Sesachacha Pond
Annual Report
2006

Prepared for:
Marine and Coastal Resources Department
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March 2007

Introduction:

Sesachacha Pond is a coastal eutrophic salt pond located on the northeast part of Nantucket Island. It is a kettle pond, formed during the last glacial period. It has two deep basins, (15-18ft. deep) on the northern and southern end. This unique physical characteristic of Sesachacha Pond allows it to support high salinity conditions when the pond is properly opened, and flushed to the sea.

The drainage basin of Sesachacha Pond covers approximately 800 acres. The watershed to pond ratio is low (3:1). The surface area of the pond during "normal conditions" covers 266 acres. During the "flooded conditions" the pond covers 279 acres. The approximate pond volume for "normal" and "flooded" conditions is 2,183 acre-ft and 3,129 acre-ft, respectively.

Development in the pond's watershed has increased nutrient loading to the pond, via groundwater and surface runoff. Nitrogen, a limiting nutrient in salt water conditions, has reached extremely high levels in the pond, severely degrading water quality conditions. The lack of flushing during some pond openings has resulted in higher concentrations of nutrients, low oxygen periods, phytoplankton blooms, and fish kills during anoxic summer events (2002), and (2006).

Water quality is continuing to degrade over time. Sesachacha Pond was first placed on the Massachusetts 303d list in 1998, for impaired water bodies. Sesachacha Pond has not met the standards for the direct consumption of shellfish due to pathogens since 1988 (Division of Marine Fisheries). The Department of Environmental Protection is the governing agency for impaired water bodies, and has included Sesachacha in the DEP Estuaries Project. This program will determine nutrient thresholds for the pond, and was scheduled to be completed by the School for Marine Science and Technology (SMAST) by June 2004. The report is now under the review of the DEP. In 2002 SMAST conducted some preliminary studies and found the pond to be in poor health, exhibiting hyper-eutrophic conditions with average total nitrogen levels at 1,200 ppb. In their Critical Indicator Interim Report '03, they classify water bodies being of significant impairment when TN levels are between 700-800 ppb.

Historically, Sesachacha was opened to the ocean seasonally to enhance marine fisheries. Pond openings were discontinued for ten years, from 1981-1991. The absence of the openings resulted in an environmental change, moving from marine to a fresh water ecosystem. Sesachacha Pond has been monitored since 1980 for water quality conditions by a variety of agencies. The consulting firm, Perkins Jordan, Inc., completed the first, most thorough study in 1985. At that time the water quality analysis indicated the pond as a mesotrophic system, in good to fair health with average TN levels at 460 ppb. The report also concluded that, not opening the pond would result in a complete freshening of the pond over time. That freshening would result in stress and death to marine life in the pond. They also found what appeared to be a clay layer, buffering the groundwater table from the saline conditions in the pond; which allowed for and maintained well water purity.

At that time, they believed that the limited number of septic systems, would not negatively influence the pond. However, nitrates and phosphates were expected to build up over time, if the pond were not flushed to the ocean. As years passed, and the pond began to freshen, phytoplankton blooms began to occur more frequently. Fish kills began to occur during the summer months, and associated odors became more prominent. The community around Sesachacha Pond became increasingly aware of these environmental conditions, and their involvement eventually lead to public demand to reopen the ponds. This movement evolved into political pressures at the federal level to grant a “home rule petition” to the Town of Nantucket to open the great ponds (1991).

Sesachacha must remain open to the ocean for at least a week, to ensure a proper volumetric exchange of water. In (2005), the pond was opened three times. Fear of flooding lead to an additional opening, which occurred in the winter (2/16-2/24). Because of low water temperatures at this time, many hundreds fish, of several species were stranded on the banks when the water level was lowered; apparently caught off guard, in a state of torpor. In 2006, the spring opening lasted 5 days, from 4/27 to 5/3, during which, herring were seen running into the pond. The fall opening lasted only two days, 10/27 to 10/29, closing prematurely due to a severe onshore storm. Neither the spring nor the fall openings successfully replaced enough ocean water, for pond water to dilute nutrient concentrations, maintain marine fisheries, or increase salinity.

Increased development to the north of Sesachacha Pond has increased nutrient loading into Sesachacha Pond. Surface water runoff and groundwater carry nitrogen and phosphorus to the pond, changing water chemistry. Most of the development (80%), around Sesachacha Pond is located in a glacial moraine known as the Plymouth-Evesboro Association. The permeability of this soil type, made up from glacial till and outwash deposits is rapid. Septic tanks placed on the downward slope to the pond will increase seepage of effluent into the pond and groundwater. Nutrients are thus entering Sesachacha Pond though groundwater infiltration. This accelerated eutrophication process has made pond openings more critical in maintaining good water quality. A proper exchange of nutrient latent pond water with alkaline-rich ocean water is now important in maintaining good water quality for marine life.

The Sesachacha water quality monitoring stations are as follows: **Site 1:** Deep basin, north side of pond, also referred to as Quidnet north corner, **Site 4:** Deep basin, south side of pond, also referred to as oyster bed south corner, **Site 5:** Ancillary pond west side of pond, not on map. These locations are designated on **Map #1.**

Sesachacha Pond Monitoring Results:

Appendix A: contains all physical and chemical water quality data. **Appendix B:** contains the averages of A with corresponding charts. **Appendix C:** contains average monthly rainfall for 2006, as collected by the Nantucket Water Company.

Temperature and Dissolved Oxygen:

Temperature and dissolved oxygen are often closely related, and inversely proportional. The solubility of oxygen in water is very dependant on the temperature, and will decrease as temperature rises. Dissolved oxygen (D.O.) is also affected by nutrients, and the biological oxygen demand (BOD) of decaying plant or animal matter. As nutrients increase, phytoplankton and macro algae increase proportionately. These plants have a relatively short life cycle, and when they die and sink to the bottom, they are consumed by bacteria. These bacteria consume oxygen, and may lead to anoxic events. When this occurs, nutrients are released from the sediments, and a process known as “internal recycling” begins. The process of eutrophication may occur naturally, but at Sesachacha Pond it is accelerated by anthropogenic uses.

Temperature in the pond follows a well defined bell curve, as expected, rising in the spring and dropping off in the fall. Sesachacha is not very deep, and because of its shape, it is very well mixed. For these reasons it is predominantly isothermic at all stations and depths. The D.O. follows a converse image of temperature, (Figures 1, and 2), except for Site 5, which is connected by a narrow and shallow tributary, and largely influenced by fresh water inputs. Temperatures peak at an average of 26.3º C at Site 4 during the August sampling round 8/8/2006. A fish kill occurred the day prior, in which approximately 24 winter flounder were seen on the Quidnet beach; blown up on the north east corner of the pond, by a south west wind. On this day the near shore water temperatures were measured as high as 28° C, or 82°F. These high temperatures combined with excessive nutrient loading would have induced an anoxic event, thus killing the bottom dwelling fish.

