SOURCES AND DYNAMICS OF FECAL COLIFORM BACTERIA IN UNIVERSITY LAKE

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FINAL REPORT

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Abstract

During the period between July 2005 and July 2006 field and lab examinations were conducted to define the sources and dynamics of Fecal Coliform (FC) bacteria in University Lake. The goal of the project was to provide site-specific recommendations towards the restoration of acceptable water quality in University Lake. University Lake is located on the Chester Creek waterway in Anchorage Alaska. It is a water body that has been defined as water quality limited by the Alaska Department of Environmental Conservation, being in violation of the drinking water quality standard of FC. During the biweekly water quality sampling events at the inlet (UL-1), outlet (UL-2) and storm drain (UL-s) outfall of University Lake we found that FC loading is highest at the inlet versus the outlet. Both average and maximum FC values were higher at UL-1 than UL-2. We found that FC concentration decreased on average 68% from the UL-1 to UL-2 over a 7 day period that also corresponded to the determined average lake residence time. We also determined University Lake is more effective in removing FC load during ice covered conditions, (85% FC load removed) than during ice free condition (35% load removed). We did not find a positive correlation between flow and FC concentration at the inlet, suggesting that the re-suspension theory does explain FC input. We also determined that Chester Creek is the dominant source of FC to University Lake. Secondary contributors include intermittent high overland input, direct water fowl input and extended survivability of FC in Lake water and sediments. We therefore recommend source tracking to determine specific source of FCs to Chester Creek and University Lake. In order to improve the water quality in University Lake, the load of FC at the inlet must be significantly lowered. Possible management practices may include increased street sweeping, restoration of riparian areas, increased education and increased sediment removal from sedimentation basins.

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Introduction

Due to non-attainment of the Fecal Coliform (FC) Bacteria standard, University Lake is listed as a Category 5 waterbody on Alaska's most recent Integrated Water Quality Monitoring and Assessment Report. In order to promote its recovery, the ADEC is currently finalizing a TMDL for the entire Chester Creek watershed, including University Lake. In its current form, the TMDL stipulates that the recovery will be accomplished primarily through implementation of BMPs, most notably through increased street sweeping and increased public education. Although these BMPs may indeed serve to decrease the fecal coliform levels, their relative effectiveness is difficult to predict due to the fact that the sources and dynamics of fecal coliform populations within the lake are poorly understood. Provided with a better understanding of fecal coliform sources within University Lake, watershed managers would be able to develop a more effective recovery plan directed specifically at the primary contributors. Moreover, through a more thorough understanding of the fecal coliform dynamics within the lake, watershed managers would be able to develop a monitoring strategy intended to maximize the relevant information provided while minimizing the sampling effort. Although the original listing and the subsequent TMDL represented the crucial first steps towards the recovery of University Lake, developing site-specific knowledge regarding the sources and dynamics of fecal coliforms in the lake represents the final step prior to implementation and assessment of appropriate BMPs.

Methods

Please refer to the Quality Assurance Project Plan as well as appendices (where noted in the text) at the end of this document for a detailed description of the laboratory methods.

Results

Data Validation and Completeness

All criteria for measurement of data were followed as outlined in the QAPP. The following shows that the number of samples collected was near or exceeded the number projected and data collection was complete. The number of samples collected at the storm drain outfall (UL-S) was less than projected. Water does not flow continuously from the storm drain, therefore samples could only be collected when water was flowing. The number of samples collected for the Lake Sediment Survivability study also fell below the projected number. Unfortunately, our *in situ* mesocosms were vandalized and the study had to be halted early.

Site Name	Location	# FC Samples	Total Samples Projected	Total Samples obtained
Bi-weekly Lake FC Input and Output Sampling Events				
UL-1	Inlet to University lake	3	78	100
UL-2	Outlet to University Lake	3	78	103
UL-S	Storm drain outfall in University Lake	3	78	54
Field Sediment and Water Column association at Transects at University Lake				
TR-1	University Lake Inlet Side	Four Locations Per transect, 3 Depths per location	36	36
TR-2	University Lake Middle	Four Locations Per transect, 3 Depths per location	36	32

TR-3	University Lake Outlet Side	Four Locations Per transect, 3 Depths per location	36	31
Lake Sediments Survivability				
	University Lake bottom	54	54	42, with 3 replicates per sample.

Fecal Coliform Inputs and Outputs

The concentration of fecal coliforms (FC) regularly exceeded the standard for drinking water quality designated by the Alaska Department of Environmental Conservation for Chester Creek (Table 1). This standard states that the geometric mean of FC samples obtained within a 30 day period may not exceed 20 colony forming units (CFU)/100ml, and that no more than 10% of samples gathered over a 30 day period may exceed 40 CFU/100ml. The geometric mean was calculated by using a minimum of 3 or more countable (relevant) plates +/- 15 days of any sample date. The Standard Method (SM 9222-D) outlined in the QAPP dictates what is countable saying that Petri plates containing less than 20 or greater than 80 colonies be treated as uncountable (less than 20 indicates too small a sample size and greater than 80 results in unacceptable variability due to counting errors and competition for nutrients limiting colony growth). This resulted in less than 30% of all plates being available for analysis.

Figures 1 and 2 show the 30-day geometric means calculated over the entire year at each site and originates from the fecal coliform data set in Appendix 1. Any time a geometric mean was calculated at either site it violated the standard. The fewer geometric means calculated at the UL-2 site versus the UL-1 site is directly related to the low number of relevant observations as seen in Table 1. At UL-2, data points were generated neither between 9-20-05 and 11-22-05 nor in 2006 (Figure 2). In contrast, data points were generated within those time spans at site UL-1 (Figure 1). Note also that the FC concentration exceeded the standards more often at the inlet to University lake (UL-1) than the outlet (UL-2) (Table 1).

Table 1. Fecal Coliform Regulatory Compliance at UL-1 and UL-2

Site	Number of Exceedances of Standard	Number of Relevant Observations	Percent of individual Exceedance	Number of Exceedances of Standard	Number of Relevant Observations	Percent of individual Exceedance
	Geometric Mean >20 CFU/100ml (30 days)			10% samples > 40CFU/100ml (30 days)		
UL-1	27	32	84%	30	36	83%
UL-2	11	19	58%	16	22	73%
Relevant observations are those samples that fall within the 20-80 colonies per plate range.						

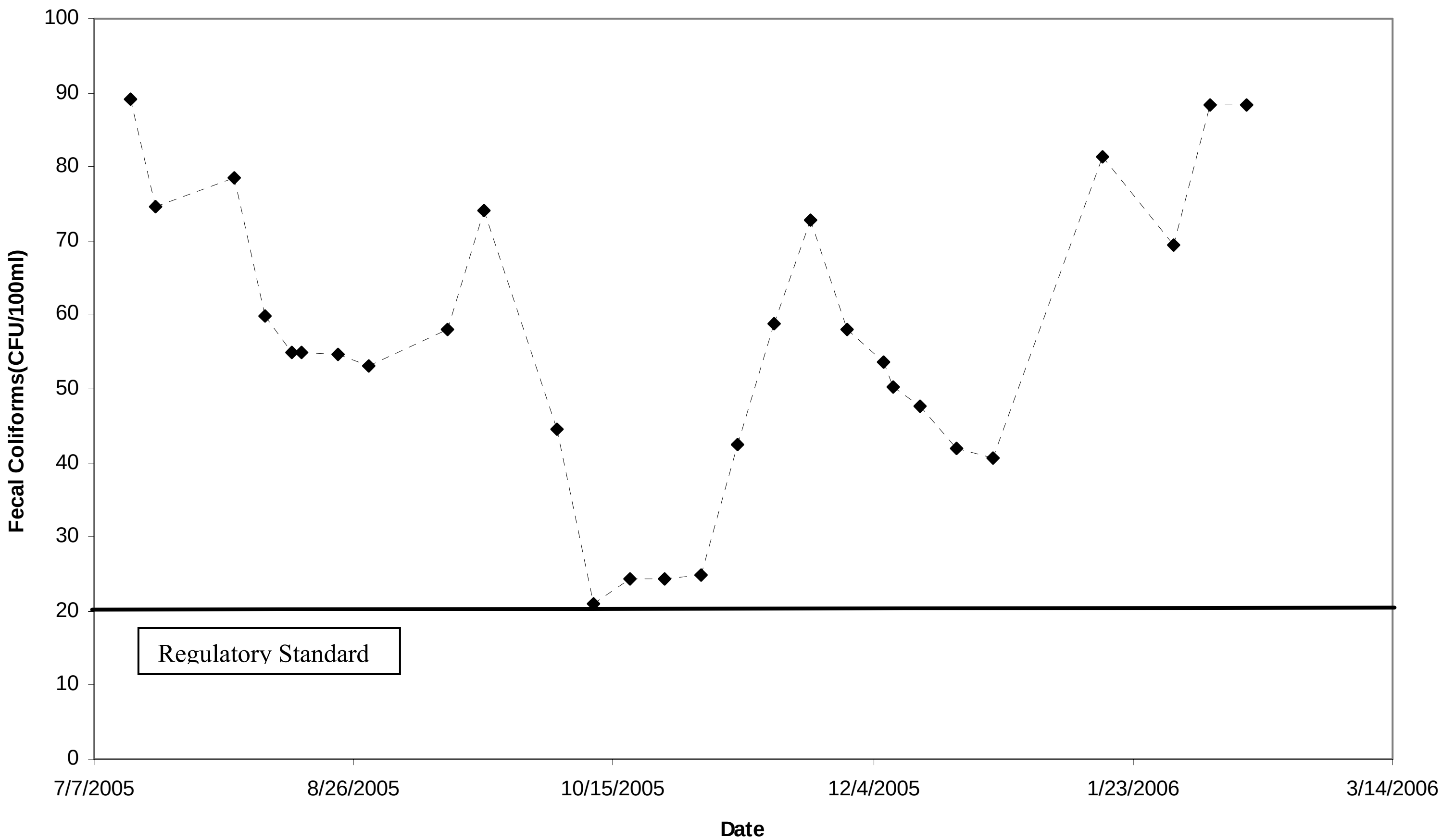

Figure 1: Geometric 30 day mean, UL-1

Geometric mean was based on 3 or more countable measurements at a given site within any 30 day period.

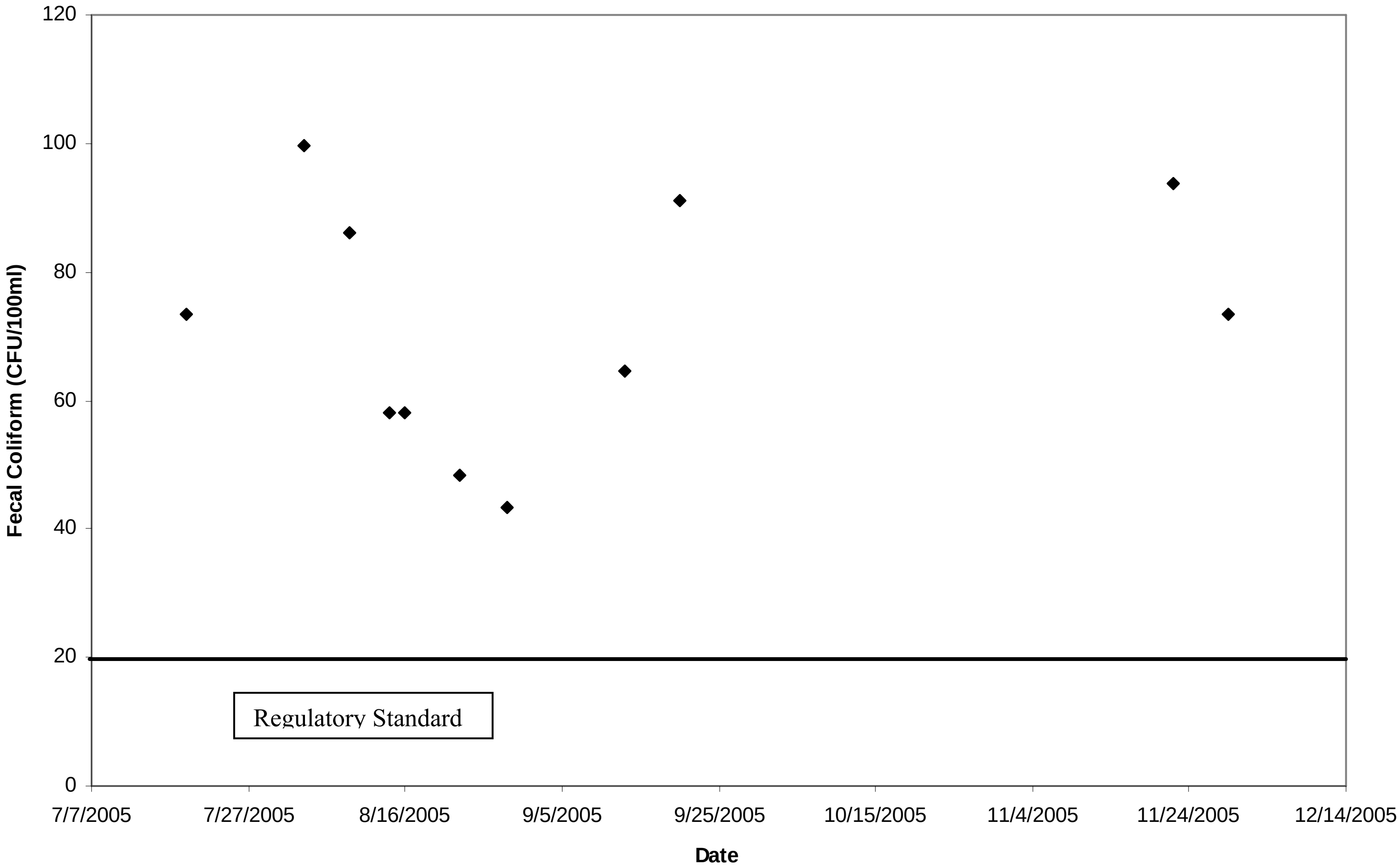

Figure 2:Geometric 30 day Mean UL-2

Geometric mean was based on 3 or more countable measurements at a given site within any 30 day period.

The inability to use data that fell outside the countable plate range negatively impacts our ability to fully understand the University Lake system. The loss of 70% of data therefore made using the SM 9222D limited in its usefulness, and ineffective in describing what is occurring at the inlet and outlet of University Lake. Therefore, the FC data were re-evaluated to include data previously excluded as uncountable.

The following methodology was employed for the purposes of re-evaluation. Counts that were below the 20 colonies per plate minimum were assigned the number counted; for example if there were 2 CFUs from the 50ml dilution, it was recorded as 4 CFU/100ml. For counts that were above the 80 colonies per plate maximum, the plate was counted a minimum of 3 times to obtain the CFU. However, some plates were uncountable due to lack of distinct, separate colonies. These were recorded as too numerous to count (TNTC). For each site, on each sampling date, the average FC CFU/100 ml was determined using the replicates for which a number could be calculated. If all three of the replicates from a site on a given day were TNTC, the CFU/100 ml was calculated by assigning the maximum value of 80 CFU to the highest dilution filtered. For example, 20ml filtered, multiplied by 80 CFU= 400 CFU/100ml. Although the value calculated in this manner is an estimated minimum number of FC, it was used in the re-analysis, as there was clearly an exceedance of the water quality standard. This new method of data evaluation increased the number of samples at UL-1 table 1 from 32 to 100 and UL-2 from 19 to 103.

The average number of FC/100 ml was greater at UL-1 than UL-2 (Table 2). The maximum number of FC at UL-1 was nearly twice the maximum at UL-2. High concentrations of fecal coliforms were also found in a storm drain (UL-S) that drains into University lake, with a maximum of 800 CFU/100 ml (Table 2).

Table 2: Summary of fecal coliform data from all counted plates during regular sampling.

Site	# Samples	Min. FC/100ml	Max. FC/100ml	Avg. FC/100ml
UL-1 Inlet	100	0	310	54
UL-2 Outlet	103	0	190	25
UL-S Storm drain	54	0	800	65
Bi-weekly sampling occurred from 7-14-05 through 6-12-06				

The data were also analyzed based on presence or absence of ice. The lake was iced over from 11-8-05 through 5-2-06 and ice free from 7-1-05 to 11-2-05 and from 5-11-06 to 6-12-06. To determine if the presence or absence of ice impacts FC concentration, a probability test for each site and condition was conducted as described by Novotny (2002), The method and calculations are presented in appendix 2.

The probability of obtaining a particular FC concentration at the same site appears to change between seasons. There was a higher probability of obtaining the 20 CFU/100ml regulatory standard at all 3 sites when the lake was free of ice (Figure 3) compared to when it was iced over (Figure 4),. Also, the probability of obtaining any particular concentration of FC is greater at UL-1 than UL-2 regardless of ice condition. This increased probability between the sites is greatest when the lake is iced over, confirming that seasonal variation occurs at the sites. The difference in probability between UL-1 and UL-2 occurs because the FC concentrations are significantly higher at UL-1 than UL-2 ($t = X$, $ά=0.05$; appendix 3).

