2.0	< 0.01	0.01	3
2/24/2010	22	< 290	0.03	< 1.0	< 5.0	< 0.5	1	< 5.0	< 0.01	< 0.01	19
3/11/2010	4	< 310	< 0.01	0.4	< 1.0	< 0.5	< 0.5	< 1.0	< 0.01	< 0.01	3
5/8/2010	< 1.0	< 360	< 0.05	0.5	< 1.0	< 0.5	< 0.5	< 1.0	< 0.01	< 0.01	1
5/14/2010	< 1.0	< 380	< 0.01	0.3	< 0.5	< 0.5	0.6	0.9	< 0.01	< 0.01	2
6/3/2010	4		< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	< 0.01	< 0.01	6
6/10/2010	4		< 0.01	< 0.1	< 0.1	< 0.5	0.7	0.7	< 0.01	< 0.01	3
6/23/2010	2		< 0.01	< 0.1	< 0.1	< 0.5	0.6	0.6	< 0.01	< 0.01	3
7/10/2010	3		< 0.01	< 0.1	< 0.1	< 0.5	< 0.5	< 0.5	0.01	< 0.01	3
7/13/2010	3	< 310	< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	0.06	0.02	4
8/9/2010	5	< 380	< 0.01	< 0.1	< 0.1	< 0.5	1.4	1.4	0.04	< 0.01	6
8/22/2010	2	< 230	< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	0.02	< 0.01	3
10/6/2010	4	< 390	< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	0.02	< 0.01	3
10/14/2010	3		< 0.01	< 0.1	< 0.1	< 0.5	0.6	0.6	0.01	< 0.01	69

OUTFALL (PICKERING BROOK)

Date	TSS	TPH-D	TZn	Nitrate-	Nitrite-	NH4	TKN	TN	TP	ortho-P	SSC
8/28/2009	5	< 440	< 0.05	0.2	< 0.1	< 0.5	3.7	3.9	0.05	0.04	6
9/12/2009	6	< 310	< 0.01	0.2	< 0.1	< 0.5	0.7	0.9	0.04	< 0.01	< 1.0
10/7/2009											
10/18/2009	10	< 330	< 0.05	0.1	< 0.1	< 0.5	1.2	1.3	0.03	< 0.01	8
12/2/2009											
12/27/2009											
1/17/2010											
1/24/2010											
2/24/2010											
3/11/2010	13	< 330	< 0.01	< 0.1	< 0.1	< 0.5	0.5	0.5	0.01	< 0.01	14
5/8/2010	93	< 380	< 0.05	0.1	< 1.0	1	3.2	3.3	0.81	0.03	120
5/14/2010	40	< 340	< 0.01	< 0.1	< 0.5	0.6	1.8	1.8	0.23	0.03	42
6/3/2010	64	< 310	< 0.01	< 0.1	< 0.1	< 0.5	0.8	0.8	0.16	0.01	74
6/10/2010	38	< 330	< 0.01	< 0.1	< 0.1	< 0.5	< 0.5	< 0.5	0.07	0.01	34
6/23/2010	300	< 390	0.02	< 0.1	< 0.1	< 0.5	2.2	2.2	0.6	0.07	310
7/10/2010	120	< 310	< 0.01	0.1	< 0.1	2.4	4.1	4.2	0.44	0.04	140
7/13/2010	86	< 300	0.01	< 0.1	< 0.1	< 0.5	1.5	1.5	0.23	0.03	100
8/9/2010	42	< 360	< 0.01	< 0.1	< 0.1	< 0.5	1.2	1.2	0.11	< 0.01	45
8/22/2010	1100	< 350	0.07	0.3	< 0.1	< 0.5	7	7.3	1.5	0.03	1600
10/6/2010	9	< 320	< 0.01	< 0.1	< 0.1	< 0.5	0.9	0.9	0.02	< 0.01	7
10/14/2010	65	< 340	< 0.01	0.1	< 0.1	< 0.5	1.1	1.2	0.13	< 0.01	1