The average D.O. was relatively good throughout the sampling period of 2006, and only one recording was taken that would indicate a stressed condition for marine animals. This is most likely due to mixing of the pond by aeolian conditions, typical on Nantucket, and the shape and relatively shallow depth of the pond. However, the bottom at Site 4, in August, recorded a value of 1.86 mg/l, (Appendix A). Low oxygen events were also recorded on the bottom at Site 5 in July and August, dropping to hypoxic conditions. These conditions would be expected to worsen during the night time hours, when a period of respiration would occur. This basically is the opposite condition of photosynthesis, where plants, at night with out sunlight consume oxygen rather than create it in order to maintain their metabolic processes. During the September sampling round, the bottom conditions at Site 4 were again poor, recording a hypoxic D.O. level of 3.09 mg/l. All other recordings did not drop below 4 mg/l. These anoxic and hypoxic conditions can be attributed to the high temperatures, the high level of nutrients entering the pond from the watershed, and the poor openings in 2005. A fish kill could almost be expected in 2006 when calculating the lack of exchange with ocean waters, in the spring opening of 2006, and when considering the nutrient loading from the watershed. Salinity and nutrients are also dependant factors, and will be discussed in later sections.

Figure 1: Average Temperature 2006

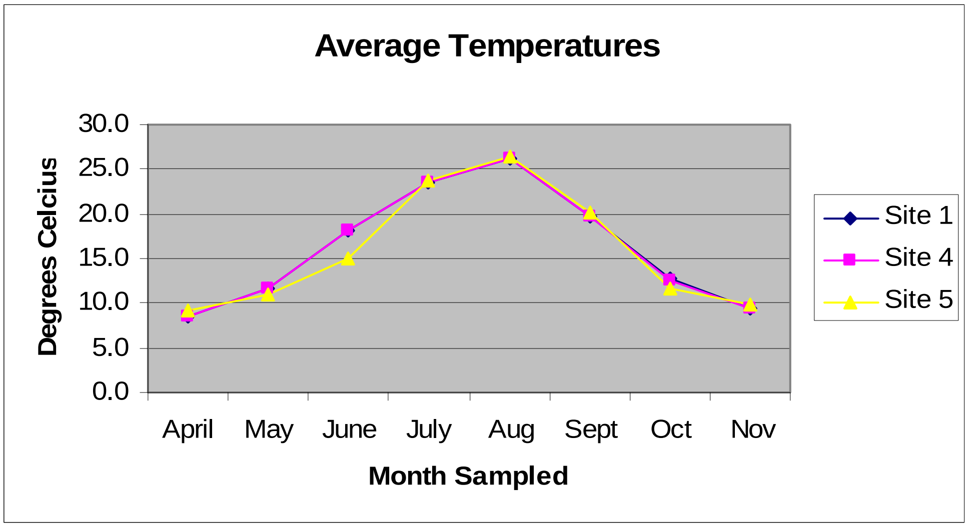
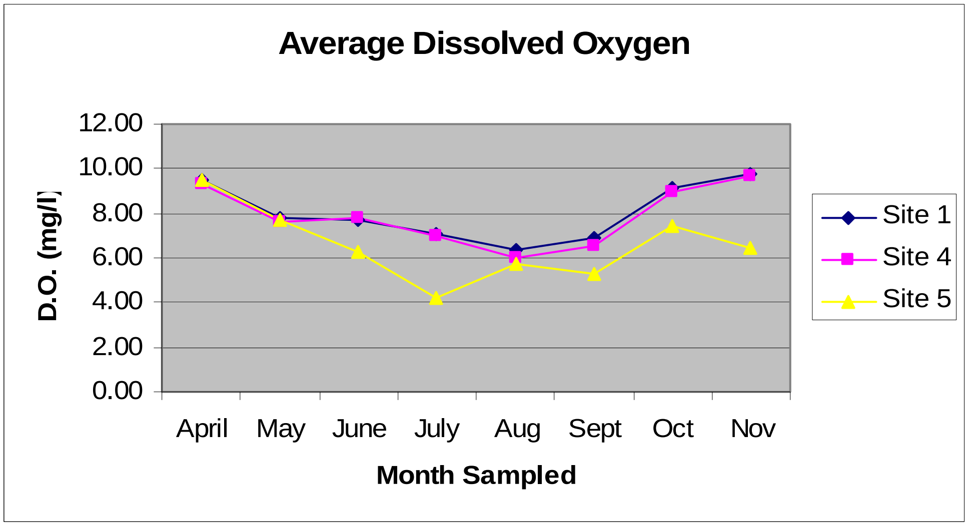


Figure 2: Average Dissolved Oxygen 2006



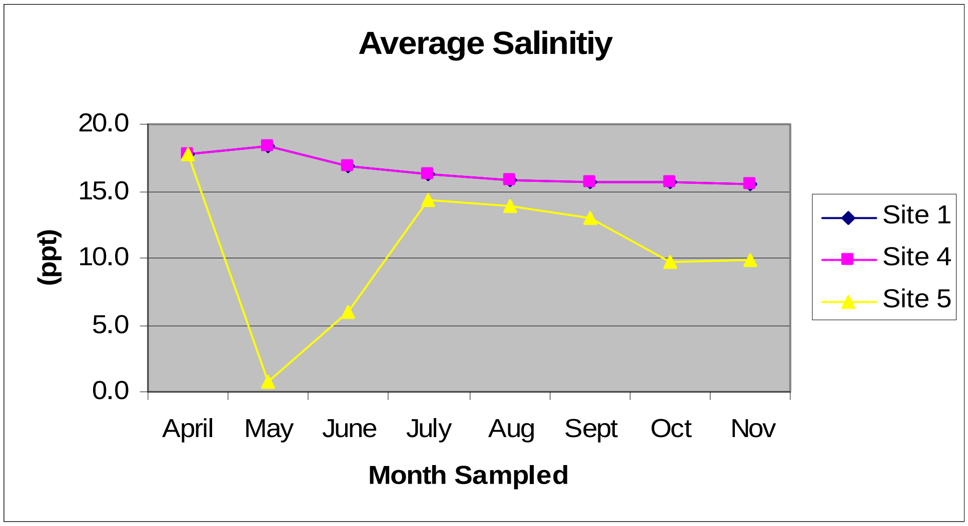
Salinity:

Sesachacha Pond has been designated to be maintained as a salt water pond. Because of its geomorphic features and watershed ratio, the pond's deep basins are capable of retaining a high level of salinity. However, if not properly maintained by prolonged openings, its health will rapidly deteriorate. Marine fisheries are susceptible to changes in salinity, and many species have varying salinity regimes throughout their life cycle. Water quality declines rapidly in this pond when an open exchange is not met for at least a week. Successive years of poor openings lead to a fish kill in the summer of 2002, and again in 2006. The salinity in the pond from ’99 to ’01 had an average below 15 parts per thousand (ppt). A repetition of less than adequate openings has occurred again from ’04 to ’06. On 11/17/2006 the final recorded average salinity in the pond had decreased to 15.5 ppt.