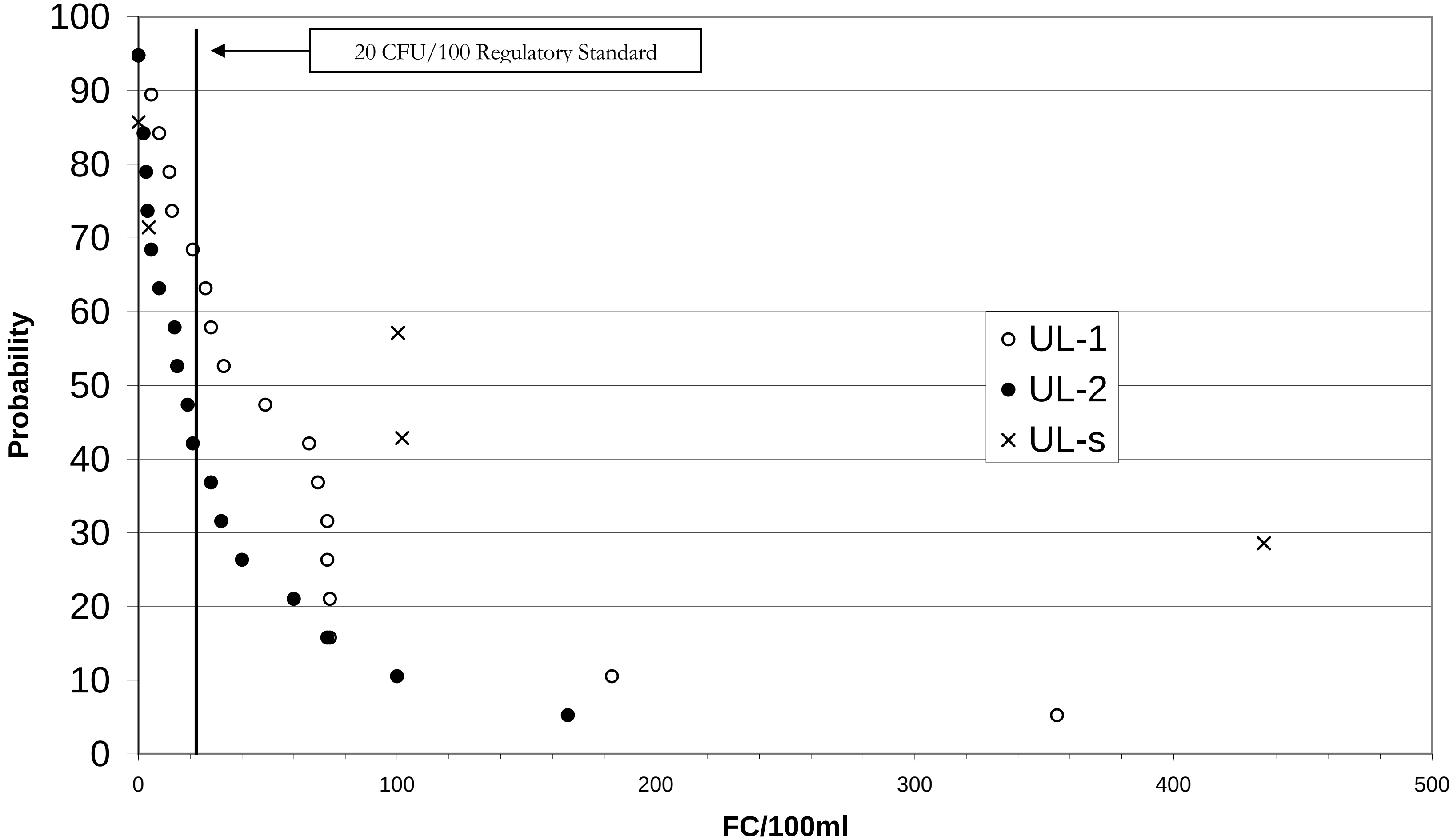

Figure 3: Probablity of Obtaining FC/100ml Summer

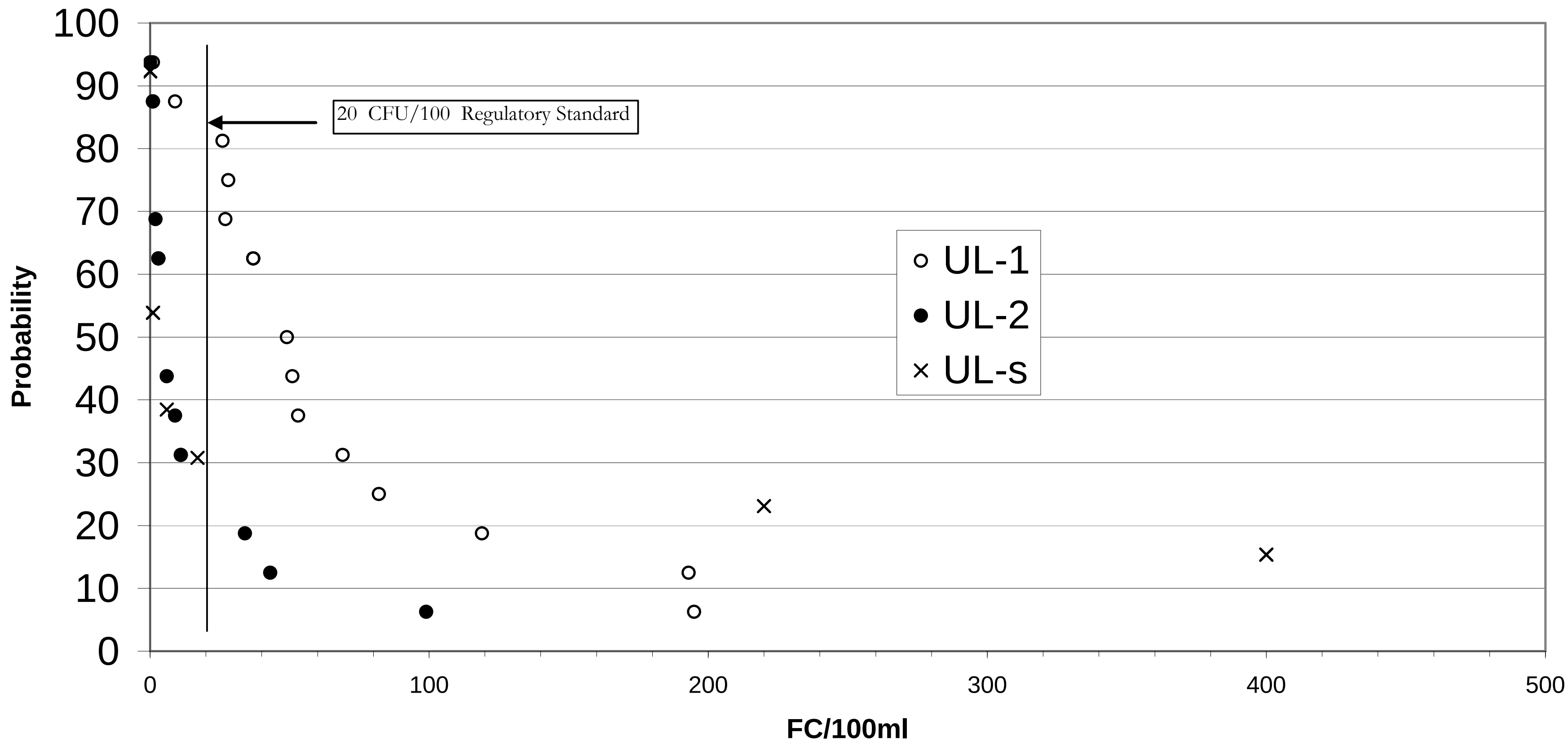

Figure 4:Probability of Obtaining FC/100 in Winter

There were two “event-driven” samplings conducted within the sampling period. The first took place on 9-13-05 (during a period of heavy rain), and second on 12-8-05 (during a melt event). The first event sampled overland flow at 5 locations around the lake. These 5 samples were taken from the newly formed rivulets created from the heavy precipitation. Rather than use the membrane filtration method as described in the QAPP, a Multiple-tube method utilizing the average most probable number (MPN) was employed to enumerate FC (authors et al., 1994: appendix 10). This change was made due to soil suspended in the water which clogged the membrane filters. The average FC was 281/g.

During the second event, UL-1, UL-2, and UL-S were sampled after a large shift in temperature caused increased runoff due to snow melt. The concentration of FC was determined using membrane filtration The result was a large change in concentration of FC at the storm drain (appendix 2), and no real noticeable change at the inlet or outlet.

The FC and water quality data were evaluated over the entire year as well as between ice-free and iced-over conditions using the Pearson r-correlation method to determine correlations between water quality parameters and FC concentrations. Only the significantly identified correlations that impact FC concentration are evaluated. Stage, the descriptor used for stream flow, and temperature correlated loosely with FC during ice free conditions (Table 3) at both UL-1 and UL-2, while temperature correlated loosely with FC at UL-1 only. The negative correlation between FC and stage during ice free conditions at UL-1 suggests that the load (FC/day) of FC coliform is constant and does support the re-suspension theory (the theory that at high stage, FCs in the sediment would be resuspended in the water column thus giving a positive correlation between stage and FC). This is in contrast to UL-2, were a positive correlation between stage and FC was observed. This was likely due to a decrease in residence time during high stage (vs. low) and thus decreased time for FC to settle out of the water column. Figures 5 and 6 depict the identified water quality parameters that impact FC concentration in graphical form.

Table 3: Correlation of fecal coliform and water quality parameters

Site	Year	FC	Stage	Temp.	pH
UL-1	FC	1			
	Stage	-.47	1		
	Temp.	.29	.40	1	
	PH	-.18	-.09	.02	1
	DO	.31	-.58	-.66	-.21
UL-2	FC	1			
	Stage	.008	1		
	Temp	.27	.60	1	
	PH	-.37	-.17	.14	1
	DO	.002	-.72	-.46	.33
UL-1	**ice free**	FC	Stage	Temp.	pH
	FC	1			
	Stage	-.58	1		
	Temp	.57	-.71	1	
	PH	-.41	-.05	-.15	1
	DO	-.02	-.38	-.40	.17
UL-2	FC	1			
	Stage	.51	1		
	Temp	.13	-.40	1	
	PH	-.63	-.80	.33	1
	DO	-.14	-.78	-.10	.55
UL-1	**iced over**	FC	Stage	Temp.	pH
	FC	1			
	Stage	-.40	1		
	Temp	-.08	.11	1	
	PH	-.10	-.48	-.27	1
	DO	.02	.55	-.16	-.67
UL-2	FC	1			
	Stage	.14	1		
	Temp	-.03	.39	1	
	PH	-.33	-.28	.08	1
	DO	-.27	-.56	-.63	.20
Correlation coefficients greater or less than .5 and -.5 are highlighted					

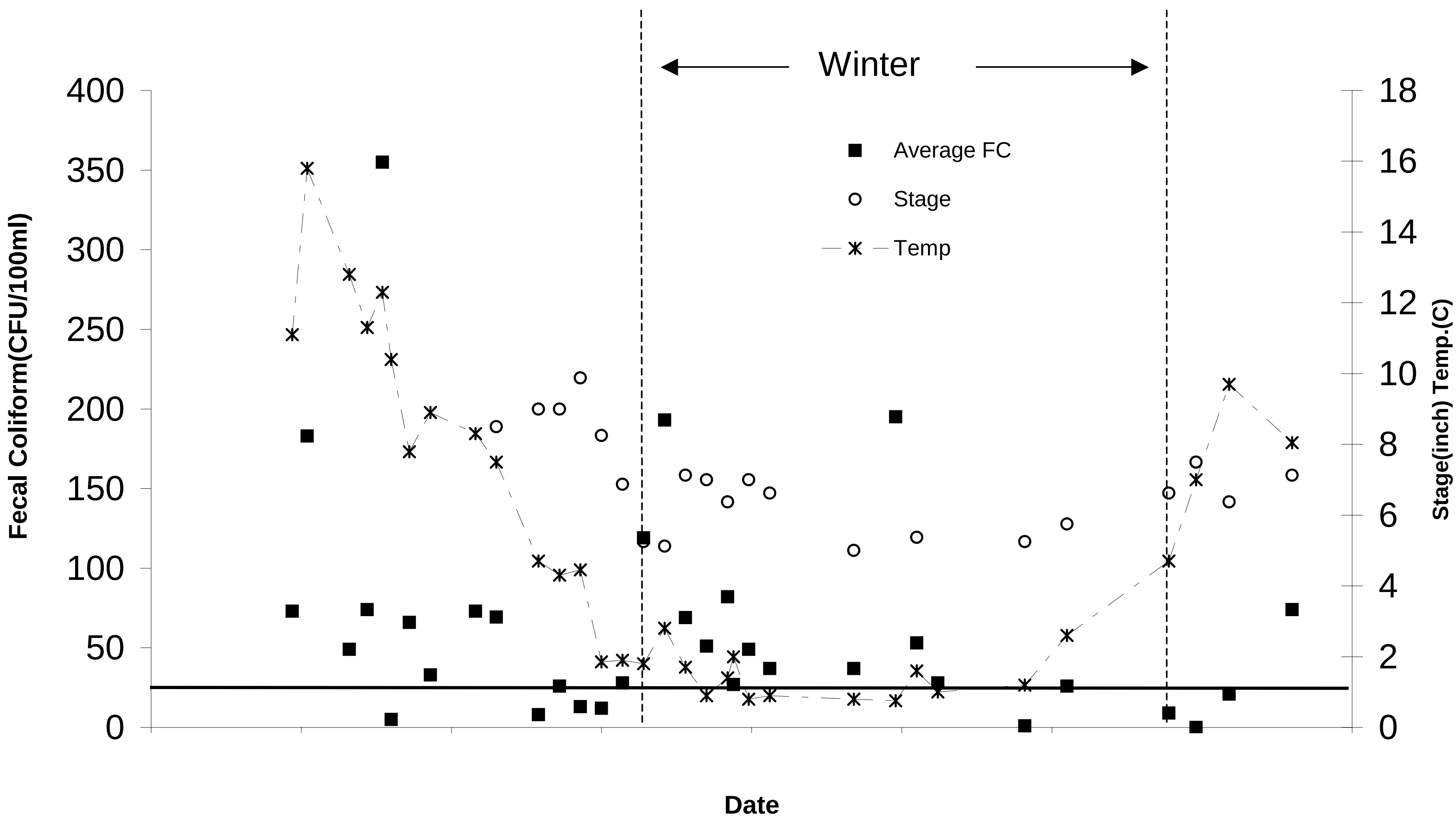

Figure 5: Fecal coliform, Stage, and Temperature UL-1

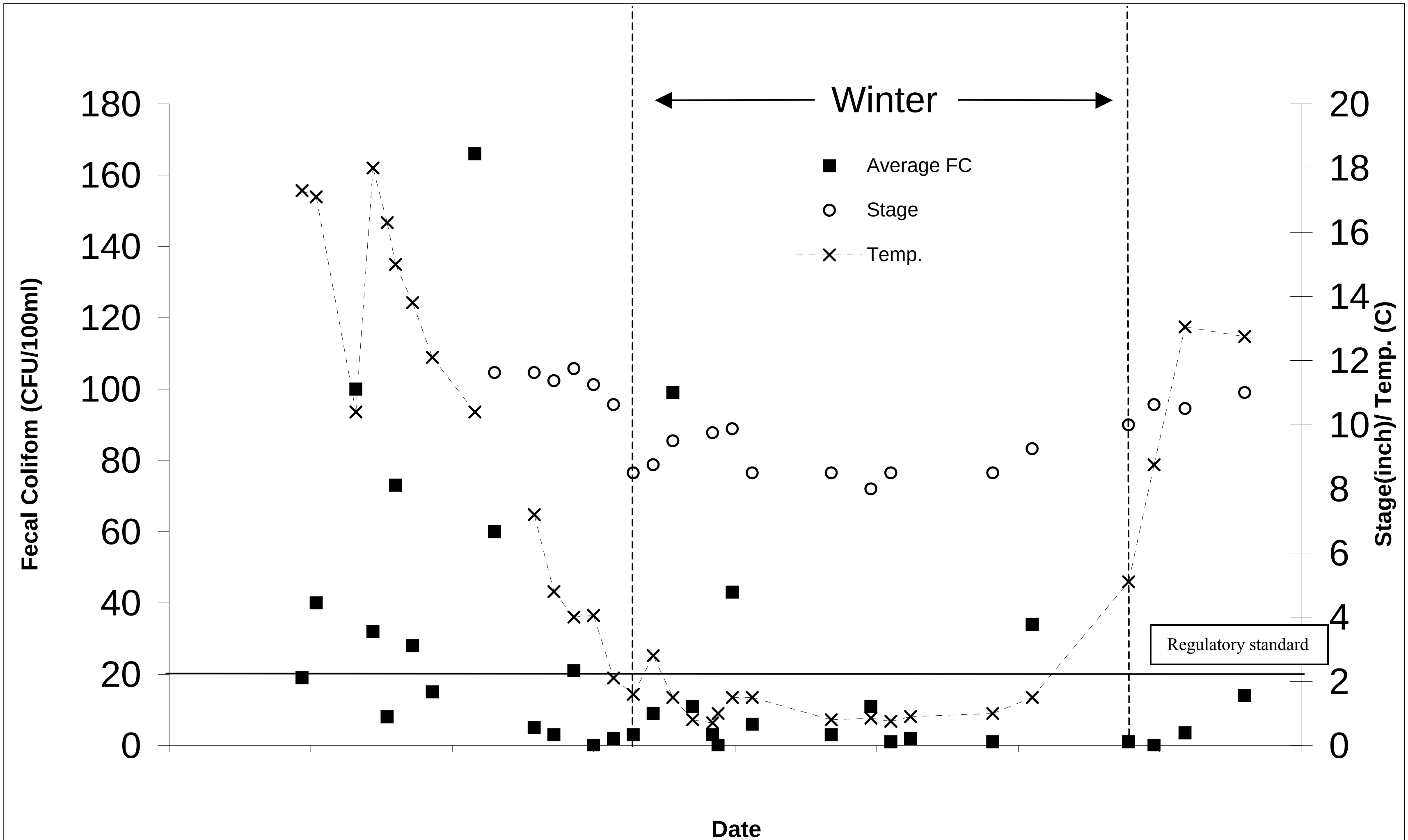

Figure 6: Fecal coliform, Stage, andTemperature at UL-2

Source Contributors.