***** Note: Gaps in data for TPH-D indicate inadequate sample volume to meet the minimum laboratory detection limit.

** Note: Large data gaps in the winter for outfall sampling are due to frozen and unmonitorable conditions.

Table 9: Results for Post-Construction Phase with 0.5 of the Detection Limit

EFFLUENT

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho-P	SSC
8/28/2009	2	170	0.005	0.05	0.05	0.25	4.1	4.1	0.01	0.01	3
9/12/2009	1	170	0.005	0.05	0.05	0.25	0.5	0.5	0.005	0.005	6
10/7/2009	1	170	0.005	0.1	0.05	0.25	0.25	0.375	0.005	0.005	4
10/18/2009	2	170	0.025	0.1	0.05	0.25	0.7	0.8	0.02	0.005	4
12/2/2009	2		0.005	0.4	0.05	0.25	0.25	0.375	0.005	0.005	3
12/27/2009	13	170	0.005	1.2	0.05	0.25	0.25	1.2	0.01	0.005	1
1/17/2010	3	170	0.005	1.4	0.05	0.25	0.9	2.3	0.005	0.005	0.5
1/24/2010	2		0.01	0.05	0.05	0.25	0.6	0.375	0.005	0.01	3
2/24/2010	22	170	0.03	0.05	0.05	0.25	1	0.375	0.005	0.005	19
3/11/2010	4	170	0.005	0.4	0.05	0.25	0.25	0.375	0.005	0.005	3
5/8/2010	0.5	170	0.005	0.5	0.05	0.25	0.25	0.375	0.005	0.005	1
5/14/2010	0.5	170	0.005	0.3	0.05	0.25	0.6	0.9	0.005	0.005	2
6/3/2010	4		0.005	0.05	0.05	0.25	0.5	0.5	0.005	0.005	6
6/10/2010	4		0.005	0.05	0.05	0.25	0.7	0.7	0.005	0.005	3
6/23/2010	2		0.005	0.05	0.05	0.25	0.6	0.6	0.005	0.005	3
7/10/2010	3		0.005	0.05	0.05	0.25	0.25	0.375	0.01	0.005	3
7/13/2010	3	170	0.005	0.05	0.05	0.25	0.5	0.5	0.06	0.02	4
8/9/2010	5	170	0.005	0.05	0.05	0.25	1.4	1.4	0.04	0.005	6
8/22/2010	2	170	0.005	0.05	0.05	0.25	0.5	0.5	0.02	0.005	3
10/6/2010	4	170	0.005	0.05	0.05	0.25	0.5	0.5	0.02	0.005	3
10/14/2010	3		0.005	0.05	0.05	0.25	0.6	0.6	0.01	0.005	69

OUTFALL (PICKERING BROOK)

Date	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho-P	SSC
8/28/2009	5	170	0.005	0.2	0.05	0.25	3.7	3.9	0.05	0.04	6
9/12/2009	6	170	0.005	0.2	0.05	0.25	0.7	0.9	0.04	0.005	0.5
10/7/2009											
10/18/2009	10	170	0.005	0.1	0.05	0.25	1.2	1.3	0.03	0.005	8
12/2/2009											
12/27/2009											
1/17/2010											
1/24/2010											
2/24/2010											
3/11/2010	13	170	0.005	0.05	0.05	0.25	0.5	0.5	0.01	0.005	14
5/8/2010	93	170	0.005	0.1	0.05	1	3.2	3.3	0.81	0.03	120
5/14/2010	40	170	0.005	0.05	0.05	0.6	1.8	1.8	0.23	0.03	42
6/3/2010	64	170	0.005	0.05	0.05	0.25	0.8	0.8	0.16	0.01	74
6/10/2010	38	170	0.005	0.05	0.05	0.25	0.25	0.375	0.07	0.01	34
6/23/2010	300	170	0.02	0.05	0.05	0.25	2.2	2.2	0.6	0.07	310
7/10/2010	120	170	0.005	0.1	0.05	2.4	4.1	4.2	0.44	0.04	140
7/13/2010	86	170	0.01	0.05	0.05	0.25	1.5	1.5	0.23	0.03	100
8/9/2010	42	170	0.005	0.05	0.05	0.25	1.2	1.2	0.11	0.005	45
8/22/2010	1100	170	0.07	0.3	0.05	0.25	7	7.3	1.5	0.03	1600
10/6/2010	9	170	0.005	0.05	0.05	0.25	0.9	0.9	0.02	0.005	7
10/14/2010	65	170	0.005	0.1	0.05	0.25	1.1	1.2	0.13	0.005	1