Salinity in the pond is representative to the health of the pond. A higher salinity is indicative to better water quality. Lower salinities reflect poor openings, with less exchange to the ocean. This lack of exchange also leads to a build up of nutrients, which then cause a further decline in water quality. An exceptionally good opening in the spring of 2003 kept the pond open for approximately a month. This high salinity, above 25 ppt. was maintained for two years, but started to decline in 2005. An appreciably head volume prior to an opening in the spring seems to be the deciding factor whether these openings go well or not. Fall openings historically have not been successful due to the lack of precipitation in summer months. In 2005 there was an extra winter opening, which decreased this spring volume for 2006, coincidentally the pond has freshened considerably.

When sampling began in April the salinity was 17.8 ppt., following the opening on 4/27 it had increased slightly. However, being open for only five days did not allow for proper exchange with the ocean, and a month later the recorded salinity was only 18.3 ppt; which did not hold for long. Salinity remained in a slow steady decline throughout the summer, with higher than usual precipitation in May, June and July; approximately 16.8” of rain. Site 5, added in 2006 because of its suspected influence had the largest drop in salinity following the opening in May, with a recorded value at 0.8 ppt. This nearly complete freshening indicates a strong groundwater intrusion from the watershed associated with this portion of the pond. If good exchanges are not met, salinity will decrease, nutrients will increase and water quality will decline.

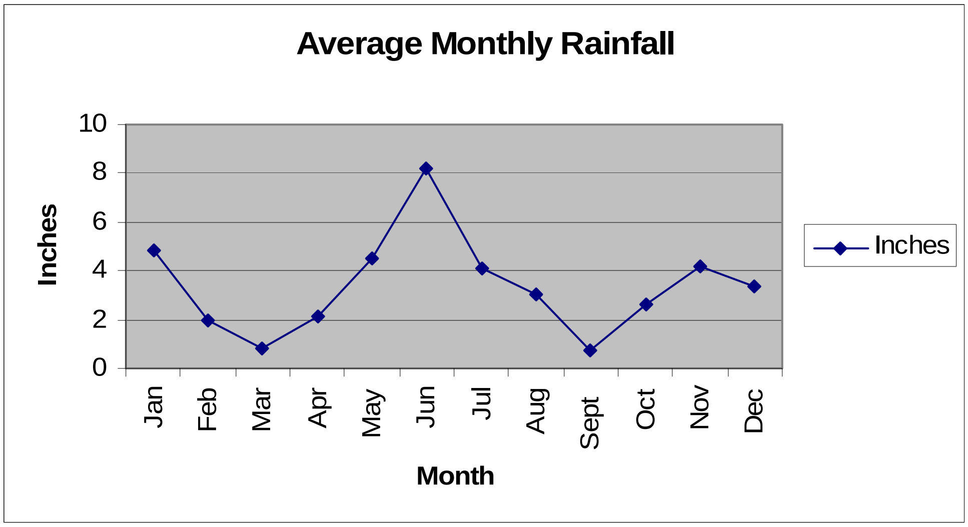
Figure 3: Average Salinity 2006



Rainfall:

Average rainfall was collected by the Nantucket Water Company, and shows considerable precipitation throughout the summer. As previously discussed rainfall directly affects volume and salinity in the ponds. It also affects the amount of nutrients that are carried in groundwater flow from watersheds to their associated water bodies. As anthropogenic uses increase, rainfall becomes an important factor in determining water quality.

Figure 4: Average Monthly Rainfall 2006

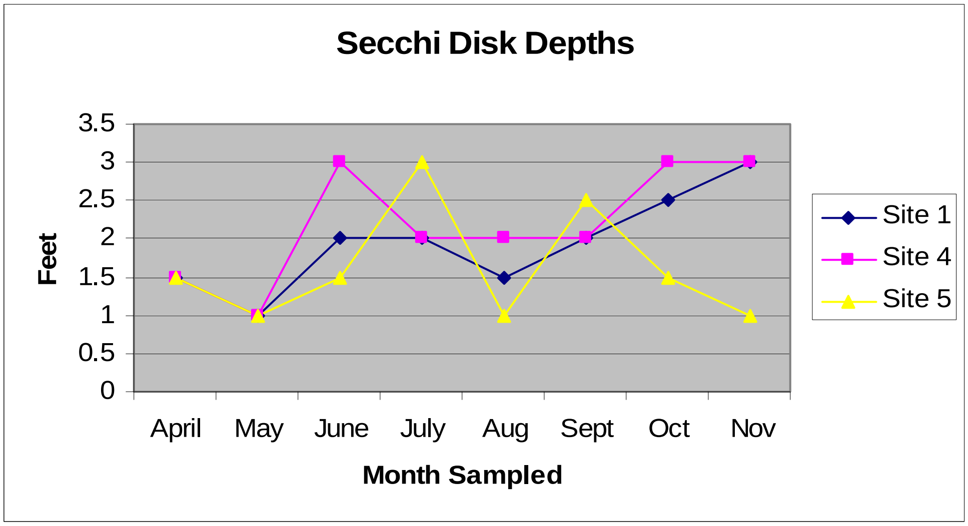


Secchi Depths:

Secchi disk depth recordings are a quick helpful test in measuring water clarity. Water transparency will indicate the amount of phytoplankton, algae, and nutrients available in the water column. The disc measures one half the visible light penetrating the water column. When you combine this information with the bathymetry of any given water body, you can roughly define aquatic plant growth boundaries. Because of Sesachacha Pond's salinity problems, and poor water quality, it has a relative low abundance of submerged aquatic vegetation. Secchi disk depth recordings reflect this condition. Also, the salinity appears to be too high to maintain fresh water pond weeds, and too low to support eel grass. With nutrient levels as high as they are, Sesachacha has become a phytoplankton dominant ecosystem.

Secchi disk depths are on average very low in this pond. This is primarily due to the intensity of phytoplankton production, which is the result of high nutrient levels. Depths in 2006 were never recorded more than 3', and began at 1.5' at all stations in April when sampling was initiated. As readily available nutrients like nitrate dropped off, secchi depths dropped even further. This action of plankton production also coincides with warming temperatures in May, revealing the lowest recorded depth at 1' at all stations. Heavy precipitation throughout the summer may also have affected plankton production, resulting in changes in communities which prefer fresh to salt water conditions. As these dominant communities change based on salinity regimes, the preferred nutrients used will also change. A fresh water system is limited in production based upon the availability of phosphorus in the system. This relationship can be seen at Site 5, which experienced the greatest salinity and secchi disk depth changes. Nutrients in a large part affect these changes, and will be discussed further in the next section. However, this is why flushing of the pond with a good exchange of salt water is so important in maintaining water quality and clarity. In 2004 Secchi disk depths were better, and reached 8' and 7' dpeths in May, and June. This relates considerably with the favorable openings that occurred in '03 and '04, when the pond stayed open longer and experienced a better exchange with the ocean.