We identified three main contributors of FC into University Lake.. The main contributor of FC is Chester Creek (Table 4). The second is direct input from waterfowl and the third is over land flow from the park.

The direct input from waterfowl was estimated by using an established bird density of 39 birds/km^2 (including Loons & Grebes, Geese, Swans, Ducks, Raptors, Sandhill cranes, Shorebirds, Gulls & Terns) as described in Murphy et al. (2001) . Given that University Lake is 38.6 acres, or 1.56 $x10^{-1}$ km^2, it is estimated that birds would therefore contribute 2.69 x 10^6 FC per day, or less than 0.1% of the input measured at UL-1. Bird fecal coliform density and feces discharge calculations were taken from Schueler and Holland 2000,

The third main contributor of FC to University Lake is over land flow that occurs during rain events. Even though over land flow contains extremely high FC concentrations and does impact UL-1 concentration over a short period, it is limited to the length and intensity of a precipitation event. The lack of known or estimated daily volume inputs and the intermittent nature of overland flow makes it a minor player in the yearly loading.

Mass Balance.

Given the sources of contributors of FC into University Lake, it was important to confirm that FC input at UL-1 was the main factor determining FC output at UL-2 (appendix 7). This was tested using binominal analysis of FC data that was paired 7 days apart (one lake residence time) at UL-1 and UL-2. (see appendix 7 for method description and calculations). This test showed that the relative increase or decrease of FC at UL-1 would correspond over the period of one lake residence time to an increase or decrease, respectively, at UL-2. It also found that the magnitude of FC change experienced at UL-1 over one lake residence time was the same as the magnitude of FC change experienced at UL-2. It is then valid to create a mass balance of FC using only input at UL-1 and output at UL-2. We were able to determine the mass balance of University Lake over the seasons (Table 4). Over the entire year an estimated input of FC into University Lake from Chester Creek was 5.0 x 10^{12} and the estimated output of FC was 2.27 x 10^{12} . A 35% reduction in the FC load occurred at UL-1 from ice free to iced conditions, while a 82% reduction occured at UL-2 during the same period. During ice free conditions there is a 35% reduction in load between UL-1 and UL-2, while during iced-over conditions there is a decrease of 83%. The overall reduction between UL-1 and UL-2 for the entire year is 53%.

Table 4: Fecal coliform mass loading into and out of University Lake

UL-1	Average flow cfs	Average FC/100ml	Load	
			FC/sec	FC/day
ice free	15.523	54	237226	2.05e10
iced over	9.878	55	153754	1.33e10
UL-2				
ice free	15.069	36	153525	1.33e10
iced over	9.067	13	27254	2.35e9

Description of University Lake Physical and Hydrologic Setting

University Lake is located in the U.S. Geological Survey (USGS) Anchorage A-8 NE quadrangle (1:25,000-scale) in south-central Alaska. Surficial deposits of glacial, glacioestuarine, and glacialalluvial origin dominate most of the A-8 NE quadrangle. During the latter part of Wisconsinan glaciation, surficial deposits were emplaced by advances and retreat of glacial ice. Glacial deposits at University Lake are a result of several glacial advances and retreats into mountains to the north and east, and local glaciers in nearby mountain valleys (Schmoll et al., 1996).

Surficial deposits at University Lake are comprised of mostly of glacialalluvial and related alluvial deposits, specifically Nunaka Valley channel deposits (Schmoll et al., 1996). Nunaka Valley channel deposits were deposited in a series of relatively short catastrophic outburst floods from the breakout of Eagle River that had been blocked by the Elmendorf glacier and its massive moraine (Schmoll et al., 1996) . Nunaka Valley deposits occur in a broad meandering channel system. The channel system splits into two main channels. South Fork Chester Creek, while underfit, presently occupies the southeasterly channel. Nunaka Valley channel deposits are partially visible along the east side of University Lake (Schmoll et al., 1996).

University Lake lies within the Anchorage lowland physiographic province. Southwest-trending low relief hills composed of glacial drift dominate the terrain. A gently sloping alluvial fan formed by Chester Creek interrupts these hills. A narrow south-trending swath of stream alluvium crosses University Lake at the west side of the East lobe (Schmoll et al., 1996).

A USGS Surficial Geology of Anchorage and Vicinity, Alaska, from 1972 shows the location of present day University Lake as a gravel pit (Schmoll and Dobrovolny, 1972). South Fork Chester Creek is located south of the gravel pit and appears to be channelized. An interview with a local gravel pit operator suggested that prior to the mid-1970s University Lake was a gravel pit, and that Rogers Brothers Construction from Seattle, WA and Babbler Construction from Portland, OR used gravel from the University Lake area and operated an asphalt plant nearby. After gravel mining operations ceased, South Fork Chester Creek was diverted into the gravel pit and the modern day inlet and outlet were established (pers. com. H. Lang, 2006).

Figure 7 is the bathymetric map of University Lake generated from data gathered on 9-2-05 (raw data is included in Appendix 4). The lake is separated into two major lobes. The eastern lobe is a deep basin into which Chester Creek flows. The eastern lobe is connected to the western lobe through a narrow, shallow section. The western lobe is a basin of moderate depth from which Chester creek flows out. From the bathymetry of the lake we estimated the lake to contain 5,600,000 cubic feet of water. Given the strong relationship of flow to stage (Table 5; raw data in appendix 3) we estimated the residence time of the lake to be 6.8 days +/- 1.8 days (see appendix 4 for bathymetry and residence time calculations)

Table 5: Linear regression of discharge and stage for UL-1 and UL-2

Site	**Regression equation**	r^2
UL-1	CFS= 2.6393(stage inch.)-6.3975	.84
UL-2	CFS=3.5713(stage inch.)-24.974	.83

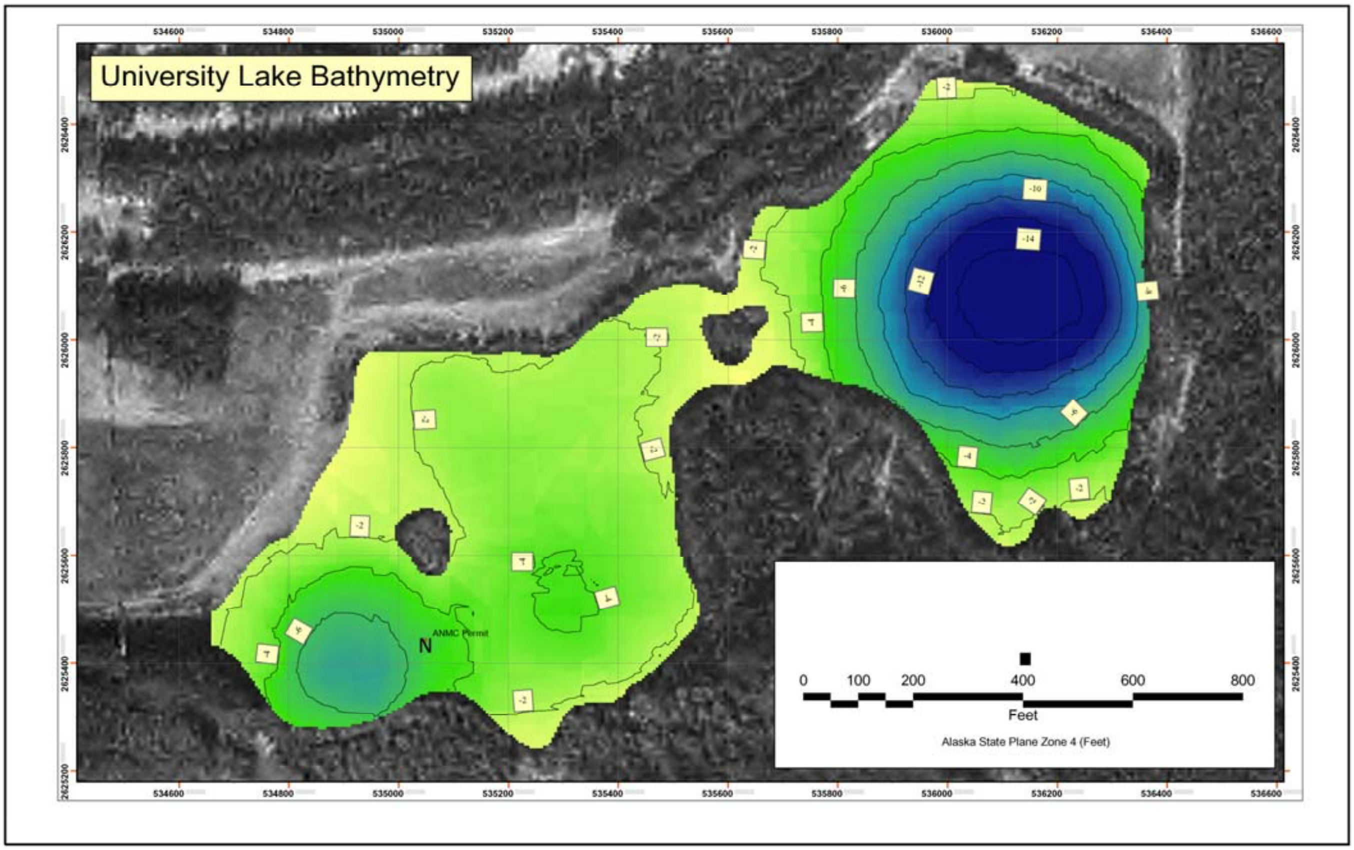

Figure 7: University Lake Bathymetry

Whole-Lake Sampling: University Lake Flow and Mixing Characteristics

Three whole lake sampling events were conducted on University Lake. These events occurred on 9-2-05, 2-10-06, and on 5-23-06. On 9-2-05 there was an average of 68 CFU/100ml within the lake. No trend in FC concentration was seen with depth or transect location, indicating that the lake is fully mixed. The results from 9-2-05 are in contrast to the that seen on both 2-10-06 and 5-23-06, where we obtained an average FC concentration of <1 CFU/100ml, and FC were only detected within 2 feet the bottom of the lake. Appendix 5 shows the raw condensed data for the whole lake sampling events. It is important to keep in mind that the lake had only been ice-free for two weeks when the last sampling event occurred and that spring breakup was a slow and gradual occurrence.

Fecal Coliform Survivability in Water Column and Sediments

Two survivability studies were conducted during this project, a laboratory study and an *in-situ* field study. Both the studies confirmed that coliform bacteria are able to survive in Chester Creek water and sediments for prolonged periods of time at both 4C and 16C (Table 6 and Fig. 8). In general, coliforms persisted for longer at 4C than at 16C, likely due to decreased metabolic activity and lower predator activity (under non-sterile conditions).

Table 6: *Escherichia coli* half-lives during laboratory incubations at varying temperatures.

Type	Temp	Regression equation.	r^2	Half-Life (days)
Non-sterile water.	4c	Y=-.0303x+6.538	.947	22.9
Non-sterile Sediment.	16c	Y=-.05x+5.889	.618	13.9
Sterile Sediment.	4c	Y=-.0249x+7.0115	.969	27.83
Sterile Sediment.	16c	Nonlinear- Y=5e-5x3- .0037x2+.0719x+7.0596	.915	
Sterile water	4c	Y=-.0035x+141.45	.713	198
Sterile water	16c	Y=-.0017x+70.298	.281	407.6
Significant departure from literature reported values are highlighted.				

The *in-situ* survivability study was modified from the original plan outlined in the QAPP. The departures from the QAPP included; 1) deployment of microcosms at one site instead of three, 2) using 10 grams of sediment instead of 50 grams because of scaling, and 3) using the 3 tube MPN method rather than the spread plate technique (appendix 10). *The in situ* field results also showed an extended survivability of FC in University lake sediment. The half-life of fecal coliforms was 69 days; greater than most other literature reported values.

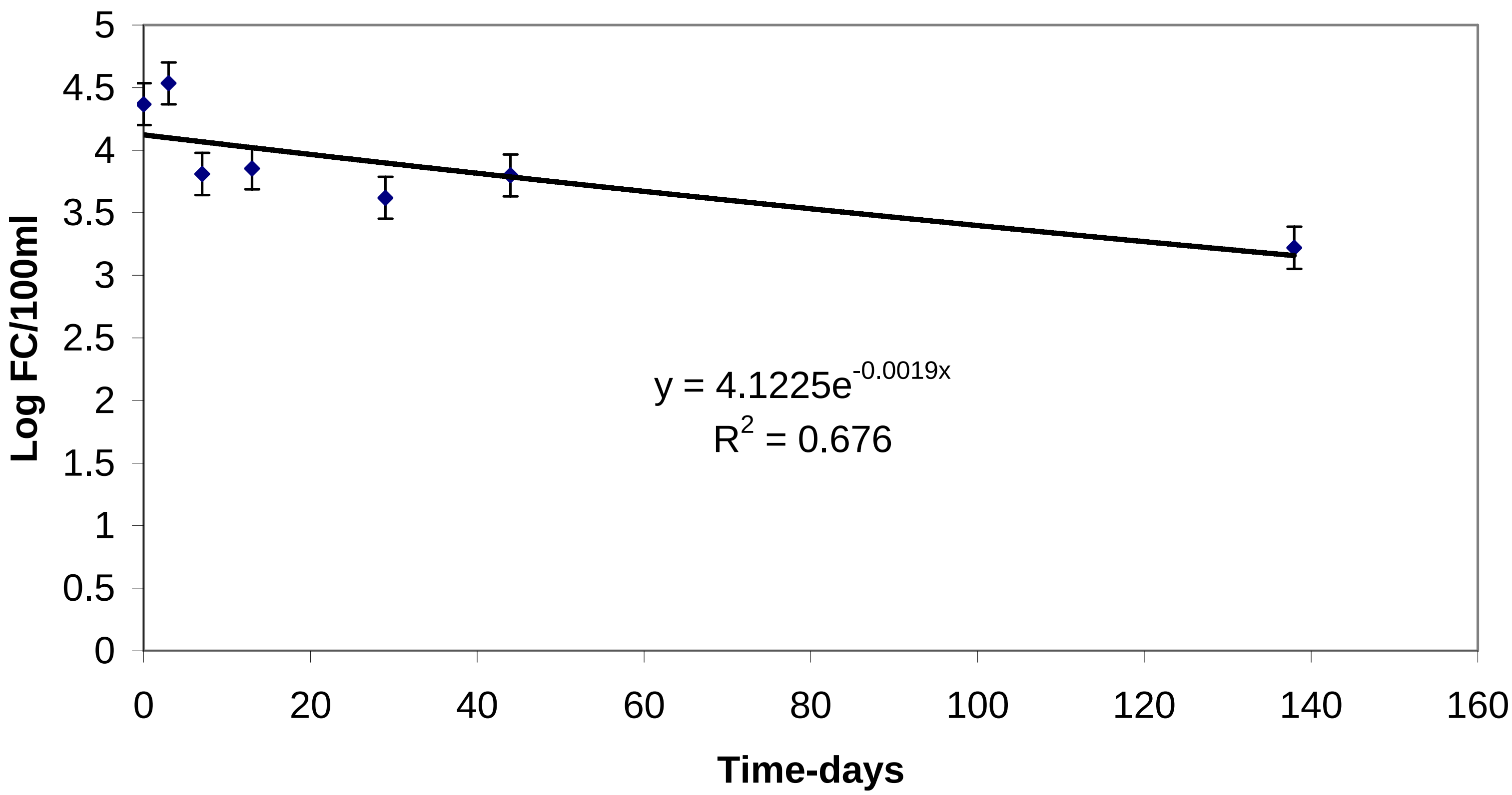

Figure 8: Coliform Survivability in the Field

Errors bars represent the standard deviation of the mean for each point. .