***** Note: Gaps in data for TPH-D indicate inadequate sample volume to meet the minimum laboratory detection limit.

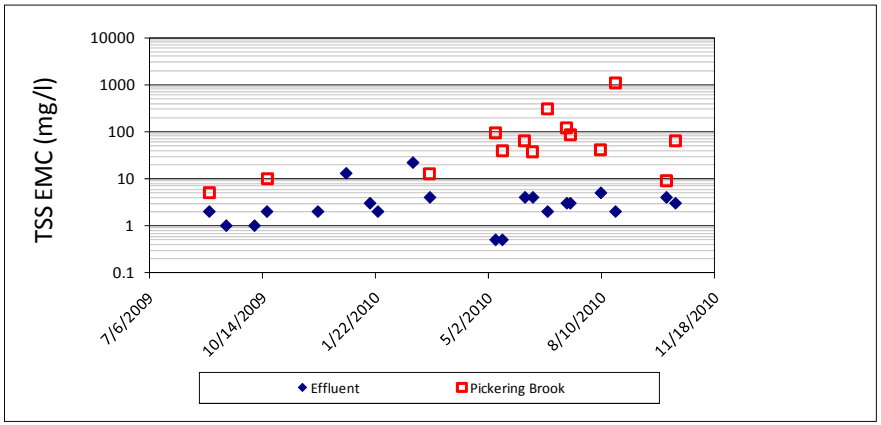
** Note: Large data gaps in the winter for outfall sampling are due to frozen and un-monitorable conditions.

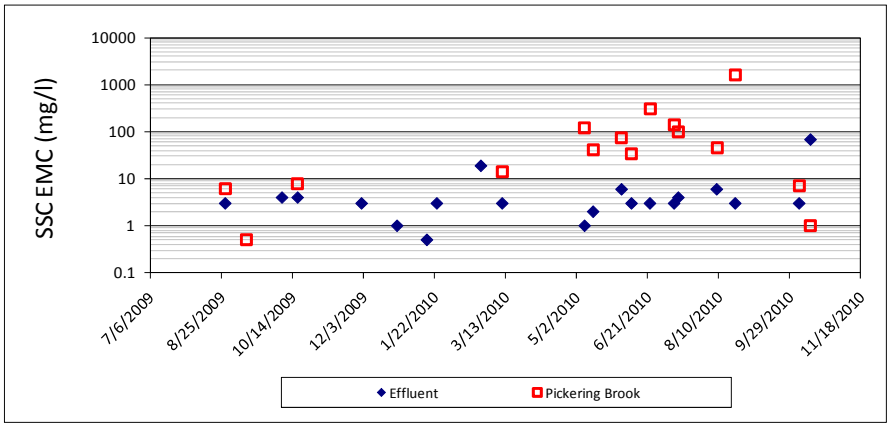
Table 10: Comparison of Pre-Construction, Construction, and Post-Construction Phase Monitoring Results for Effluent Discharge and Pickering Brook Receiving Waters

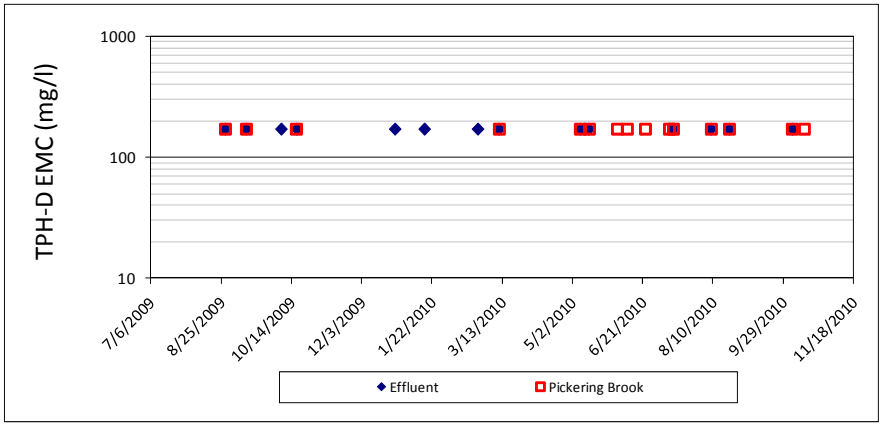
	TSS	TPH-D	TZn	Nitrate-N	Nitrite-N	NH4	TKN	TN	TP	ortho- P	SSC
Background											
average	5.0	180.8	0.007	0.052	0.050	0.250	0.663	0.671	0.043	0.050	
median	5.0	172.5	0.005	0.050	0.050	0.250	0.550	0.550	0.050	0.050	
Construction											
average	14.4	118.3	0.008	0.950	0.050	0.250	1.250	1.994	0.071	0.018	
median	14.0	105.0	0.005	0.700	0.050	0.250	1.000	1.700	0.070	0.015	
Post-Construction Effluent *											
average	4	170	0.007	0.2	0.05	0.25	0.74	0.86	0.012	0.006	7
median	3	170	0.005	0.1	0.05	0.25	0.55	0.50	0.005	0.005	3
Post -Construction Receiving Stream (Pikering Brook) *											
average	142	170	0.011	0.1	0.05	0.47	2.10	2.18	0.314	0.021	167
median	53	170	0.005	0.1	0.05	0.25	1.35	1.40	0.145	0.010	42