Figure 5: Secchi Depth 2006



Nutrients:

Nitrogen:

Sesachacha Pond is a salt water pond, and as such it is limited by nitrogen with respects to nutrients and plant growth. Nitrogen levels in the pond are exceedingly high. When sampling began in April, total nitrogen levels already exceeded a state of significant impairment, (@ or > 700 ppb TN, as defined by recent SMAST studies). In fact TN levels were recorded well over 1,000 ppb (Figure 7). Total nitrogen is comprised of inorganic nitrogen, or nitrate (NO3), nitrite (NO2), and Kjeldhal nitrogen (TKN), which includes ammonia (NH3); both components of organic nitrogen. NH3 sampling in years past was always below the reportable limit (100 ppb), so for 2006 the detection limit was lowered to (20 ppb), (Appendix A). NO3 is commonly associated with chemical fertilizers, and TKN is most often associated with decaying matter, and septic effluent. TKN takes longer to break down, and so is not as readily available for plant production as NO3. Because of this, TKN is more easily detectable, and reportable in a chemical analysis. As such it is the predominant contributor to the reportable levels of nitrogen in TN.

TN concentrations followed a high and steady pattern throughout the summer, with a couple of upward spikes in July and September, and a complete drop in October. The first and highest spike occurred at Site 1 in July, reaching 1,780 ppb. The TN values are largely made up from the TKN values, and the two graphs mirror each other well, (Appendix B). The second spike occurs in September, however this time the values are extremely high at all stations. July and August are coincidentally the months of peak visitation to the island. This September spike in TN is most likely the result of anoxia occurring on the bottom during August. The D.O. on the bottom at Site 4 in August was 1.86 mg/l (Appendix A). This would not only have resulted in a fish kill, but would have led to a large release of nutrients from the mud on the bottom. The effect would initiate a recycling process of nutrients into the water column, creating large phytoplankton blooms. The temperature drop in October combined with a change in anthropogenic uses, i.e. drop in residents in the area undoubtedly led to a huge drop in available nutrients in the water column. The temperature change may also have led to a change over of dominant phytoplankton species, which for a temporary period would help to drop available nutrients. However as the emerging phytoplankton species take up nutrients, the pre-existing species would be dying off creating a whole new source of available nutrients; as seen in the November sampling round (Appendix B).

Nitrate NO3, was initially very high in April at Site 5 when sampling began (Figure 6). Because it is so readily available for plant production, the threshold concentration that leads to impairment is much lower than that for TN. Eutrophic conditions begin to occur when nitrate levels reach 70 ppb. Site 5 was 80 ppb above this mark when sampled 4/11, but had dropped below 50 ppb along with the other sites by May. NO3 levels remained low or below the reportable limit (10 ppb) for most of the sampling period. However there was sharp increase in July at all stations. Most likely the influx of summer residents, the use of fertilizers, would have had an influence on the system by this time. Also, the spike in July would likely have been affected by the freshening of the system as a result of precipitation (Figure 4). A maximum level of uptake of nutrients for phytoplankton production may have been met, which also would have led to an excess of nutrients in the water column at this time of sampling.

In August the NO3 levels at all sites dropped to concentrations below the reportable limit (BRL). There are several possible hypotheses for this occurrence. Either the nitrate in the system was used up, and no more was coming in. Or more likely, with temperatures rising, plant production had increased to a level, such that the nitrate in the system was being used as rapidly as it entered the system. There is a slight rebound of available NO3 in September, probably the result of continued activity in and around the watershed. However these numbers are below the values suggested for eutrophic conditions. The following sampling rounds in October and November are (BRL), and

<10 at all stations (Appendix B); being the result of the decrease in anthropogenic uses on the Island, and the drop in temperatures.

Figure 6: Nitrate 2006

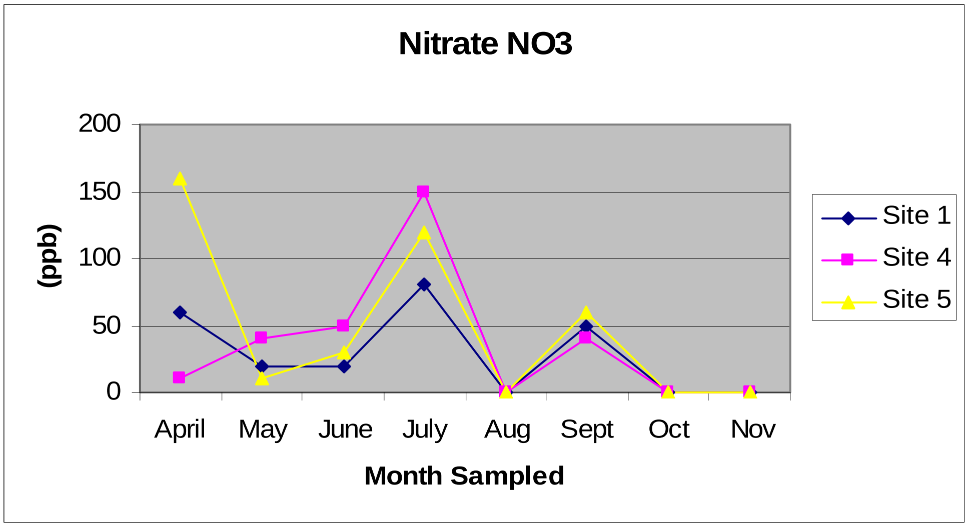
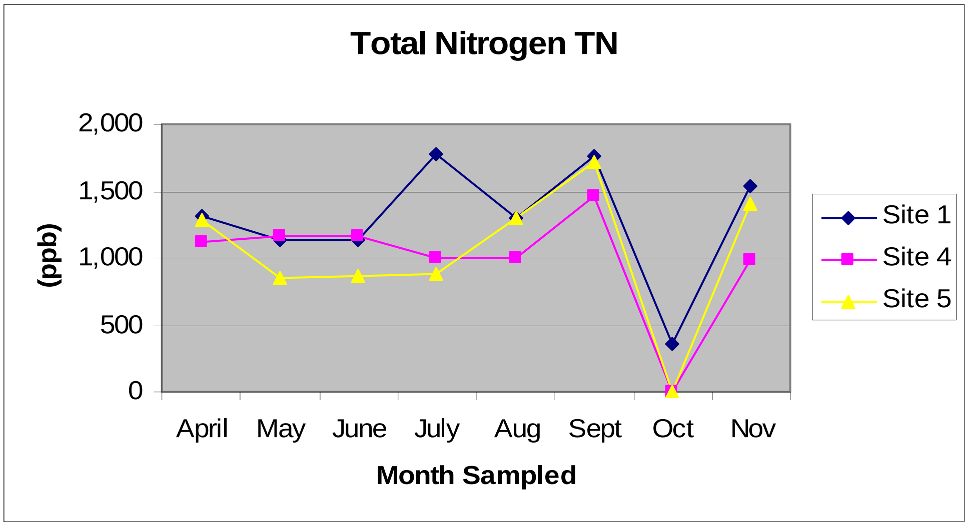