Conclusions

University Lake acts as a sink for FC; it is capable of removing over half of the yearly FC load from Chester Creek. University Lake is a more efficient sink during iced over conditions than ice free conditions. This could be due to decreased mixing under ice allowing for increased settling, or a decreased input from overland sources as the lake is isolated from those inputs by ice cover. The latter is less likely as the data indicate the dominant input of FC into University Lake is Chester Creek and that the FC observed at UL-1 was the identified factor for FC observed at UL-2 (appendix 7). It is clearly demonstrated that both the inlet and outlet of University Lake exceed the water quality standard (Table 1, Figures 5 and 6), and that FC concentrations at the inlet regularly exceeded those at the outlet. These findings combined with the fact that the lake is a sink for FC leads to the conclusion that, in order to improve the water quality downstream of University Lake, there needs to be a decrease in FC concentrations at the inlet, thus those upstream of the lake in Chester Creek

Recommendations

Microbial source tracking is important to determine the contribution of different sources of FC to the Chester Creek watershed, including the inlet and outlet to University Lake. Source knowledge is important for determining what actions are best able to decrease the FC load into the creek as well as the lake. With the current study, no direct corrective measures toward specific sources can be recommended. The following are more general recommendations to help meet the standard.

- Review the Water Quality Standard designated for Chester Creek and consider changing the standard to that for contact recreational use rather than drinking water use. This is proposed because the high exceedance of the regulatory standard indicates that it may be an unrealistic classification, and FC concentrations in Chester Creek are due to its location in a highly urbanized area.
- Increased street sweeping, increased maintenance of storm drain settling basins and public education may reduce inlet loads sufficiently to decrease outlet concentrations such that Chester Creek comes into compliance with the regulatory standard.
- Decrease overland flow contributions by restoring and maintaining riparian vegetation areas around and upstream of University Lake.
- Increase University Lake sink capacity by dredging the western lobe of University lake, thereby increasing settling time for FC out of the water column.

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Appendix 1:Fecal Coliform Data.

Chester Creek Date	UL-1 amount filtered	FC plate count	Other Bacteria No notation indicates zero	Countable	FC/100ml	geometric mean fc/100ml	countable Ave. FC/100ml	all counted Ave.FC/100ml
7/14/2005	20ml	10	0	n	50	68.8915	84	73
7/14/2005	50ml	59	0	y	118			
7/14/2005	100ml	50	0	y	50			
7/19/2005	20ml	62	5	y	310	78.40324	310	183
7/19/2005	50ml	tntc		n	160			
7/19/2005	100ml	tntc		n	80			
8/3/2005	20ml	2	0	n	10	78.40324	69	49
8/3/2005	50ml	52	0	y	110			
8/3/2005	100ml	28	2	y	28			
8/9/2005	20ml	30	0	y	150	78.86406	74	74
8/9/2005	50ml	24	2	y	48			
8/9/2005	100ml	24	0	y	24			
8/14/2005	20ml	23	5	y	115	54.91928	115	355
8/14/2005	50ml	tntc		n	160			
8/14/2005	100ml	tntc		n	80			
8/16/2005	20ml	3	0	n	15	54.91928	15	5
8/16/2005	50ml	0	0	n	0			
8/16/2005	100ml	1	0	n	1			
8/23/2005	20ml	19	0	n	95	54.05767	52	66
8/23/2005	50ml	26	1	y	52			
8/23/2005	100ml	51	7	y	51			
8/29/2005	20ml	8	1	n	40	53.22061	28	33
8/29/2005	50ml	16	2	n	32			
8/29/2005	100ml	28	4	y	28			
9/13/2005	20ml	17		n	85	58.1016	50	73
9/13/2005	50ml	25		y	50			
9/13/2005	100ml	85		n	85			
9/20/2005	20ml	2		n	10	74.10795	114.5	69.4
9/20/2005	50ml	3		n	6			
9/20/2005	100ml	44		y	44			
9/20/2005	20ml	37		y	185			
9/20/2005	50ml	51		n	102			
10/4/2005	20ml	1		n	5	44.52899	10	8
10/4/2005	50ml	5		n	10			
10/4/2005	100ml	9		n	9			
10/11/2005	20ml	9		n	45	20.93631	23	26
10/11/2005	50ml	5		n	10			
10/11/2005	100ml	23	1	y	23			
10/18/2005	20ml	2	4	n	10	24.30083	21	13
10/18/2005	50ml	4	2	n	8			
10/18/2005	100ml	21	8	y	21			
10/25/2005	20ml	2	14	n	10	24.30083	19	12
10/25/2005	50ml	4	8	n	8			
10/25/2005	100ml	19	17	y	19			
11/1/2005	20ml	9	0	n	45	24.75059	38	28
11/1/2005	50ml	16	2	n	32			
11/1/2005	100ml	38	19	y	38			
11/8/2005	20ml	12		n	60	42.40859	160	119
11/8/2005	50ml	86		n	172			
11/8/2005	100ml	124		n	124			
11/15/2005	20ml	56	31	n	280	58.75433	193	193
11/15/2005	50ml	53	28	n	106			
11/15/2005	100ml	tntc		n				
11/22/2005	20ml	16	24	y	80	72.88777	64	69
11/22/2005	50ml	28	20	y	56			
11/22/2005	100ml	72	tntc	n	72			
11/29/2005	20ml	14	45	y	70	57.99081	49	51
11/29/2005	50ml	17	tntc	n	34			
11/29/2005	100ml	49	58	n	49			
12/6/2005	20ml	18	28	y	90	53.65855	78	82
12/6/2005	50ml	54	86	n	108			
12/6/2005	100ml	48	46	n	48			
12/8/2005	20ml	4	1	n	20	50.37445	48	27
12/8/2005	50ml	24	19	y	48			
12/8/2005	100ml	13		n	13			
12/13/2005	20ml	10	7	n	50	50.37445	48	49
12/13/2005	50ml	37	25	y	74			
12/13/2005	100ml	22	5	y	22			
12/20/2005	20ml	6	5	n	30	41.99778	41	37
12/20/2005	50ml	22	17	y	44			
12/20/2005	100ml	38	33	y	38			
12/27/2005	20ml	nd				40.61839	0	

12/27/2005	50ml	nd						
12/27/2005	100ml	nd						
1/17/2006	20ml	13	10	n	65	81.42481	34	37
1/17/2006	50ml	17	15	y	34			
1/17/2006	100ml	11	4	n	11			
1/31/2006	20ml	39	31	y	195	69.54414	195	195
1/31/2006	50ml	tntc		n				
1/31/2006	100ml	tntc		n				
2/7/2006	20ml	8	4	n	40	69.54414	59.5	53
2/7/2006	50ml	28	9	y	56			
2/7/2006	100ml	63	13	y	63			
2/14/2006	20ml	10	1	n	50	88.27839	16	28
2/14/2006	50ml	9	2	n	18			
2/14/2006	100ml	16	2	n	16			
3/15/2006	20ml	140	8	n	0	53	1	1
3/15/2006	50ml	tntc		n				
3/15/2006	100ml	tntc		n				
3/29/2006	20ml	2		n	10	53	53	26
3/29/2006	50ml	8		n	16			
3/29/2006	100ml	53	7	y	53			
4/13/2006	20ml	nd		n		28.19574		
4/13/2006	50ml	nd		n				
4/13/2006	100ml	nd		n				
5/2/2006	20ml	0		n	0	15	15	9
5/2/2006	50ml	6	1	n	12			
5/2/2006	100ml	15	5	y	15			
5/11/2006	20ml	0		n	0	15	0	0
5/11/2006	50ml	0		n	0			
5/11/2006	100ml	0	1	n	0			
5/22/2006	20ml	nd		n			15	21
5/22/2006	50ml	13		n	26			
5/22/2006	100ml	15	2	n	15			
6/12/2006	20ml	18		n	90	65.87868	66	74
6/12/2006	50ml	35		y	70			
6/12/2006	100ml	62	5	y	62			

Date	Chester Creek UL-2	FC plate count	Other Bacteria		Countable FC/100ml	geometric mean fc/100ml	countable Ave. FC/100ml	all counted Ave FC/100ml
7/14/2005	20ml	5	0	n	25	73.3178	28	19
7/14/2005	50ml	3	0	n	6			
7/14/2005	100ml	28	0	y	28			
7/19/2005	20ml	3	0	n	15	77.37876	86	40
7/19/2005	50ml	43	0	y	86			
7/19/2005	100ml	18	0	n	18			
8/3/2005	20ml	25	1	y	125	99.76719	111	100
8/3/2005	50ml	48		y	96			
8/3/2005	100ml	tntc		n	80			
8/9/2005	20ml	0	0	n	0	65.18262	96	32
8/9/2005	50ml	48	0	y	96			
8/9/2005	100ml	1	0	n	1			
8/14/2005	20ml	3	0	n	15	58.05836	15	8
8/14/2005	50ml	3	0	n	6			
8/14/2005	100ml	2	0	n	2			
8/16/2005	20ml	20	0	y	100	48.42681	73	73
8/16/2005	50ml	26	1	y	52			
8/16/2005	100ml	68	3	y	68			
8/23/2005	20ml	3	1	n	15	51.1086	30	28
8/23/2005	50ml	20	1	y	40			
8/23/2005	100ml	20	0	y	20			
8/29/2005	20ml	4	0	n	20	51.1086	23	15
8/29/2005	50ml	1	2	n	2			
8/29/2005	100ml	23	1	y	23			
9/13/2005	20ml	28		y	140	64.54479	140	166
9/13/2005	50ml	95		n	190			
9/13/2005	100ml	169		n	169			
9/20/2005	20ml	1		n	5	91.0414	95	60
9/20/2005	50ml	9		n	18			
9/20/2005	100ml	35		y	35			
9/20/2005	20ml	18		n	90			
9/20/2005	50ml	77		y	154			
10/4/2005	20ml	2		n	10	73.41662	5	5
10/4/2005	50ml	0		n	0			
10/4/2005	100ml	5		n	5			
10/11/2005	20ml	0		n	0		5	3
10/11/2005	50ml	2		n	4			
10/11/2005	100ml	5		n	5			
10/18/2005	20ml	5		n	25		13	21
10/18/2005	50ml	12		n	24			
10/18/2005	100ml	13	3	n	13			
10/25/2005	20ml	0		n	0		0	0
10/25/2005	50ml	0		n	0			

10/25/2005	100ml	0		n	0			
11/1/2005	20ml	0		n	0		6	2
11/1/2005	50ml	3		n	6			
11/1/2005	100ml	1		n	1			
11/8/2005	20ml	1		n	5		4	3
11/8/2005	50ml	0		n	0			
11/8/2005	100ml	4		n	4			
11/15/2005	20ml	3		n	15		6	9
11/15/2005	50ml	3		n	6			
11/15/2005	100ml	6		n	6			
11/22/2005	20ml	25	7	y	125	93.82675	99	99
11/22/2005	50ml	56	10	y	112			
11/22/2005	100ml	59	16	y	59			
11/29/2005	20ml	3		n	15		7	11
11/29/2005	50ml	5	7	n	10			
11/29/2005	100ml	7	1	n	7			
12/6/2005	20ml	0		n	0		8	3
12/6/2005	50ml	4	2	n	8			
12/6/2005	100ml	2	2	n	2			
12/8/2005	20ml	0		n	0		0	0
12/8/2005	50ml	0		n	0			
12/8/2005	100ml	0		n	0			
12/13/2005	20ml	5		n	25	50.7937	51.5	43
12/13/2005	50ml	30	10	y	60			
12/13/2005	100ml	43	7	y	43			
12/20/2005	20ml	0		n	0	50.7937	7	6
12/20/2005	50ml	5		n	10			
12/20/2005	100ml	7	6	n	7			
12/27/2005	20ml			n				
12/27/2005	50ml			n				
12/27/2005	100ml			n				
1/17/2006	20ml	1		n	5		2	3
1/17/2006	50ml	1		n	2			
1/17/2006	100ml	2		n	2			
1/31/2006	20ml	5		n	25		25	11
1/31/2006	50ml	3	1	n	6			
1/31/2006	100ml	1	2	n	1			
2/7/2006	20ml	0	0	n	0		2	1
2/7/2006	50ml	0	1	n	0			
2/7/2006	100ml	2	0	n	2			
2/14/2006	20ml	0		n	0		3	2
2/14/2006	50ml	2		n	4			
2/14/2006	100ml	3	1	n	3			
3/15/2006	20ml	0	3	n	0		1	1
3/15/2006	50ml	0	6	n	0			
3/15/2006	100ml	1	10	n	1			
3/29/2006	20ml	2		n	10	28.98275	31	34
3/29/2006	50ml	20	2	y	40			
3/29/2006	100ml	21		y	21			
4/13/2006	20ml	nd		n	0	28.98275	0	
4/13/2006	50ml	nd		n	0			
4/13/2006	100ml	nd		n	0			
5/2/2006	20ml	0		n	0		2	1
5/2/2006	50ml	0		n	0			
5/2/2006	100ml	2		n	2			
5/11/2006	20ml	0		n	0		0	0
5/11/2006	50ml	0	4	n	0			
5/11/2006	100ml	0	2	n	0			
5/22/2006	20ml	nd		n			3	3.5
5/22/2006	50ml	2		n	4			
5/22/2006	100ml	3		n	3			
6/12/2006	20ml	2	0	n	10	17	17	14
6/12/2006	50ml	8	2	n	16			
6/12/2006	100ml	17	5	y	17			
Chester Creek		**FC plate count**	**Other Bacteria**	**Countable**	**Geometric**		**countable**	**all counted**
Date	**UL-S1**				**mean fc/100ml**	**FC/100ml**	**Ave. FC/100ml**	**Ave FC/100ml**
7/14/2005	20ml	nd						
7/14/2005	50ml	nd						
7/14/2005	100ml	nd						
7/19/2005	20ml	13	56	y		65	65	102
7/19/2005	50ml	tntc		n		160		
7/19/2005	100ml	tntc		n		80		
8/3/2005	20ml	nd						
8/3/2005	50ml	nd						
8/3/2005	100ml	nd						
8/9/2005	20ml	nd						
8/9/2005	50ml	nd						
8/9/2005	100ml	nd						
8/14/2005	20ml	nd						
8/14/2005	50ml	nd						

8/14/2005	100ml	nd					
8/16/2005	20ml	nd					
8/16/2005	50ml	nd					
8/16/2005	100ml	nd					
8/23/2005	20ml	nd					
8/23/2005	50ml	nd					
8/23/2005	100ml	nd					
8/29/2005	20ml	nd					
8/29/2005	50ml	nd					
8/29/2005	100ml	nd					
9/13/2005	10ml	tntc		n	800	800	800
9/13/2005	20ml	tntc		n			
9/13/2005	50ml	tntc		n			
9/20/2005	20ml			n		nd	
9/20/2005	50ml			n			
9/20/2005	100ml			n			
9/20/2005	20ml			n			
9/20/2005	50ml			n			
10/4/2005	20ml			n		nd	
10/4/2005	50ml			n			
10/4/2005	100ml			n			
10/11/2005	20ml			n		nd	
10/11/2005	50ml			n			
10/11/2005	100ml			n			
10/18/2005	20ml	87	2	n	435	435	435
10/18/2005	50ml	tntc		n			
10/18/2005	100ml	179	1	n	179		
10/25/2005	20ml	22		y	110	109	100.3333
10/25/2005	50ml	58		y	108		
10/25/2005	100ml	83	5	n	83		
11/1/2005	20ml			n		nd	
11/1/2005	50ml			n			
11/1/2005	100ml			n			
11/8/2005	20ml	0		n	0	0	0
11/8/2005	50ml	0		n	0		
11/8/2005	100ml	0		n	0		
11/15/2005	20ml	0		n	0	0	0
11/15/2005	50ml	0		n	0		
11/15/2005	100ml	0		n	0		
11/22/2005	20ml	6	3	n	30	18	17
11/22/2005	50ml	2	0	n	4		
11/22/2005	100ml	18	5	y	18		
11/29/2005	20ml	2	3	n	10	6	6
11/29/2005	50ml	3	1	n	6		
11/29/2005	100ml	1		n	1		
12/6/2005	20ml	0		n	0	1	1
12/6/2005	50ml	1		n	2		
12/6/2005	100ml	1		n	1		
12/8/2005	20ml	tntc		n	400	400	400
12/8/2005	50ml	tntc		n			
12/8/2005	100ml	tntc		n			
12/13/2005	20ml	0		n	0	0	0
12/13/2005	50ml	0		n	0		
12/13/2005	100ml	0		n	0		
12/20/2005	20ml	tntc		n		400	400
12/20/2005	50ml	tntc		n			
12/20/2005	100ml	tntc		n			
12/27/2005	20ml	nd		n			
12/27/2005	50ml	nd		n			
12/27/2005	100ml	nd		n			
1/17/2006	20ml	nd		n			
1/17/2006	50ml	nd		n			
1/17/2006	100ml	nd		n			
1/31/2006	20ml	nd		n			
1/31/2006	50ml	nd		n			
1/31/2006	100ml	nd		n			
2/7/2006	20ml	0		n	0	0	0
2/7/2006	50ml	0	3	n	0		
2/7/2006	100ml	0		n	0		
2/14/2006	20ml	0		n	0	1	1
2/14/2006	50ml	0		n	0		
2/14/2006	100ml	1		n	0		
3/15/2006	20ml	nd		n			
3/15/2006	50ml	nd		n			
3/15/2006	100ml	nd		n			
3/29/2006	20ml	29	1	y	145	145	220
3/29/2006	50ml	147	3	n	294		
3/29/2006	100ml	tntc		n			
4/13/2006	20ml	nd		n			
4/13/2006	50ml	nd		n			
4/13/2006	100ml	nd		n			