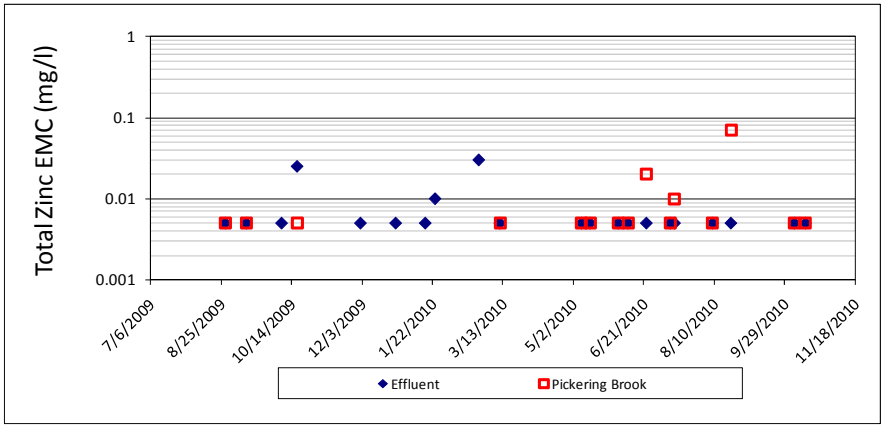
* Note: BDL values reported as 0.5 of the median DL value.

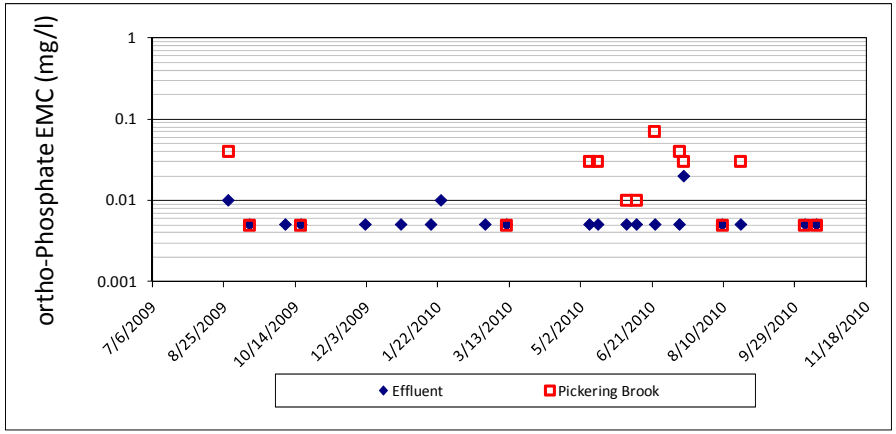
Figure 3: Effluent and Receiving Water Contaminant Concentration Time Series Plots for the Range of Post-Construction Monitoring Data.











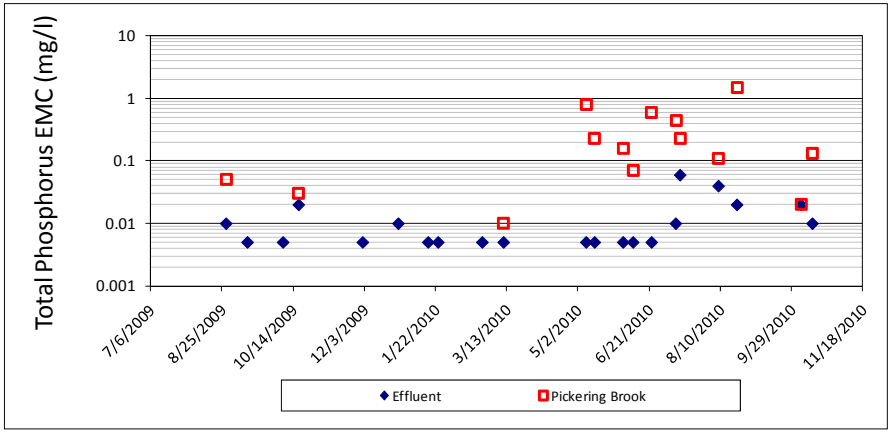


Figure 4: Effluent and Receiving Water Contaminant Concentration Time Series Plots for the Range of Post-Construction Monitoring Data (cont).