Figure 7: Total Nitrogen 2006



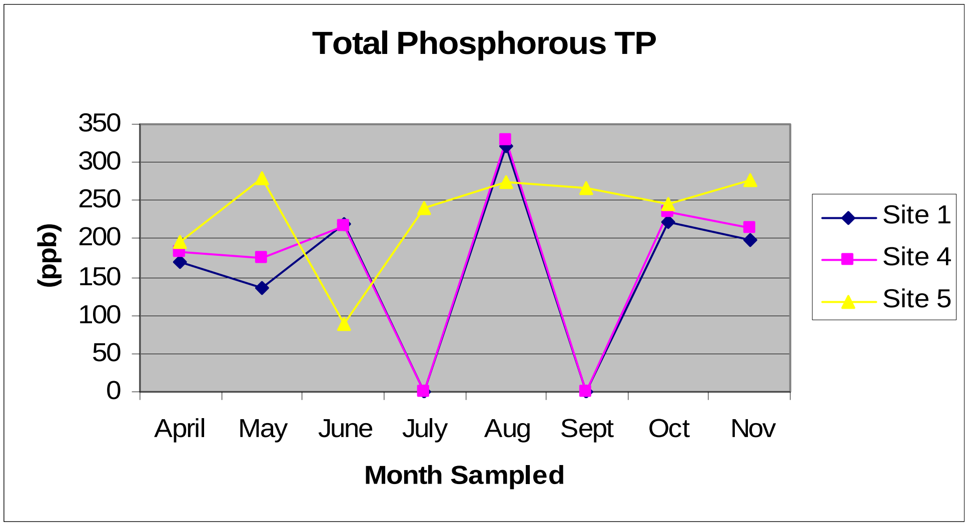
Phosphorous:

Sesachacha Pond is now being maintained as a salt water pond, and as such phytoplankton growth will be limited by nitrogen instead of phosphorous. However, when poor openings occur, and salinity levels drop, phosphorous may become the limiting nutrient to fresh water phytoplankton. It is suggested that for fresh water ponds, a eutrophic condition will begin to occur when TP levels exceed 50ppb. Water quality in Sesachacha has been best when salinity levels have been maintained above 24 ppt. (Town Biologist Reports). It may be that at this high level, the growth of fresh water species of phytoplankton is prohibited, or at least restricted by nitrogen limitation.

When sampling began in April 2005, TP levels were already high, 170 ppb, 182 ppb, and 197 at Sites 1, 4, and 5 respectively (Figure 8). Following this sampling period, salinity began decreasing, as fresh water inputs increased, with 16.8" of precipitation from May through July. When TP was sampled in July it had decreased below the reportable limit (BRL) at Sites 1, and 4, but remained high at Site 5 (240 ppb). Based on salinity readings, Site 5 has major fresh water inputs, and so may be considered a temporary fresh water system, with phosphorous maintaining the limiting balance on dependant species. As such, TP concentrations remain high throughout the sampling period. However at Sites 1 and 4, the fresh water inputs may have excited a phosphorous limited phytoplankton bloom, which had in turn reduced the level of TP in the system by the July sampling period. Where the main pond, (Sites 1 and 4) are predominantly nitrogen limited, salinity changes excite phosphorous use. The ancillary pond, (Site 5) has a well established community of phosphorous utilizing species. This makes the instantaneous uptake of TP more likely to happen in the main pond, than the ancillary pond. This then accounts for the sudden drops in TP in the main pond, and steady trends in the ancillary pond.

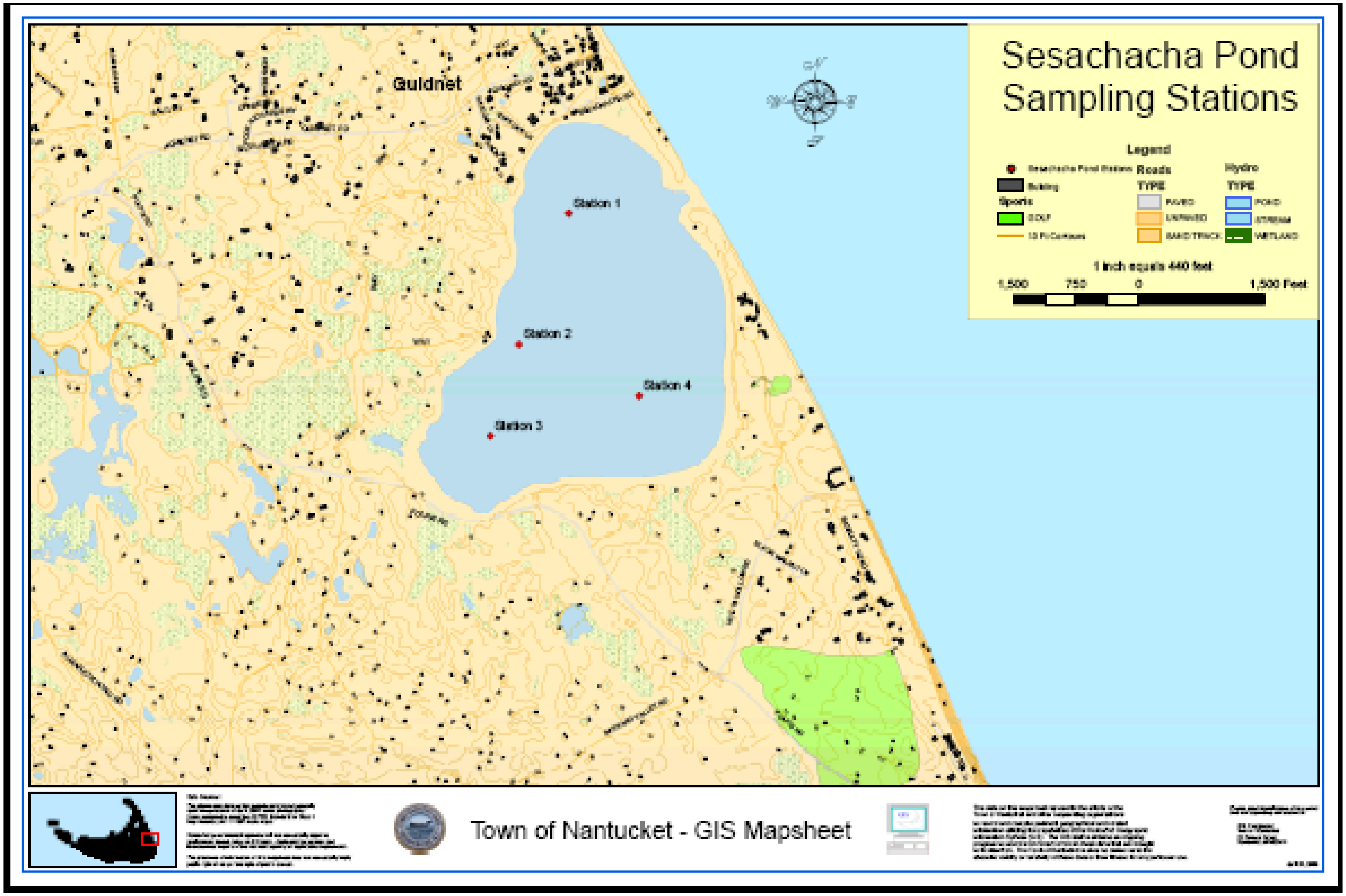
In August there was an anoxic event that resulted in the death of approximately two dozen winter flounder. This event caused by the existing eutrophic conditions and the high water temperatures, also caused the release of nutrients previously bound up in the benthic soils. The recorded highs in August were 320 ppb, and 328 ppb at Sites 1, and 4 respectively. At these levels, TP was seven times higher than necessary to induce a eutrophic condition. At this level it would most likely be negatively affecting any system, fresh or salt because of nitrogen phosphorous ratios. In September it is interesting to note a dramatic drop in TP, coinciding with a drop in precipitation, with only 0.76" recorded. The phosphorous that was released in August was most likely used up. This is shown when secchi disk depths also dropped in August showing another phytoplankton bloom to occur. Site 1 decreased its secchi disc recording to a summer low point of 1.5'; but showed continual improvement from September to the end of the sampling period. TP levels however rebounded to eutrophic conditions in October, and remained high through to November. It would then appear that the two dramatic drops in TP, in July and September are the result of post affected conditions induced from heavy precipitation in June, and an anoxic event in August. Contributions of phosphorous are likely coming from septic systems and fertilizers originating in the Quidnet area to the north, fertilizers from the cranberry bogs to the west, and fertilizers from the golf course to the south; as well as internal recycling, and atmospheric loading.