5/2/2006	20ml	0		n	0	0	0
5/2/2006	50ml	0		n	0		
5/2/2006	100ml	0		n	0		
5/11/2006	20ml	0		n	0	0	0
5/11/2006	50ml	0		n	0		
5/11/2006	100ml	0		n	0		
5/22/2006	20ml	nd		n			
5/22/2006	50ml	nd		n			
5/22/2006	100ml	nd		n			
6/12/2006	20ml	1		n	5	4	4
6/12/2006	50ml	2		n	4		
6/12/2006	100ml	4	1	n	4		

Appendix 2: Calculating the Probability of Attaining FC/100ml during Summer and Winter Season (Novotny, 2002)

Chester Creek	UL-1 all counted plates					UL-2 all counted plates					UL-SD all counted plates				
Date			m	n=18, samples					n=18 samples					n=6	
	Ave.FC/100ml	log(ave)	M= rank	p(m*100/n+1)	1-p	Ave FC/100ml	log(ave)	M=rank	p(m*100/n+1)	1-p	Ave FC/100ml	log(ave)	M=rank	p(m*100/n+1)	1-p
7/14/2005	73	1.863323	14	73.68421	26.31579	19	1.278754	10	52.63158	47.36842					
7/19/2005	183	2.262451	17	89.47368	10.52632	40	1.60206	14	73.68421	26.31579	102	2.0086	4	57.14286	42.85714
8/2/2005	49	1.690196	10	52.63158	47.36842	100	2	17	89.47368	10.52632					
8/8/2005	74	1.869232	15	78.94737	21.05263	32	1.50515	13	68.42105	31.57895					
8/13/2005	355	2.550228	18	94.73684	5.263158	8	0.90309	7	36.84211	63.15789					
8/16/2005	5	0.69897	2	10.52632	89.47368	73	1.863323	16	84.21053	15.78947					
8/22/2005	66	1.819544	11	57.89474	42.10526	28	1.447158	12	63.15789	36.84211					
8/29/2005	33	1.518514	9	47.36842	52.63158	15	1.176091	9	47.36842	52.63158					
9/13/2005	73	1.863323	13	68.42105	31.57895	166	2.220108	18	94.73684	5.263158	800	2.90309	6	85.71429	14.28571
9/20/2005	69.4	1.841359	12	63.15789	36.84211	60	1.778151	15	78.94737	21.05263					
10/4/2005	8	0.90309	3	15.78947	84.21053	5	0.69897	6	31.57895	68.42105					
10/11/2005	26	1.414973	7	36.84211	63.15789	3	0.477121	4	21.05263	78.94737					
10/18/2005	13	1.113943	5	26.31579	73.68421	21	1.322219	11	57.89474	42.10526	435	2.638489	5	71.42857	28.57143
10/25/2005	12	1.079181	4	21.05263	78.94737	0	#NUM!	1	5.263158	94.73684	100.3333	2.001445	3	42.85714	57.14286
11/1/2005	28	1.447158	8	42.10526	57.89474	2	0.30103	3	15.78947	84.21053					
5/11/2006	0	#NUM!	1	5.263158	94.73684	0	#NUM!	1	5.263158	94.73684	0		1	14.28571	85.71429
5/22/2006	21	1.322219	6	31.57895	68.42105	3.5	0.544068	5	26.31579	73.68421					
6/12/2006	74	1.869232	16	84.21053	15.78947	14	1.146128	8	42.10526	57.89474	4	0.60206	2	28.57143	71.42857

	ul1			n=15		ul2			n=15		Uls			n=12	
	Ave FC/100ml	log(ave)	M=rank	p(m*100/n+1)	1-p	Ave FC/100ml	log(ave)	M=rank	p(m*100/n+1)	1-p	Ave FC/100ml	log(ave)	M=rank	p(m*100/n+1)	1-p
11/8/2005	119	2.075547	13	81.25	18.75	3	0.477121	6	37.5	62.5	0		1	7.692308	92.30769
11/15/2005	193	2.285557	14	87.5	12.5	9	0.954243	10	62.5	37.5	0		1	7.692308	92.30769
11/22/2005	69	1.838849	11	68.75	31.25	99	1.995635	15	93.75	6.25	17	1.230449	9	69.23077	30.76923
11/29/2005	51	1.70757	9	56.25	43.75	11	1.041393	11	68.75	31.25	6	0.778151	8	61.53846	38.46154
12/6/2005	82	1.913814	12	75	25	3	0.477121	6	37.5	62.5	1	0	6	46.15385	53.84615

12/8/2005	27	1.431364	5	31.25	68.75	0	#NUM!	1	6.25	93.75	400	2.60206	11	84.61538	15.38462	
12/13/2005	49	1.690196	8	50	50	43	1.633468	14	87.5	12.5	0		1	7.692308	92.30769	
12/20/2005	37	1.568202	6	37.5	62.5	6	0.778151	9	56.25	43.75	400	2.60206	11	84.61538		15.38462
1/17/2006	37	1.568202	6	37.5	62.5	3	0.477121	6	37.5	62.5				0	100	
1/31/2006	195	2.290035	15	93.75	6.25	11	1.041393	11	68.75	31.25				0	100	
2/7/2006	53	1.724276	10	62.5	37.5	1	0	2	12.5	87.5	0		1	7.692308	92.30769	
2/14/2006	28	1.447158	4	25	75	2	0.30103	5	31.25	68.75	1	0	6	46.15385	53.84615	
3/15/2006	1	0	1	6.25	93.75	1	0	2	12.5	87.5				0	100	
3/29/2006	26	1.414973	3	18.75	81.25	34	1.531479	13	81.25	18.75	220	2.342423	10	76.92308	23.07692	
5/2/2006	9	0.954243	2	12.5	87.5	1	0	2	12.5	87.5	0		1	7.692308	92.30769	

Appendix 3: Statistical analysis of all counted plates by season

Analysis of variance via use of the F-test was conducted on data to determine proper Student t-test to employ for testing population differences. The variance of concentrations comparisons in which population variances that are not equal are noted in bold. T-test determination of populations that are not equal are highlighted. All tests were conducted at the α=.05

F-Test Two-Sample for Variances

	UL-2 summer	*UL-2 winter*
Mean	36.07692	12.7451
Variance	2407.367	665.5137
Observations	52	51
Df	51	50
F	***3.617306***	
P(F<=f) one-tail	5.58E-06	
F Critical one-tail	1.596737	

t-Test: Two-Sample Assuming Unequal Variances

	UL-2 summer	*UL-2 winter*
Mean	36.07692308	12.7451
Variance	2407.366516	665.5137
Observations	52	51
Hypothesized Mean Difference	0	
df	78	
t Stat	3.028707833	
P(T<=t) one-tail	0.001664597	
t Critical one-tail	1.664625415	
P(T<=t) two-tail	0.003329195	
t Critical two-tail	1.990847522	

F-Test Two-Sample for Variances

summer	*ul-1*	*ul-2*
Mean	54.13462	36.07692
Variance	3560.276	2407.367
Observations	52	52
Df	51	51
F	1.478909	
P(F<=f) one-tail	0.082869	
F Critical one-tail	1.591971	

t-Test: Two-Sample Assuming Equal Variances

summer	*UL-1*	*UL-2*
Mean	54.13461538	36.07692
Variance	3560.275641	2407.367
Observations	52	52
Pooled Variance	2983.821078	
Hypothesized Mean Difference	0	
df	102	
t Stat	1.685631094	
P(T<=t) one-tail	0.047461911	
t Critical one-tail	1.659930149	
P(T<=t) two-tail	0.094923821	
t Critical two-tail	1.983494258	

F-Test Two-Sample for Variances

	UL-1 summer	*UL-1 winter*
Mean	54.13461538	54.62222222
Variance	3560.275641	2912.10404
Observations	52	45
Df	51	44
F	1.222578449	
P(F<=f) one-tail	0.249019071	
F Critical one-tail	1.629828716	

t-Test: Two-Sample Assuming Equal Variances

	UL-1 summer	*UL-1 winter*
Mean	54.13462	54.62222
Variance	3560.276	2912.104
Observations	52	45
Pooled Variance	3260.07	
Hypothesized Mean Difference	0	
df	95	
t Stat	-0.04194	
P(T<=t) one-tail	0.483315	
t Critical one-tail	1.661051	
P(T<=t) two-tail	0.966631	
t Critical two-tail	1.98525	

F-Test Two-Sample for Variances

winter	*ul-1*	*ul-2*
Mean	54.62222222	12.74509804
Variance	2912.10404	665.5137255
Observations	45	51
Df	44	50
F	***4.375723488***	
P(F<=f) one-tail	4.90788E-07	
F Critical one-tail	1.618360557	

t-Test: Two-Sample Assuming Unequal Variances

Winter	*UL-1*	*UL-2*
Mean	54.62222	12.7451
Variance	2912.104	665.5137
Observations	45	51
Hypothesized Mean Difference	0	
df	61	
t Stat	4.74888	
P(T<=t) one-tail	6.41E-06	
t Critical one-tail	1.670219	
P(T<=t) two-tail	1.28E-05	
t Critical two-tail	1.999624	

Appendix 4: University Lake Bathymetry data, Volume and Residence time calculations.

		GPS position				GPS position	
Name, Local	Depth (ft)	East	North	**Name, Local**	Depth	East	North
107A	10.7	349307	6786630	**40A**	4	349186	6786683
109	10.9	349423	6786683	**43**	4.3	349263	6786744
113	11.3	349616	6786744	**44**	4.4	349608	6786710
124A	12.4	349261	6786644	**45**	4.5	349376	6786778
128	12.8	349620	6786906	**47**	4.7	349676	6786786
133A	13.3	349205	6786630	**47A**	4.7	349315	6786759
16	16	349224	6786643	**53**	5.3	349369	6786661
170	17	349574	6786834	**54**	5.4	349613	6786715
174	17.4	349677	6786808	**63A**	6.3	349320	6786713
180	18	349595	6786869	**64**	6.4	349343	6786676
188	18.8	349608	6786818	**67**	6.7	349429	6786833
194	19.4	349660	6786885	**70**	7	349418	6786731
195A	19.5	349251	6786628	**73**	7.3	349387	6786830
196	19.6	349556	6786792	**75**	7.5	349479	6786862
20	2	349345	6786729	**77**	7.7	349540	6786910
204	20.4	349650	6786824	**82**	8.2	349552	6786778
205	20.5	349662	6786859	**90A**	9	349263	6786699
21	2.1	349409	6786779	**93A**	9.3	349232	6786681
212	21.2	349667	6786832	**95**	9.5	349512	6786791
25	2.5	349501	6786837	**96**	9.6	349381	6786644
30	3	349435	6786794	**99**	9.9	349292	6786805
32	3.2	349442	6786821	**39**	3.9	349494	6786890
38	3.8	349523	6786846				

Appendix 4 continued, volume and residence time calculations.

Volume – Model type (CF output value)			1) Inverse distance 4500000	2) Universal Krieging 5200000	3) Normal Krieging 7200000	Average Volume 5600000
Quartile	CFS cubic feet per second	CFD cubic feet per day	Residence time			SD(y)
1	7.284	629337.6	7.2 days	8.3 days	11.4 days	2.226
2	10.194	880761.6	5.1 days	5.9 days	8.2 days	1.590
3	12.587	1087517	4.1 days	4.8 days	6.6 days	1.288
Standard Deviation, SD(i)			1.537	1.776	2.460	ave sd(i,y), 1.81

Average Lake Volume: 5600000, divide by average CFD= Residence time of 6.8 +/- 1.8 day variance

Appendix 5 Whole lake sampling events, fecal coliform data.

The depths were not uniform from site to site nor date to date: A notes near surface, B notes mid water column, C notes near lake bottom.

	events	1		2		3	
		9/2/2005		2/10/2006		5/23/2006	
sample location name		Depth ft	FC/100ml	Depth ft	FC/100ml	Depth ft	FC/100ml
NS11	a	1	*	2	0	1	0
	b	3	0	4	0	2	0
	c	5	40	5	0	3	0
NS12	a	1	*	2	0	2	0
	b	2	38	4	0		*
	c	4	28	5	0	5	10
NS13	a	1	13	3	2	2	*
	b	4	43	6	0	5	0
	c	8	50	9	0	10	0
NS14	a	1	23	3	0	2	0
	b	4	100	6	0	5	0
	c	8	78	9	0	8	1
NS21	a	1	105	2	0	2	0
	b	3	55	4	0	5	0
	c	5	198	8	0	8	0
NS22	a	1	40	2	0	2	0
	b	6	75	4	0	7	0
	c	12	40	8	0	12	0
NS23	a	1	43	5	0	2	0
	b	7	75	10	0	9	2
	c	14	70	15	0	16	0

NS24	a	1	15	5	0	2	0
	b	2	*	10	5	5	0
	c	4	103	15	0	nd	0
EW1	a	1	40	4	0	2	0
	b	7	53	10	0	10	0
	c	14	270	18	0	18	
EW2	a	1	92.5	1	0	2	0
	b	4	*	2	0	4	0
	c	6	75	4	0		0
EW3	a	1	40	2	0	2	0
	b	2	*	3	*	4	*
	c	3.4	*		*		*
EW4	a	1	90	2	0	2	0
	b	2	83	4	0	5	0
	c	3	67.5	6	0		*
	average		68.1		0.205882		0.433333

* No data was obtained from this depth.

Date	9/2/2005
Transect	NS1-1
Coordinates	61.18703
	149.802

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
234	7.68	5.3	1	1	7.55	143.6	12.4			nd		40
			2	3	7.56	140.6	12.3			0	0	40
			3	5	7.56	140.8	11.2			16	40	40

Date	2/10/2006
Transect	NS1-1
Coordinates	61.18703
	149.802

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	6.9		1	2	6.95	136.4			21	0	0	50
			2	4	6.94	132.2				0	0	20
			3	5	6.94	130.4	1.3	12		0	0	20

Date	5/23/2006
Transect	NS1-1
Coordinates	61.18703
	149.802

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	7.5		1	2	8.34		12.6	13.6		0	0	50
			2	5	8.31		11.6	13.6		0	0	100
			3	7	8.25		nd	nd		0	0	50

Date	9/2/2005
Transect	NS1-2
Coordinates	61.18652
	149.082

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
150	4.92	3.5	1	1	7.94	143.4	12.5			nd		40
			2	2	7.98	142.5	12.3			15	38	40
			3	4	7.96	142.1	12			11	28	40

Date 2/10/2006
Transect NS1-2
Coordinates 61.18652
149.082

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	6.9		1	2			0.8	12.78	20.5	0	0	50
			2	4	7.15	130.4	0.8	11.18		0	0	20
			3	5	7.14		1	13.32		0	0	20

Date 5/23/2006
Transect NS1-2
Coordinates 61.18652
149.082

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	5.4		1	2	8.27		12.8	13.6		0	0	50
			2									
			3	5	8.21		11.3	13.2		5	10	50

Date 9/2/2005
Transect NS1-3
Coordinates 61.18557
149.8017

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice thickness	FC plate	FC/100ml	Sample dilution
373	12.25	5.4	1	1	7.81	143.5	12.2			5	12.5	40
			2	4	7.71	143.2	11.9			17	42.5	40
			3	8	7.61	132.1	11.4			20	50	40

Date 2/10/2006
Transect NS1-3
Coordinates 61.18557
149.8017

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice thickness	FC plate	FC/100ml	Sample dilution
	10		1	3	7.18	131.6	0.8	12.14	18	1	2	50
			2	6	7.19	132.8	0.8	11.76		0	0	20
			3	9	7.11	137.3	1.1	10.02		0	0	20

Date 5/23/2006
Transect NS1-3
Coordinates 61.18557
149.8017

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice thickness	FC plate	FC/100ml	Sample dilution
	10.3		1	2	8.24		13	14.2		nd		50
			2	5	8.38		11.5	14.5		0	0	100
			3	10	8.24		10	15.1		0	0	50

Date 9/2/2005
Transect NS1-4
Coordinates 61.18595
149.8015

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
335	11.00	5.9	1	1	7.8	145.9	12.5			9	23	40
			2	4	7.73	143.7	11.9			40	100	40
			3	8	7.57	134.7	11.3			31	78	40

Date	2/10/2006												
Transect	NS1-4												
Coordinates	61.18595												
	149.8015												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		11.2		1	3	7.24	132	0.6	12.06	22	0	0	50
				2	6	7.26					0	0	20
				3	9	7.2	135.8	1.8	8.73		0	0	20
Date	5/23/2006												
Transect	NS1-4												
Coordinates	61.18595												
	149.8015												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		11		1	2	8.3		12.5	13.5		0	0	50
				2	5	8.39		11.6	14.7		0	0	100
				3	8	8.26		nd			1	1	100

Date	9/2/2005												
Transect	NS2-1												
Coordinates	61.18839												
	149.7956												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	221	7.26	5.5	1	1	7.43	142	12.1			42	105	40
				2	3	7.56	139	10.9			22	55	40
				3	5	7.79	138.6	10.5			79	198	40

Date 2/10/2006
Transect NS2-1
Coordinates 61.18839
149.7956

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	10		1	2	7.45	130.6	0.8	12.6	19	0	0	50
			2	4	7.47	128.9				0	0	20
			3	8	7.26	139.7	1.4	7.2		0	0	20

Date 5/23/2006
Transect NS2-1
Coordinates 61.18839
149.7956

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	9.3		1	2	8.02		11.2	13.4		0	0	50
			2	5	7.9		10.1	13.4		0	0	100
			3	8	8.01		9.8	13.7		0	0	50

Date 9/2/2005
Transect NS2-2
Coordinates 61.18839
149.7956

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
500	16.41	6.2	1	1	7.72	144.4	11.7			16	40	40
			2	6	7.64	142.2	11			30	75	40
			3	12	7.57	136	11			16	40	40

Date 2/10/2006
Transect NS2-2
Coordinates 61.18839
149.7956

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	9.9		1	2	7.42	128.7	0.9	12.56	15.5	0	0	50
			2	4	7.44	130.6				0	0	20
			3	8	7.48	130.9	1	11.84		0	0	20

Date 5/23/2006
Transect NS2-2
Coordinates 61.18839
149.7956

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	13		1	2	8.05		11.6	13.6		0	0	50
			2	7	8.01		10.1	13.8		0	0	100
			3	12	7.96		8.7	14.1		0	0	50

Date 9/2/2005
Transect NS2-3
Coordinates 61.18739
149.7955

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
593	19.47	7	1	1	7.6	144.5	12.9			17	43	40
			2	7	7.62	142.5	10.8			30	75	40
			3	14	7.6	141.5	10.3			28	70	40

Date	2/10/2006												
Transect	NS2-3												
Coordinates	61.18739												
	149.7955												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		17.7		1	5	7.49		0.7	14.4	18	0	0	50
				2	10						0	0	20
				3	15	7.48		1	13.7		0	0	20

Date	5/23/2006												
Transect	NS2-3												
Coordinates	61.18739												
	149.7955												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		17.9		1	2	8.02		11.7	13.5		0	0	50
				2	9	7.99		10.2	14.4		2	2	100
				3	16	7.95		7.9	11.6		0	0	50

Date	9-2-.5												
Transect	NS2-4												
Coordinates	61.18654												
	149.7952												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	173	5.68	5.68	1	1	7.68	144.9	12.1			6	15	40
				2	2	7.62	144.9	12.1			nd		40
				3	4	7.63	141.1	11			41	103	40

Date	2/10/2006												
Transect	NS2-4												
Coordinates	61.18654												
	149.7952												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		18.3		1	5	7.58	130.5	0.8	15	15	0	0	50
				2	10	7.56	128.3				1	5	20
				3	15	7.55	128.4	1.1	14.5		0	0	20
Date	5/23/2006												
Transect	NS2-4												
Coordinates	61.18654												
	149.7952												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		8.1		1	2	7.98		11.2	13.7		0	0	50
				2	5	7.95		10.1	13.8		0	0	100
				3	nd	nd		nd	nd				

Date	9/2/2005												
Transect	EW1-1												
Coordinates	61.1875												
	149.7942												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	582	19.11	7.2	1	1	7.67	143	12.5			16	40	40
				2	7	7.6	140.2	10.3			21	53	40
				3	14	7.59	141.3	10.3			108	270	40

Date	2/10/2006
Transect	EW1-1
Coordinates	61.1875
	149.7942

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	19.5		1	4	7.52	128.6	0.9	12.76	15	0	0	50
			2	10	7.5	128.4				0	0	20
			3	18	7.28	137.2	1	14.13		0	0	20

Date	5/23/2006
Transect	EW1-1
Coordinates	61.1875
	149.7942

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	20		1	2	8.23		12.2	13.6		0	0	50
			2	10	8.11		8.5	13.8		0	0	100
			3	18	7.81		7.1	8.1		0	0	50

Date	9/2/2005
Transect	EW1-2
Coordinates	61.18758
	149.7966

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
242	7.94	7.1	1	1	7.68	146.3	12.1			37	92.5	40
			2	4	7.63	143.4	11.1			nd		40
			3	6	7.61	139.6	10.5			30	75	40

Date 2/10/2006
Transect EW1-2
Coordinates 61.18758
149.7966

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	4.7		1	1	7.51	129.5	0.9	12.63	16.5	0	0	50
			2	2	7.48	127.9				0	0	20
			3	4	7.47	128.1	0.9	12.47		0	0	20

Date 5/23/2006
Transect EW1-2
Coordinates 61.18758
149.7966

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	4.7		1	2	8.25		10.4	13.5		0	0	50
			2	4	8.18		nd	nd		0	0	50
			3									

Date 9/2/2005
Transect EW1-3
Coordinates 61.18687
149.7997

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
105	3.45	bottom	1	1	8.03	135.9	12.9			16	40	40
			2	2	8.01		12.6			nd		40
			3	3.4	8.36	131	12.3			nd		40

Date	2/10/2006
Transect	EW1-3
Coordinates	61.18687
	149.7997

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	4.2		1	2	7.43	128.1	0.8	11.95	18.5	0	0	50
			2	3						nd	nd	
			3									

Date	5/23/2006
Transect	EW1-3
Coordinates	61.18687
	149.7997

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
	4.2		1	2	8.29		12.5	14.5		0	0	50
			2	4	8.36		nd	nd		0	0	50
			3									

Date	9/2/2005
Transect	EW1-4
Coordinates	61.18591
	149.8033

Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
179	5.88	5	1	1	8.05	150.1	12.9			36	90	40
			2	2	7.79	150.1	12.6			33	83	40
			3	3	7.82	148.1	12.5			27	67.5	40

Date	2/10/2006												
Transect	EW1-4												
Coordinates	61.18591												
	149.8033												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		8.6		1	2	7.53	128.1	0.7	13.02	21 in	0	0	50
				2	4	7.45	129.4	0.7			0	0	20
				3	6	7.41	131.2	0.9			0	0	20
Date	5/23/2006												
Transect	EW1-4												
Coordinates	61.18591												
	149.8033												
	Depth cm	depth ft	Secch D. ft	sample	depth	ph	cond	Temp C	DO mg/l	Ice Depth	FC plate	FC/100ml	Sample dilution
		6.5		1	2	8.36		12.5	13.5		0	0	50
				2	5	8.26		11.6	14.7		0	0	50
				3									

Appendix 6A. Fecal Coliform Survivability Lab Data.

Chester Creek Water Sterilized.

Temperature, 4c

Date	7/5/05	7/14/05	7/22/05	7/28/05	8/4/05	8/10/05	8/19/05	8/25/05	9/6/05	9/22/05	9/28/05	10/6/05	10/14/05	10/20/05	10/25/05	11/6/05	11/18/05	11/22/05	12/1/05	12/15/05
Replicate A	4.70E+05	7.10E+05	2.73E+05	2.57E+05	2.40E+05	1.93E+05	2.02E+05	1.80E+05	1.63E+05	1.11E+05	8.70E+04	1.58E+05	9.60E+04	1.01E+05	1.01E+05	9.80E+04	7.70E+04	1.47E+05	9.20E+04	6.50E+04
Replicate B	5.30E+05	3.50E+05	3.70E+05	3.40E+05	2.58E+05			2.16E+05	1.88E+05	1.62E+05	2.80E+05	1.91E+05	2.15E+05	1.23E+05	1.25E+05	1.49E+05	1.32E+05	1.57E+05	9.60E+04	5.80E+04
Replicate C	2.21E+05	2.79E+05	1.74E+05	1.75E+05	1.28E+05	1.06E+05	8.50E+04	1.11E+05	7.00E+04	4.30E+04	3.20E+04	5.60E+04	5.10E+04	3.40E+04	5.00E+04		4.00E+04	3.50E+04		2.30E+05
Average.	4.07E+05	4.46E+05	2.72E+05	2.57E+05	2.09E+05	1.50E+05	1.44E+05	1.69E+05	1.40E+05	1.05E+05	1.33E+05	1.35E+05	1.21E+05	8.60E+04	9.20E+04	1.24E+05	8.30E+04	1.13E+05	9.40E+04	1.18E+05
Log Average	5.609594	5.649659	5.435101	5.410496	5.319453	5.174641	5.156852	5.227887	5.147161	5.022566	5.123852	5.1303338	5.0815873	4.9344985	4.963788	5.091667	4.9190781	5.053078	4.9731279	5.070653

Temperature, 16c

Date	7/5/05	7/14/05	7/22/05	7/28/05	8/4/05	8/10/05	8/19/05	8/25/05	9/6/05	9/22/05	9/28/05	10/6/05	10/14/05	10/20/05	11/6/05	11/6/20	11/18/20	11/22/05	12/1/2005	12/15/05
Replicate A	7.90E+05	1.03E+06	1.01E+06	8.00E+05	1.15E+06		9.90E+05	8.90E+05	6.00E+05	6.90E+05	5.62E+05	8.20E+05	5.40E+05	5.00E+05	3.80E+05	4.00E+05	5.00E+05	3.30E+05	5.90E+04	9.80E+04
Replicate B	6.50E+05	5.20E+05	1.01E+06	9.90E+05	9.80E+05	7.60E+04	1.00E+06	3.90E+05	7.60E+05	9.70E+05	9.50E+05	1.16E+06	7.90E+05	4.30E+05	6.60E+05	8.30E+05	9.20E+05	1.30E+06	3.90E+05	6.30E+05
Replicate C	1.12E+06	8.60E+05	1.38E+06	1.99E+06	1.07E+06		1.01E+06	8.90E+05	9.90E+05	1.59E+06	1.47E+06	2.20E+06	1.22E+06	1.19E+06	9.90E+05	1.39E+06	1.20E+06	1.35E+06	5.30E+05	
Average	8.53E+05	8.03E+05	1.13E+06	1.26E+06	1.07E+06	7.60E+04	1.00E+06	7.23E+05	7.83E+05	1.08E+06	9.94E+05	1.39E+06	8.50E+05	7.07E+05	6.77E+05	8.73E+05	8.73E+05	9.93E+05	3.26E+05	3.64E+05
Log Average	5.931119	5.904896	6.054358	6.100371	6.028029		6	5.859338	5.893947	6.034762	5.997386	6.144055	5.9294189	5.8492146	5.830375	5.94118	5.94118	5.997095	5.5136614	5.561101

Chester Creek Sediment

Temperature, 4c

Day	0	9	16	24	37	53
Replicate, a	4.10E+06	1.69E+06	2.02E+06	1.74E+06	2.60E+05	7.40E+04
Replicate b	3.70E+06	1.07E+06	6.20E+05	2.70E+05	2.95E+05	
Replicate c	4.70E+06	4.90E+05	9.60E+05	9.20E+05		
Replicate d	2.80E+06					
Replicate e	5.00E+06					
sum	4.06E+06	1.08E+06	1.20E+06	9.77E+05	2.78E+05	7.40E+04
log of ave	6.608526	6.034762	6.079181	5.989746	5.443263	4.869232

Temperature, 16c

Day	0	9	16	24	37	53
Replicate a	4.10E+06	1.69E+05	4.60E+04	7.40E+04	4.80E+03	
Replicate b	3.70E+06	3.40E+04	3.80E+04	4.90E+03	8.50E+04	
Replicate c	4.70E+06	5.50E+04		1.23E+04	4.30E+03	
Replicate d	2.80E+06					
Replicate e	5.00E+06					
sum	4.06E+06	8.60E+04	4.20E+04	3.04E+04	3.14E+04	
log of ave	6.608526	4.934498	4.623249	4.482874	4.496468	

Chester Creek Sterilized Sediment.

Temperature, 4c

Day	0	7	12	19	33	47
Replicate a	1.23E+07	5.10E+06	4.90E+06	4.50E+06	1.23E+06	7.20E+05
Replicate b	1.25E+07	4.30E+06	5.00E+06	2.90E+06	1.73E+06	
Replicate c	8.30E+06	5.50E+06	7.00E+06	3.80E+06	1.46E+06	
Replicate d	1.52E+07					
Replicate e	1.39E+07					
sum	1.23E+07	4.97E+06	5.63E+06	3.73E+06	1.47E+06	7.20E+05
log of ave	7.09108	6.696065	6.750765	6.572097	6.168301	5.857332

Temperature, 16c

day	0	7	12	19	33	47
Replicate a	1.23E+07	1.22E+07	3.03E+07	4.21E+07	1.30E+07	1.95E+07
Replicate b	1.25E+07	2.04E+07	3.15E+07	2.25E+07		
Replicate c	8.30E+06	2.89E+07	3.44E+07	2.46E+07		
Replicate d	1.52E+07					
Replicate e	1.39E+07					
	1.18E+07					
sum	1.23E+07	2.05E+07	3.21E+07	2.97E+07	1.30E+07	1.95E+07
log of ave	7.09108	7.311754	7.506054	7.473244	7.113943	7.290035

Appendix 6B. Fecal Coliform Survivability Field Data.

Raw data for in-field study, subsequent analysis was done on data after it was normalized to CFU/100ml water assuming total recovery of coliform into receiving water and Log transformed (Woomer P. 1994)[1].

Day	Trial	Positive results at 10^{-2} 10^{-3} 10^{-4} dilutions	MPN Number	Average MPN
12/16/2005	**1**	2,0,0	83	
	2	3,2,0	919	
	3	2,1,0	147	
	4	2,0,0	83	
	5	2,0,0	83	
	6	2,0,0	83	
	Day 0		1398	233
12/19/2005	**1**	3,2,0	919	
	2	2,1,1	188.5	
	3	3,0,1	382	
	4	2,0,0	83	
	5	1,0,1	58	
	6	3,1,0	425	
	Day 3		2055.5	342.5
12/23/2005	**1**	1,0,0	42	
	2	1,1,0	74	
	3	1,0,0	42	
	4	2,0,0	83	
	5	2,1,0	147	
	6	0,0,0	0	
	Day 7		388	64.6
12/29/2005	**1**	3,0,0	230	
	2	2,0,0	42	
	3	0,0,0	0	
	4	2,0,0	83	
	5	0,0,0	0	
	6	1,1,0	74	
	Day 13		429	71.5
1/13/2006	**1**	2,0,0	83	
	2	1,0,0	42	
	3	1,0,0	42	
	4	2,0,0	83	
	5	0,0,0	0	
	6	0,0,0	0	
	Day 29		250	41.6

Day	Trial	Positive results at 10^{-2} 10^{-3} 10^{-4} dilutions	Number	Average MPN
1/28/2006	**1**	2,1,0	147	
	2	2,1,0	147	
	3	1,0,0	42	
	4	2,1,1	0	
	5	1,0,0	42	
	6	0,2,0	0	
	Day 44		378	63
2/14/2005	**1**	nd		
	2	nd		
	3	nd		
	4	nd		
	5	nd		
	6	nd		
	Day 61			
5/2/2006	**1**	0,0,0	0	
	2	0,1,1	0	
	3	1,0,1	58	
	4	1,0,0	42	
	5	0,0,0	0	
	6	0,0,0	0	
	Day 138		100	16.6

Control

day	date	MPN
0	1/28/2006	0
4	2/1/2006	0
9	2/9/2006	0
35	3/15/2006	0

Appendix 7A: Impacts of fecal coliform concentrations at UL-1 on UL-2: Method description

We surveyed the relative increase and decrease of FC at the UL-1 and UL-2 site over a 7 day period. The assumption is that if the lake residence time is 6.8 day +-1.8 there would be an anticipated correlation in relative increase and decrease of FC after 7 days between the UL-1 and UL-2. This will also tell us if changes in FC concentration at the Inlet will impact the concentrations seen out the Outlet. Data sets collected 7 days apart were extracted from the whole data set. This resulted in 15 data set pairs that could be tested. We used binominal analysis ,in which a 1 was assigned when an increase in the averaged FC from all counted plates over a 7 day period was observed and a 0 when a decrease was observed. Each 7 day pair period was assigned the appropriate value for both UL-1 and UL-2. If an increase in FC was seen at UL-1 between days 0 and 7 and an increase would be was?seen at UL-2 between days 7 and 14, then these match. We found there to be 13 matching pairs

The probability of p (matches)=.77 and q (mismatchs) =.23 with n=13 and X=2 is found by

$P(X)= n(n-1)/2\ p^2 q^{n-2}$ Which relates to a 4.4×10^{-6} probability that it is by chance (Zar 1999)[2]

The magnitude of increase and decrease for these pairings was then analyzed. At each site the absolute difference between average FC of all counted plates at time 1 and the average FC of all counted plates at time 2 was calculated and repeated for each time step. This absolute change was then normalized by the average FC value of all counted plates at each of those sites for the specified sample dates. This places the magnitude of increase and decrease in perspective of FC concentrations observed at each site. The magnitude data at UL-1 and UL-2 sites were compared to each other using the students t-test two tailed with $\alpha= .05$ assuming unequal variance. Variance of deviation at the sites was determined unequal after testing the variance using the F test with $\alpha =.05$

The null hypothesis is that the magnitudes of change in FC at UL-1 and UL-2 are equal; the alternate hypothesis is that the magnitudes of change are different. The t- test statistic found was –1.54 which is less than the critical value of 2.11 therefore we do not find that the magnitude of change is different.