Figure 8: Total Phosphorous 2006



Conclusions:

The water quality of Sesachacha Pond appears to be entirely dependant on the success or failure of the bi-annual openings. Water quality improves when prolonged flushing occurs, and a good exchange with the ocean results in a higher salinity in the pond. However the increased nutrient loading from the watershed, and recycling of nutrients during anoxic events have degenerated water quality to a hyper-eutrophic state. When salinity levels greater than 24 ppt. are not maintained, and substantial flushing does not occur, this salt water habitat declines rapidly. A decline in habitat, and an example of the poor condition the pond is in, can be seen by the pond's phytoplankton dominant plant community. High nutrients, low dissolved oxygen levels, and fish kills will continue to occur if the pond is not properly flushed. If the future health of the pond is to be improved, alternative long term methods of mitigation should be sought after. This is because successful openings can never be guaranteed, as there are too many variables outside our control. Actions that should be initiated would include reductions in fertilizer use, improved methods of filtration for septic systems, and control of stormwater runoff.



Sesachacha Pond
Sampling Stations
Legend
Sesachacha Pond Stations
Building
Sports
GOLF
10 Ft Contours
Roads
TYPE
PAVED
UNPAVED
SAND TRACK
Hydro
TYPE
POND
STREAM
WETLAND
1 inch equals 440 feet
1,500
750
0
1,500 Feet
Quidnet
Station 1
Station 2
Station 3
Station 4
N
S
E
W
Town of Nantucket - GIS Mapsheet

Appendix A

Sesachacha Pond 2006
Physical and Chemical Data

Site 1	Quidnet North Corner
Site 4	Oyster Bed South Corner
Site 5	Ancillary Pond West End

Temperature (ºC)

Site 1	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	8.8	11.7	18.1	23.7	26.3	19.9	12.7	9.4
3	8.7	11.7	18.1	23.7	26.3	19.8	12.7	9.4
6	8.6	11.7	18.2	23.7	26.2	19.7	12.7	9.4
9	8.6	11.7	18.2	23.6	26.2	19.7	12.7	9.3
12	8.5	11.6	18.2	23.5	26.1	19.6	12.7	9.3
15	8.5	11.6	18.2	23.3	26	19.6	12.7	9.3
16	8.5		18.2		26	19.6		9.3

Site 4	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	8.8	11.7	18.2	23.5	26.3	19.7	12.6	9.6
3	8.7	11.6	18.2	23.5	26.3	19.7	12.6	9.5
6	8.7	11.6	18.2	23.5	26.3	19.6	12.6	9.4
9	8.7	11.6	18.2	23.4	26.3	19.6	12.6	9.4
12	8.6	11.6	18.2	23.4	26.3	19.6	12.6	9.3
15	8.5	11.6	18.2	23.4	26.2	19.6	12.6	9.3
18	8.4	11.6	18.2	23.3	26.1	19.6	12.5	9.2
20	8.4							9.2

Site 5	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	10	10.9	14.3	23.7	26.8	20.5	10.9	9.7
3	8.9	10.9	15.7	23.8	26.1	20	12.5	9.9
4	8.8							

Dissolved Oxygen (mg/l)

Site 1	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	9.48	7.81	7.63	7.35	6.99	7.23	9.22	9.64
3	9.47	7.81	7.61	7.31	6.87	7.1	9.22	9.66
6	9.49	7.8	7.67	7.26	6.81	6.96	9.19	9.71
9	9.49	7.77	7.69	7.18	6.75	6.79	9.21	9.76
12	9.52	7.72	7.7	6.96	5.8	6.82	9.24	9.81
15	9.51	7.6	7.66	6.51	5.62	6.79	8.97	9.78
17	9.51		7.64		5.62	6.67		9.81

Site 4	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	9.34	7.74	7.78	7.22	6.71	7.28	8.98	9.75
3	9.36	7.72	7.75	7.13	6.66	7.22	9.01	9.72
6	9.38	7.69	7.73	7.02	6.66	7.1	9.02	9.73
9	9.37	7.67	7.73	6.98	6.69	7.08	9.02	9.75
12	9.34	7.65	7.75	6.95	6.69	7.11	9.03	9.76
15	9.34	7.59	7.74	6.95	6.53	7.14	9.04	9.69
18	9.25	7.32	7.76	6.44	5.85	3.09	8.87	9.49
20	9.11				1.86			9.36

Site 5	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	9.32	7.66	6.67	6.25	8.78	5.07	9.48	10.05
3	9.53	7.66	5.88	2.13	2.76	5.41	5.41	2.87
4	9.55							

Salinity (ppt.)