The magnitude of change in FC load between UL-1 and UL-2 after 1 lake residence time is the same, showing that load changes at UL-2 are dependent upon or predicted by changes at UL-1.

Appendix 7B: Impacts of fecal coliform concentrations at UL-1 on UL-2: Calculations

This data also demonstrates the capacity of University Lake to act as a sink over the period of one lake residence time. The only data point in non agreement is 8-16 to 8-22 which coincided with a heavy rain event on 8-21 indicating influence from the storm drain.

Reduction of FC concentration, between UL-1 and UL-2 after 7 Days

Dates	ul-1	ul-2	1-(ul2/ul1)
8-2,8-8	49	32	35%
8-16,8-22	5	28*	-460%
10-4,10-11	8	3	63%
10-11,10-18	26	21	19%
10-18-10-25	13	0	100%
10-25,11-1	12	2	83%
11-1,11-8	28	3	89%
11-8,11-15	119	9	92%
11-15,11-22	193	99	49%
11-22,11-29	69	11	84%
11-29,12-6	51	3	94%
12-6,12-13	82	43	48%
8-8,8-13	74	8	89%
8-22,8-29	66	15	77%
10-11,10-18	26	21	19%
10-18,10-25	13	0	100%
10-25,11-1	12	2	83%
11-1,11-8	28	3	89%
11-8,11-15	119	9	92%
11-15,11-22	193	99	49%
11-22,11-29	69	11	84%
11-29,12-6	51	3	94%
12-6,12-13	82	43	48%
12-13,12-20	49	6	88%
			73%Average

Ice free		Iced over	
35%		89%	
63%		92%	
19%		49%	
100%		84%	
83%		94%	
89%		48%	
89%		88%	
77%		78%	average
19%			
83%			
66%	Average		

Appendix 8: Water Quality Parameter Data

	UL1 Inlet					UL2 outlet					UL-SD			
Date:	pH	Aver. Temp (C)	D.O mg/l	Discharge (CFS)	Stage (inch)	pH	Aver. Temp	D.O mg/l	Discharge CFS	stage	ph	Temp. C	Aver. Temp	D.O mg/l
7/14/2005	7.92	11.1				8.54	17.3							
7/19/2005		15.8					17.1							
7/28/2005						8.29	15.9							
8/2/2005	7.43	12.8				7.6	10.4							
8/4/2005	7.72	13.8				7.62	12.8							
8/8/2005	7.81	11.3				7.88	18							
8/13/2005	7.92	12.3				8.19	16.3							
8/16/2005	7.83	10.4				7.96	15							
8/19/2005						7.8	13.5							
8/22/2005	9.7	7.79				7.68	13.8							
8/25/2005	7.67	11.9				7.61	13.4							
8/29/2005	7.46	8.9				7.54	12.1							
9/6/2005						7.4	10.5							
9/9/2005	7.1	11.5				7.22	9.8							
9/13/2005	7.48	8.3				7.09	10.4							
9/20/2005	7.48	7.5		20.85	8.5				19.52	11.625				
9/27/2005	7.38	6.7			9.125	6.73	8.7			11.75				
10/4/2005	7.96	4.7	11.72	17.69	9	7.49	7.2	9.11	18.29	11.625				
10/11/2005	8.5	4.3	14.42	16.27	9	8.1	4.8	12.35	13.66	11.375				
10/18/2005	7.51	4.45	13.86	18.09975	9 7/8	7.23	4	13.12	17.3985	11 3/4				
10/25/2005	7.86	1.85	14.62	13.438	8.25	7.51	4.05	12.94	13.25	11 1/4				
11/1/2005	8.03	1.9	16.72		6 7/8	8.18	2.1	15.4	9.72	10 5/8				
11/8/2005	7.97	1.8	16.18	7.122822	5 1/4	8.02	1.6	15.27	6.038	8.5				
11/15/2005	8.04	2.8	15.8	6.77175	5 1/8	8.04	2.8	15.8	5.47	8 3/4				
11/22/2005	7.65	1.7	16.43		7 1/8	7.32	1.5	14.6	11.41	9.5				
11/29/2005	7.8	0.9	17.3		7	8.11	0.8	15.41	10.329					
12/6/2005					6 3/8	7.59	0.7	16.07	9.892	9 3/4				

12/13/2005	7.45	0.8	17.26		7	7.74	1.5	14.32	10.0075	9 7/8			
12/20/2005	8.04	0.9	16.66	11.22225	6 5/8	7.73	1.5	14.51		8 1/2			
1/17/2006	7.84	0.8			5	8.06	0.8	14.53		8 1/2			
1/31/2006	7.53	0.75	16.68			7.25	0.85	16.46		8			
2/7/2006	7.96	1.6	17.1		5 3/8	8.12	0.75	15.48		8 1/2			
2/14/2006	7.86	1	15.14			7.94	0.9	15.63					
2/21/2006													
3/15/2006	8.01	1.2	15.32		5 1/4	7.89	1	15.76		8 1/2			
3/29/2006	7.88	2.6	16.95		5 3/4	8.36	1.5	14.58		9 1/4	8.08.8/1.0	0.9	8.92
5/2/2006	7.91	4.7	16.31		6 5/8	7.79	5.1	13.28		10	8.371.9/1.8	1.85	9.58
5/11/2006	7.74	7	15.01		7 1/2	8.03	8.75	14.96		10 5/8	7.888.7/8.7	8.7	13.18
5/22/2006	8.01	9.7	13.73		6 3/8	8.41	13.05	14.56		10 1/2			
6/12/2006	7.49	8.05	13.49		7 1/8	7.58	12.75	13.41		11	13.4/13. 7.634	13.4	13.21

Appendix 9: Relative percent different (RPD) for fecal coliform sampling from countable plates.

The sample dates that had two or more countable plates as dictated by the SM 9222-d across the three sites were checked for precision using the RPD method outlined in the QAPP. Samples are only identified by letter and not by sample id.

Samples that contained countable plates

RPD	A	B	C	D	C	Log A	Log B	Log C	Log D	Log E
7/14/2005	28	50	118			1.447158	1.69897	2.071882		
8/3/2005	110	28	125	96		2.041393	1.447158	2.09691	1.982271	
8/9/2005	150	48	24	96		2.176091	1.681241	1.380211	1.982271	
8/16/2005	100	52	68			2	1.716003	1.832509		
8/23/2005	52	51	40	20		1.716003	1.70757	1.60206	1.30103	
8/29/2005	28	23				1.447158	1.361728			
9/13/2005	50	140				1.69897	2.146128			
9/20/2005	44	185	35	154		1.643453	2.267172	1.544068	2.187521	
10/25/2005	19	110	108			1.278754	2.041393	2.033424		
11/22/2005	80	56	125	112	59	1.90309	1.748188	2.09691	2.049218	1.770852
12/13/2005	74	22	60	43		1.869232	1.342423	1.778151	1.633468	
12/20/2005	44	38				1.643453	1.579784			
2/7/2006	56	63				1.748188	1.799341			
3/29/2006	53	40	21			1.724276	1.60206	1.322219		
6/12/2006	70	62	17			1.845098	1.792392			

	Countable Sample						
Date	RPD A-B	RPD B-C	RPD C-A	RPD D-A	RPD D-B	Sum RPD	RPD Ave
7/14/2005	0.367119	0.600077	1.249409			2.216605	0.738868
8/3/2005	1.211731	0.263823	1.110325	0.967578	1.138307	4.691764	0.938353
8/9/2005	1.304379	0.77957	0.156417	0.935662	1.064441	4.240469	0.848094
8/16/2005	1.076425	0.683171	0.788806			2.548403	0.849468
8/23/2005	0.718467	0.73945	0.56772	0.163486	0.165904	2.355027	0.471005
8/29/2005	0.477572	1.361728				1.8393	0.91965
9/13/2005	0.582677	2.146128				2.728805	1.364403
9/20/2005	0.483959	1.456901	0.512889	1.329539	1.16964	4.952928	0.990586
10/25/2005	0.049053	1.043348	1.261271			2.353672	0.784557

11/22/2005	0.945514	0.657495	1.145365	1.086191	1.128491	4.963056	0.992611
12/13/2005	1.033262	0.202792	0.75318	0.566159	0.73127	3.286663	0.657333
12/20/2005	0.663206	1.579784				2.242989	1.121495
2/7/2006	0.733769	1.799341				2.533109	1.266555
3/29/2006	0.761018	0.697756	0.190246			1.649019	0.549673
6/12/2006	0.859588	1.792392				2.651979	1.32599

Appendix 10: Multiple tube fermentation method and results.

This project utilized two different variations of the multiple tube fermentation method (most probable number (MPN) outlined in Woomer P.1994. The MPN method is conducted by taking a sample of sediment and subjecting that to a serial dilution series. Replicate samples are taken from each individual dilution and transferred to lauryl tryptose (LT) broth and allowed to incubate at 37C for 24-48 hours. The LT tube was examined for gas production in the Durham tub. If positive for gas production, a sample from the tube was used to inoculate a tube of EC broth, or tube containing MUG, and allowed to incubate for 24 hours at 44.4 C. Positive indication for FC would be either gas production in the EC tube, or florescence of the MUG tube under a UV lamp. Number of double positives tube results at each dilution level was recorded and the MPN for the sequence of positive results was determined from specific MPN tables.

1. The first MPN employed was for the 1st event-driven sampling, during which the rivulets around University Lake were analyzed. It was necessary and appropriate to use this method because the high sediment content of the water would have clogged and disputed the membrane filters.

The MPN test used in this event was the was two replicate test per dilution using the gas production/ UV reaction . The sample dilution series employed was of 5^{-1}, 5^{-2}, 5^{-3}, 5^{-4}, 5^{-5}, 5^{-6}

2. A second MPN was used to measure FC in lake sediment during the whole lake sampling events and in the field survivability study. The QAPP had outlined that the Spread Plate Technique would be used, however use of the MPN method allowed for a greater number of replicates to be tested on each sample, and thus provided greater accuracy of obtaining the total coliform count.

The MPN test used in these tests followed the LT and EC gas production as outlined in Woomer R. 1994 but varied on dilution series tested. The sediment analysis conducted on the whole lake sampling tested the sample in the series dilution at 10^{-1},10^{-2}, 10^{-3}, 10^{-4} dilution , with 3 replicates being generated from each dilution. The in field study used the same dilution series, but only tested the 10^{-2}, 10^{-3}, and 10^{-4} dilution, again with 3 replicates being generated from each tested dilution.

Results of Rivulet and Whole Lake Sampling.

lake sed. 9/3/2005	event 1 Location	Test. Modified plate, dilution plate	FC/gram	
	NS23	13	65	
	NS14	30	150	
	NS12	20	100	
	NS13	3	15	
	EW2	Tntc		
	EW1	17	85	
	NS24	Tntc		
			70	Average

lake sed. 2/10/2006	event 2 location	Multiple Tube 3 reps, Gas/Gas 4 (1/10) dilutions	MPN fc/gram	
	NS23	0,0,0,0	0	
	NS23	1,0,1,0	67	
	EW4	1,1,0,0	74	
	EW4	2,2,1,0	442	
			145.75	Average

Rivulet 9/13/2005	Location	Multiple tube 2 reps, Gas/UV 6 (1/5) diltuions	MPN fc/gram	
	Canoe 1	2,2,2,2,0,0	1016	
	Canoe 2	2,2,2,0,0,0	202	
	Island	2,2,1,0,0,0	81	
	Inlet	2,1,1,0,0,0	28	
	Sandbar	2,2,1,0,0,0	81	
			281.6	Average

Appendix 11. Transfer Log.

Date	Time	Site ID	Sample ID	Sample Type	Sampler	Method	Notes
7/14/2005		UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/14/2005		UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/14/2005		UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/14/2005		UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/14/2005		UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/14/2005		UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
7/19/2005		UL-1	U1-1	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-1	U1-2	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-1	U1-3	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-2	U2-1	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-2	U2-2	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-2	U2-3	FC	Heather, Maciej	Grab	Temp, partly cloudy
7/19/2005		UL-S	US-1	FC	Heather, Maciej	Grab	Temp, partly cloudy, Storm drain is flowing.
7/19/2005		UL-S	US-2	FC	Heather, Maciej	Grab	Temp, partly cloudy, Storm drain is flowing.
7/19/2005		UL-S	US-3	FC	Heather, Maciej	Grab	Temp, partly cloudy, Storm drain is flowing.
8/2/2005	2:15	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/2/2005	2:15	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/2/2005	2:15	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/2/2005	1:43	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/2/2005	1:43	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/2/2005	1:43	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy light rain
8/8/2005	12:48	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH
8/8/2005	12:48	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH
8/8/2005	12:48	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH
8/8/2005	11:38	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH
8/8/2005	11:38	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH
8/8/2005	11:38	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH
8/13/2005	5:10pm	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny
8/13/2005	5:10pm	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny

8/13/2005	5:10pm	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny
8/13/2005	5:00pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny
8/13/2005	5:00pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny
8/13/2005	5:00pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, Clear Sunny
8/16/2005	5:26pm	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/16/2005	5:26pm	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/16/2005	5:26pm	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/16/2005	5:10pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/16/2005	5:10pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/16/2005	5:10pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, cloudy
8/22/2005	3:36pm	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/22/2005	3:36pm	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/22/2005	3:36pm	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/22/2005	3:24pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/22/2005	3:24pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/22/2005	3:24pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, Cloudy
8/29/2005	11:35am	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH,
8/29/2005	11:35am	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH,
8/29/2005	11:35am	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH,
8/29/2005	12:02pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH,
8/29/2005	12:02pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH,
8/29/2005	12:02pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH,
9/13/2005	1:04pm	UL-1	U1-1	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005	1:04pm	UL-1	U1-2	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005	1:04pm	UL-1	U1-3	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005	12:12pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005	12:12pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005	12:12pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Temp. pH, clear
9/13/2005		UL-S	US-1	FC	Heather, Maciej	Grab	No sample taken
9/13/2005		UL-S	US-2	FC	Heather, Maciej	Grab	No sample taken
9/13/2005		UL-S	US-3	FC	Heather, Maciej	Grab	No sample taken
9/20/2005	1:18pm	UL-1	U1-1	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH,
9/20/2005	1:18pm	UL-1	U1-2	FC	Heather,	Grab	Flow, Stage, Temp. pH,

					Maciej		
9/20/2005	1:18pm	UL-1	U1-3	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH,
9/20/2005	1:18pm	UL-1	U1-4	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH,
9/20/2005	1:18pm	UL-1	U1-5	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH,
9/20/2005	12:33pm	UL-2	U2-1	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH , error on pH meter
9/20/2005	12:33pm	UL-2	U2-2	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH , error on pH meter
9/20/2005	12:33pm	UL-2	U2-3	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH , error on pH meter
9/20/2005	12:33pm	UL-2	U2-4	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH , error on pH meter
9/20/2005	12:33pm	UL-2	U2-5	FC	Heather, Maciej	Grab	Flow, Stage, Temp. pH , error on pH meter
10/4/2005	12:43pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly sunny
10/4/2005	12:43pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly sunny
10/4/2005	12:43pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly sunny
10/4/2005	11:41am	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Partly cloudy
10/4/2005	11:41am	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Partly cloudy
10/4/2005	11:41am	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Partly cloudy
10/11/2005	12:40pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/11/2005	12:40pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/11/2005	12:40pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/11/2005	11:40am	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/11/2005	11:40am	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/11/2005	11:40am	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear, sunny , and cold
10/18/2005	12:51pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy
10/18/2005	12:51pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy
10/18/2005	12:51pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy
10/18/2005	11:48am	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy
10/18/2005	11:48am	UL-2	U2-2	FC	Heather,	Grab	Flow, Stage, Temp. pH. DO, Cloudy

					Maciej, Ryon		
10/18/2005	11:48am	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy
10/18/2005	12:20pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp. Ph. DO, cloudy, no flow
10/18/2005	12:20pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp. Ph. DO, cloudy, no flow
10/18/2005	12:20pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp. Ph. DO, cloudy, no flow
10/25/2005	12:30pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Clear Sky, noticeable sediment in water
10/25/2005	12:30pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Clear Sky, noticeable sediment in water
10/25/2005	12:30pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Clear Sky, noticeable sediment in water
10/25/2005	11:36am	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear sky
10/25/2005	11:36am	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear sky
10/25/2005	11:36am	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH, DO, Clear sky
10/25/2005	12:15pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp. pH. DO, clear, no flow, ice forming
10/25/2005	12:15pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp. pH. DO, clear, no flow, ice forming
10/25/2005	12:15pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp. pH. DO, clear, no flow, ice forming
11/1/2005	1:15pm	UL-1	U1-1	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Cold, light fog, Flow meter stopped operating
11/1/2005	1:15pm	UL-1	U1-2	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Cold, light fog, Flow meter stopped operating
11/1/2005	1:15pm	UL-1	U1-3	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Cold, light fog, Flow meter stopped operating
11/1/2005	12:30pm	UL-2	U2-1	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold, light fog
11/1/2005	12:30pm	UL-2	U2-2	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold, light fog
11/1/2005	12:30pm	UL-2	U2-3	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold, light fog
11/8/2005	1:34pm	UL-1	U1-1	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005	1:34pm	UL-1	U1-2	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005	1:34pm	UL-1	U1-3	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005	12:45pm	UL-2	U2-1	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005	12:45pm	UL-2	U2-2	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005	12:45pm	UL-2	U2-3	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH, DO, cold 10F, partly sunny
11/8/2005		UL-S	US-1	FC	Ryon,	Grab	No sample taken