Site 1	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	17.8	18.3	16.8	16.3	15.9	15.6	15.6	15.5
3	17.8	18.3	16.8	16.3	15.9	15.7	15.6	15.5
6	17.8	18.3	16.8	16.3	15.9	15.6	15.6	15.5
9	17.8	18.3	16.8	16.3	15.8	15.6	15.6	15.5
12	17.8	18.3	16.9	16.3	15.9	15.6	15.6	15.5
15	17.8	18.3	16.9	16.3	15.9	15.6	15.6	15.5
17	17.8		16.9	16.3	15.9	15.6		15.5

Site 4	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	17.8	18.2	16.9	16.3	15.9	15.6	15.6	15.5
3	17.8	18.2	16.9	16.3	15.9	15.6	15.6	15.5
6	17.8	18.2	16.9	16.3	15.9	15.6	15.6	15.5
9	17.8	18.2	16.9	16.3	15.9	15.6	15.6	15.5
12	17.8	18.2	16.9	16.3	15.9	15.6	15.6	15.5
15	17.8	18.3	16.9	16.3	15.9	15.6	15.6	15.5
18	17.8	18.3	16.9	16.3	15.8	15.6	15.6	15.5
20	17.8							15.5

Site 5	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
0	17.5	0.7	0.3	13.1	13.1	12.4	8.6	8.2
3	17.8	0.8	11.5	15.5	14.7	13.6	10.8	11.5
4	17.8							

Secchi (ft.)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	1.5	1	2	2	1.5	2	2.5	3
Site 4	1.5	1	3	2	2	2	3	3
Site 5	1.5	1	1.5	3	1	2.5	1.5	1

Nitrate NO3 (ppb)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	60	20	20	80	BRL	50	BRL	<10
Site 4	10	40	50	150	BRL	40	BRL	<10
Site 5	160	10	30	120	BRL	60	BRL	<10

Ammonia NH3 (ppb)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	110	190	25	ND	57	80	70	130
Site 4	98	76	49	ND	100	70	90	120
Site 5	84	130	24	67	ND	110	80	70

Kjeldhal Nitrogen TKN (ppb)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	1,260	1,120	1,120	1,700	1,300	1,710	360	1,540
Site 4	1,120	1,120	1,120	850	1,000	1,430	BRL	980
Site 5	1,120	840	840	760	1,300	1,650	BRL	1,400

Total Nitrogen TN (ppb)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	1,320	1,140	1,140	1,780	1,300	1,760	360	1,540
Site 4	1,120	1,160	1,170	1,000	1,000	1,470	<100	980
Site 5	1,280	850	870	880	1,300	1,710	<100	1,400

Total Phosphorous TP (ppb)

	4/11/2006	5/10/2006	6/8/2006	7/5/2006	8/8/2006	9/25/2006	10/24/2006	11/7/2006
Site 1	170	137	220	BRL	320	BRL	222	198
Site 4	182	174	217	BRL	328	BRL	235	215
Site 5	197	279	88	240	273	266	245	276

BRL	Below Reportable Limit
ND	Not Detected, below detection limit

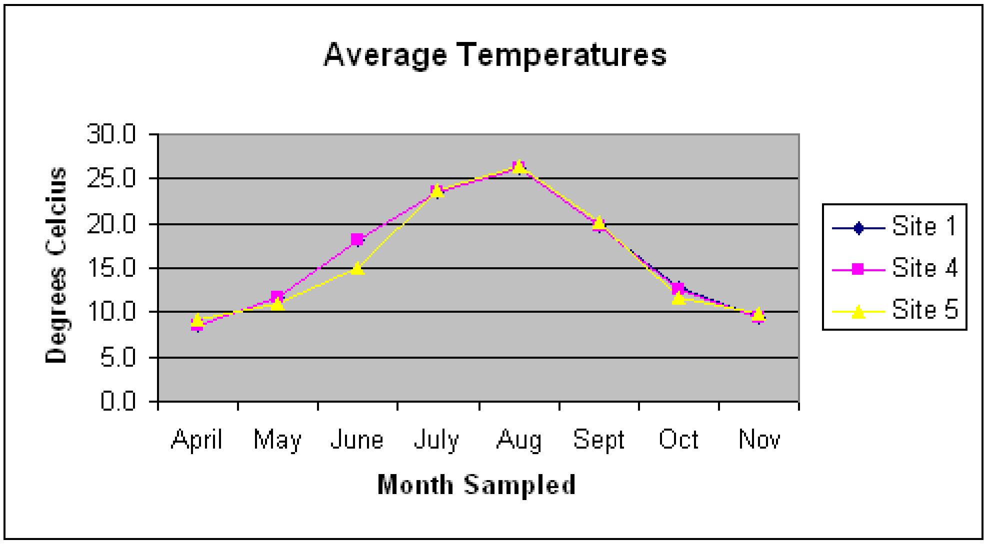
Appendix B

Sesachcha Pond 2006
Average Physical and Chemical Data with Charts

Site 1	Quidnet North Corner
Site 4	Oyster Bed South Corner
Site 5	Ancillary Pond West End

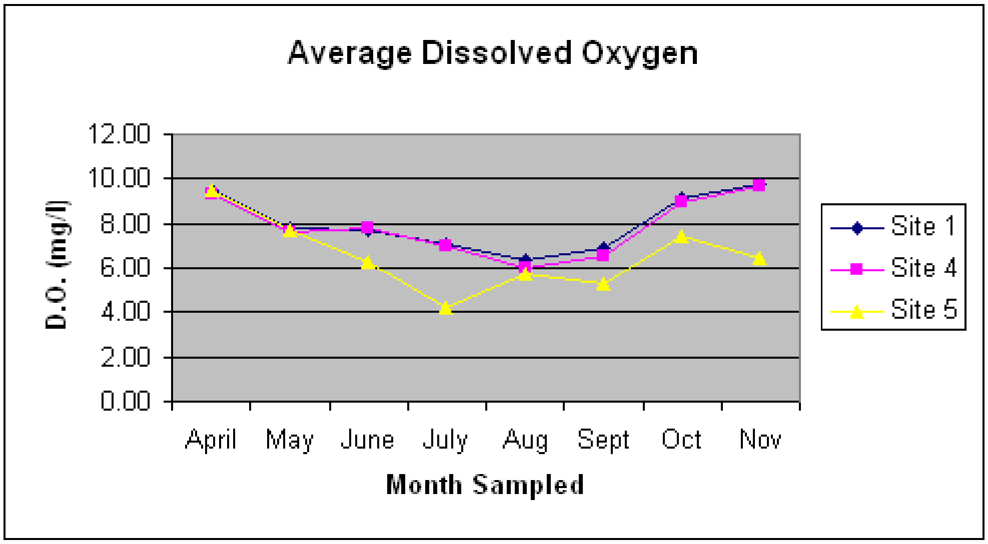
Temperature (ºC)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	8.6	11.7	18.2	23.6	26.2	19.7	12.7	9.3
Site 4	8.6	11.6	18.2	23.4	26.3	19.6	12.6	9.4
Site 5	9.2	10.9	15.0	23.8	26.5	20.3	11.7	9.8