					Maciej		
11/8/2005		UL-S	US-2	FC	Ryon, Maciej	Grab	No sample taken
11/8/2005		UL-S	US-3	FC	Ryon, Maciej	Grab	No sample taken
11/15/2005	12:50pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, cloudy and snowing.
11/15/2005	12:50pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, cloudy and snowing.
11/15/2005	12:50pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, cloudy and snowing.
11/15/2005	11:59am	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, flow meter was set on ft/s remember to convert to m/s in calc. Cloudy.
11/15/2005	11:59am	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, flow meter was set on ft/s remember to convert to m/s in calc. Cloudy.
11/15/2005	11:59am	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, flow meter was set on ft/s remember to convert to m/s in calc. Cloudy.
11/15/2005	12:30pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
11/15/2005	12:30pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
11/15/2005	12:30pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
11/22/2005	1:26pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy, Water very clear, Flow meter stopped operating midstream.
11/22/2005	1:26pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy, Water very clear, Flow meter stopped operating midstream.
11/22/2005	1:26pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Cloudy, Water very clear, Flow meter stopped operating midstream.
11/22/2005	12:23pm	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, mostly cloudy, water is very cloudy,
11/22/2005	12:23pm	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, mostly cloudy, water is very cloudy,
11/22/2005	12:23pm	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, mostly cloudy, water is very cloudy,
11/22/2005	1:01pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO, ice sheet, recent flow activity , appears dirty water flowed over top of ice.
11/22/2005	1:01pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO, ice sheet, recent flow activity , appears dirty water flowed over top of ice.
11/22/2005	1:01pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO, ice sheet, recent flow activity , appears dirty water flowed over top of ice.
11/29/2005	1:08pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, Flow meter stopped workign mid stream, mostly cloudy.
11/29/2005	1:08pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, Flow meter stopped workign mid stream, mostly cloudy.
11/29/2005	1:08pm	UL-1	U1-3	FC	Heather,	Grab	Flow, Stage, Temp, pH, DO, Flow meter stopped workign mid

					Maciej, Ryon		stream, mostly cloudy.
11/29/2005	12:12pm	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly cloudy
11/29/2005	12:12pm	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly cloudy
11/29/2005	12:12pm	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp, pH, DO, mostly cloudy
11/29/2005	12:51pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
11/29/2005	12:51pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
11/29/2005	12:51pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp, pH, DO
12/6/2005	2:20pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, , Flow meter stopped operating midstream, Sleet.
12/6/2005	2:20pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, , Flow meter stopped operating midstream, Sleet.
12/6/2005	2:20pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, , Flow meter stopped operating midstream, Sleet.
12/6/2005	1:20pm	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Evidence of sediment being dumped into stream from road by grater, snowing.
12/6/2005	1:20pm	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Evidence of sediment being dumped into stream from road by grater, snowing.
12/6/2005	1:20pm	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, Temp. pH. DO, Evidence of sediment being dumped into stream from road by grater, snowing.
12/6/2005	1:50pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp, pH. DO
12/6/2005	1:50pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp, pH. DO
12/6/2005	1:50pm	UL-S	US-3	FC	Heather, Maciej, Ryon	Grab	Temp, pH. DO
12/8/2005	11:40am	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp, pH. DO, water has high sediment load , very cloudy.
12/8/2005	11:40am	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp, pH. DO, water has high sediment load , very cloudy.
12/8/2005	11:40am	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp, pH. DO, water has high sediment load , very cloudy.
12/8/2005	11:00am	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH. DO.
12/8/2005	11:00am	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH. DO.
12/8/2005	11:00am	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH. DO.
12/8/2005	11:25am	UL-S	US-1	FC	Ryon	Grab	Temp. pH. DO. Evidence of recent water flow from drain, had created an ice free area.
12/8/2005	11:25am	UL-S	US-2	FC	Ryon	Grab	Temp. pH. DO. Evidence of recent water flow from drain, had created an ice free area.
12/8/2005	11:25am	UL-S	US-3	FC	Ryon	Grab	Temp. pH. DO. Evidence of recent water flow from drain, had created an ice free area.
12/13/2005	1:30pm	UL-1	U1-1	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH. DO, Flow meter stopped operating midstream. Overcast.
12/13/2005	1:30pm	UL-1	U1-2	FC	Ryon,	Grab	Flow, Stage, Temp, pH. DO, Flow meter stopped operating

					Maciej		midstream. Overcast.
12/13/2005	1:30pm	UL-1	U1-3	FC	Ryon, Maciej	Grab	Flow, Stage, Temp, pH. DO, Flow meter stopped operating midstream. Overcast.
12/13/2005		UL-2	U2-1	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Water appears very sediment laden, weather is over cast.
12/13/2005		UL-2	U2-2	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Water appears very sediment laden, weather is over cast.
12/13/2005		UL-2	U2-3	FC	Ryon, Maciej	Grab	Stage, Temp, pH, DO. Water appears very sediment laden, weather is over cast.
12/13/2005		UL-S	US-1	FC	Ryon, Maciej	Grab	Temp, pH, DO.
12/13/2005		UL-S	US-2	FC	Ryon, Maciej	Grab	Temp, pH, DO.
12/13/2005		UL-S	US-3	FC	Ryon, Maciej	Grab	Temp, pH, DO.
12/20/2005	1:10pm	UL-1	U1-1	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, pH, DO, Clear sky
12/20/2005	1:10pm	UL-1	U1-2	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, pH, DO, Clear sky
12/20/2005	1:10pm	UL-1	U1-3	FC	Heather, Maciej, Ryon	Grab	Flow, Stage, pH, DO, Clear sky
12/20/2005	2:00pm	UL-2	U2-1	FC	Heather, Maciej, Ryon	Grab	Stage, Temp. pH, DO , flow meter stopped functioning due to cold.
12/20/2005	2:00pm	UL-2	U2-2	FC	Heather, Maciej, Ryon	Grab	Stage, Temp. pH, DO , flow meter stopped functioning due to cold.
12/20/2005	2:00pm	UL-2	U2-3	FC	Heather, Maciej, Ryon	Grab	Stage, Temp. pH, DO , flow meter stopped functioning due to cold.
12/20/2005	1:45pm	UL-S	US-1	FC	Heather, Maciej, Ryon	Grab	Temp. pH, DO, weather clear and cold.
12/20/2005	1:45pm	UL-S	US-2	FC	Heather, Maciej, Ryon	Grab	Temp. pH, DO, weather clear and cold.
12/20/2005	1:45pm	UL-s	US-3	FC	Heather, Maciej, Ryon	Grab	Temp. pH, DO, weather clear and cold.
1/17/2006	12:45pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp. pH, DO meter read Error 4 indication. Weather is mostly sunny and cold. Water appears to be very clear.
1/17/2006	12:45pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp. pH, DO meter read Error 4 indication. Weather is mostly sunny and cold. Water appears to be very clear.
1/17/2006	12:45pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp. pH, DO meter read Error 4 indication. Weather is mostly sunny and cold. Water appears to be very clear.
1/17/2006	12:00pm	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, sunny very cold around 10F.
1/17/2006	12:00pm	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, sunny very cold around 10F.
1/17/2006	12:00pm	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, sunny very cold around 10F.
1/17/2006	1:25pm	UL_S	US-1	FC	Ryon	Grab	Ice depth exceeds 2 feet unable to sample. Weather is sunny and clear
1/17/2006	1:25pm	UL-S	US-2	FC	Ryon	Grab	Ice depth exceeds 2 feet unable to sample. Weather is sunny and clear
1/17/2006	1:25pm	UL-S	US-3	FC	Ryon	Grab	Ice depth exceeds 2 feet unable to sample. Weather is sunny and clear
1/31/2006	12:45pm	UL-1	U1-1	FC	Ryon, Bill	Grab	Temp, pH, DO, Flow meter stopped functioning due to low temperature, weather was partly cloudy, around 5 F
1/31/2006	12:45pm	UL-1	U1-2	FC	Ryon, Bill	Grab	Temp, pH, DO, Flow meter stopped functioning due to low temperature, weather was partly cloudy, around 5 F
1/31/2006	12:45pm	UL-1	U1-3	FC	Ryon, Bill	Grab	Temp, pH, DO, Flow meter stopped functioning due to low temperature, weather was partly cloudy, around 5 F

1/31/2006	11:30am	UL-2	U2-1	FC	Ryon, Bill	Grab	Flow, Stage, pH, DO, weather was partly cloudy, temper about 5F
1/31/2006	11:30am	UL-2	U2-2	FC	Ryon, Bill	Grab	Flow, Stage, pH, DO, weather was partly cloudy, temper about 5F
1/31/2006	11:30am	UL-2	U2-3	FC	Ryon, Bill	Grab	Flow, Stage, pH, DO, weather was partly cloudy, temper about 5F
1/31/2006		UL-S	US-1	FC	Ryon, Bill	Grab	Ice Depth exceeds 2 feet unable to sample.
2/7/2006	1:00pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp. pH, DO, water is somewhat cloudy,
2/7/2006	1:00pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp. pH, DO, water is somewhat cloudy,
2/7/2006	1:00pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp. pH, DO, water is somewhat cloudy,
2/7/2006	12:10pm	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear, surface ice has melted, cloudy about 31F
2/7/2006	12:10pm	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear, surface ice has melted, cloudy about 31F
2/7/2006	12:10pm	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear, surface ice has melted, cloudy about 31F
2/7/2006	12:30pm	UL-S	US-1	FC	Ryon	Grab	Temp. pH, DO, evidence of flow from drain, water appeared to run over top of ice.
2/7/2006	12:30pm	UL-S	US-2	FC	Ryon	Grab	Temp. pH, DO, evidence of flow from drain, water appeared to run over top of ice.
2/7/2006	12:30pm	UL-S	US-3	FC	Ryon	Grab	Temp. pH, DO, evidence of flow from drain, water appeared to run over top of ice.
2/14/2006	12:00pm	UL-1	U1-1	FC	Ryon	Grab	Temp, pH, DO, weather was partly cloudy, cold around 25F
2/14/2006	12:00pm	UL-1	U1-2	FC	Ryon	Grab	Temp, pH, DO, weather was partly cloudy, cold around 25F
2/14/2006	12:00pm	UL-1	U1-3	FC	Ryon	Grab	Temp, pH, DO, weather was partly cloudy, cold around 25F
2/14/2006	10:43am	UL-2	U2-1	FC	Ryon	Grab	Temp, pH, DO, water is clear, weather partly cloudy.
2/14/2006	10:43am	UL-2	U2-2	FC	Ryon	Grab	Temp, pH, DO, water is clear, weather partly cloudy.
2/14/2006	10:43am	UL-2	U2-3	FC	Ryon	Grab	Temp, pH, DO, water is clear, weather partly cloudy.
2/14/2006	11:10am	UL-S	US-1	FC	Ryon	Grab	Temper, pH, DO, evidence of recent flow from drain.
2/14/2006	11:10am	UL-S	US-2	FC	Ryon	Grab	Temper, pH, DO, evidence of recent flow from drain.
2/14/2006	11:10am	UL-S	US-3	FC	Ryon	Grab	Temper, pH, DO, evidence of recent flow from drain.
3/15/2006	11:55am	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp. pH, DO,
3/15/2006	11:55am	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp. pH, DO,
3/15/2006	11:55am	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp. pH, DO,
3/15/2006	11:10am	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, partly cloudy
3/15/2006	11:10am	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, partly cloudy
3/15/2006	11:10am	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, partly cloudy
3/15/2006		UL-S		FC	Ryon	Grab	Ice to thick to sample
3/29/2006	12:30pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp. pH, DO, water is cloudy, weather sunny about 41 F
3/29/2006	12:30pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp. pH, DO, water is cloudy, weather sunny about 41 F
3/29/2006	12:30pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp. pH, DO, water is cloudy, weather sunny about 41 F
3/29/2006	11:45am	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water is somewhat clear, weather is sunny,
3/29/2006	11:45am	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water is somewhat clear, weather is sunny,
3/29/2006	11:45am	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water is somewhat clear, weather is sunny,
3/29/2006	12:00pm	UL-S	US-1	FC	Ryon	Grab	Temp, pH, DO, very little flow from drain, no evidence of large flow, still iced over,
3/29/2006	12:00pm	UL-S	US-2	FC	Ryon	Grab	Temp, pH, DO, very little flow from drain, no evidence of large flow, still iced over,
3/29/2006	12:00pm	UL-S	US-3	FC	Ryon	Grab	Temp, pH, DO, very little flow from drain, no evidence of large flow, still iced over,

5/2/2006	12:00pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear sunny, about 45F
5/2/2006	12:00pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear sunny, about 45F
5/2/2006	12:00pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water is clear sunny, about 45F
5/2/2006	11:00am	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, snow still on banks, Mostly sunny about 45F
5/2/2006	11:00am	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, snow still on banks, Mostly sunny about 45F
5/2/2006	11:00am	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water is very clear, snow still on banks, Mostly sunny about 45F
5/2/2006	11:25am	UL-S	US-1	FC	Ryon	Grab	Temp, pH, DO, ice sheet still covering area, some evidence of recent water flow, but no flow at sample time.
5/2/2006	11:25am	UL-S	US-2	FC	Ryon	Grab	Temp, pH, DO, ice sheet still covering area, some evidence of recent water flow, but no flow at sample time.
5/2/2006	11:25am	UL-S	US-3	FC	Ryon	Grab	Temp, pH, DO, ice sheet still covering area, some evidence of recent water flow, but no flow at sample time.
5/11/2006	1:30pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water somewhat cloudy can still see creek bttm, weather cloudy, about 54F
5/11/2006	1:30pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water somewhat cloudy can still see creek bttm, weather cloudy, about 54F
5/11/2006	1:30pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water somewhat cloudy can still see creek bttm, weather cloudy, about 54F
5/11/2006	12:45pm	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, water alitte cloudy , large amount of algal growth, weather is cloudy,
5/11/2006	12:45pm	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, water alitte cloudy , large amount of algal growth, weather is cloudy,
5/11/2006	12:45pm	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, water alitte cloudy , large amount of algal growth, weather is cloudy,
5/11/2006	1:00pm	UL-S	US-1	FC	Ryon	Grab	Temp, pH, DO, lake and site is ice Free, no flow from drain, but noticable bubbles at underwater pipe.
5/11/2006	1:00pm	UL-S	US-2	FC	Ryon	Grab	Temp, pH, DO, lake and site is ice Free, no flow from drain, but noticable bubbles at underwater pipe.
5/11/2006	1:00pm	UL-S	US-3	FC	Ryon	Grab	Temp, pH, DO, lake and site is ice Free, no flow from drain, but noticable bubbles at underwater pipe.
5/22/2006	1:45pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp, pH , DO, weather is sunny about 59F ,
5/22/2006	1:45pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp, pH , DO, weather is sunny about 59F ,
5/22/2006	1:45pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp, pH , DO, weather is sunny about 59F ,
5/22/2006	1:25pm	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO , noticeable algal growth on creek bttm, weather is sunny about 59F
5/22/2006	1:25pm	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO , noticeable algal growth on creek bttm, weather is sunny about 59F
5/22/2006	1:25pm	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO , noticeable algal growth on creek bttm, weather is sunny about 59F
6/12/2006	12:09pm	UL-1	U1-1	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is partly cloudy around 58F
6/12/2006	12:09pm	UL-1	U1-2	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is partly cloudy around 58F
6/12/2006	12:09pm	UL-1	U1-3	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is partly cloudy around 58F
6/12/2006	11:04am	UL-2	U2-1	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is parlty cloudy,
6/12/2006	11:04am	UL-2	U2-2	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is parlty cloudy,
6/12/2006	11:04am	UL-2	U2-3	FC	Ryon	Grab	Stage, Temp, pH, DO, weather is parlty cloudy,
6/12/2006	11:45am	UL-S	US-1	FC	Ryon	Grab	Temp, pH, DO, no flow from drain, weather is partly cloudy .
6/12/2006	11:45am	UL-S	US-2	FC	Ryon	Grab	Temp, pH, DO, no flow from drain, weather is partly cloudy .
6/12/2006	11:45am	UL-S	US-3	FC	Ryon	Grab	Temp, pH, DO, no flow from drain, weather is partly cloudy .