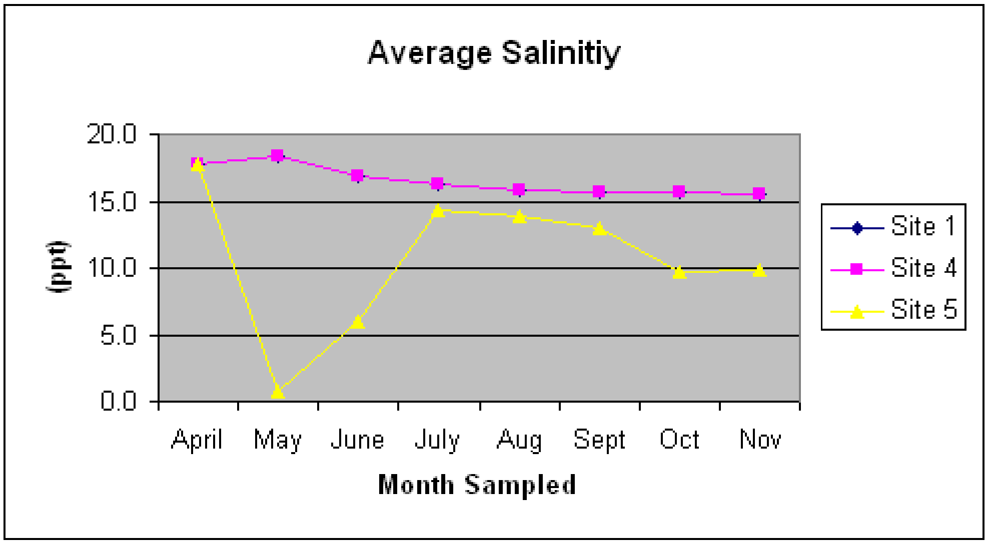
Dissolved Oxygen (mg/l)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	9.50	7.75	7.66	7.10	6.35	6.91	9.18	9.74
Site 4	9.31	7.63	7.75	6.96	5.96	6.57	9.00	9.66
Site 5	9.47	7.66	6.28	4.19	5.77	5.24	7.45	6.46



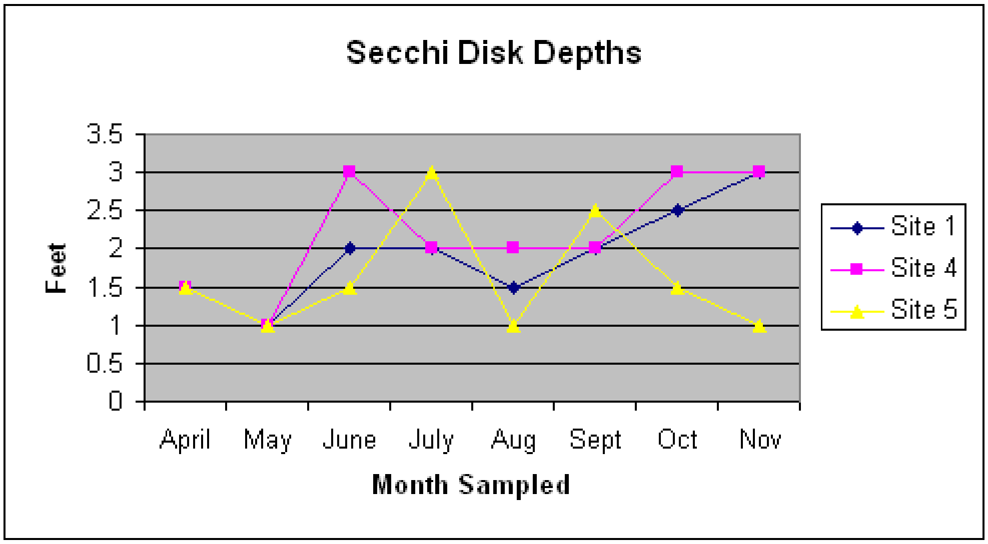
Salinity (ppt)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	17.8	18.3	16.8	16.3	15.9	15.6	15.6	15.5
Site 4	17.8	18.3	16.8	16.3	15.9	15.6	15.6	15.5
Site 5	17.7	0.8	5.9	14.3	13.9	13.0	9.7	9.9



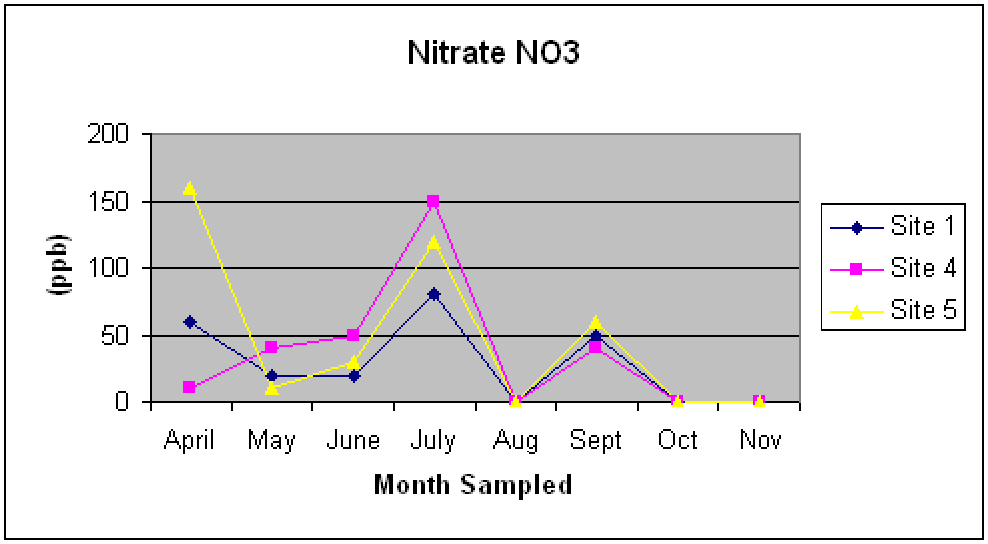
Secchi (ft.)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	1.5	1	2	2	1.5	2	2.5	3
Site 4	1.5	1	3	2	2	2	3	3
Site 5	1.5	1	1.5	3	1	2.5	1.5	1



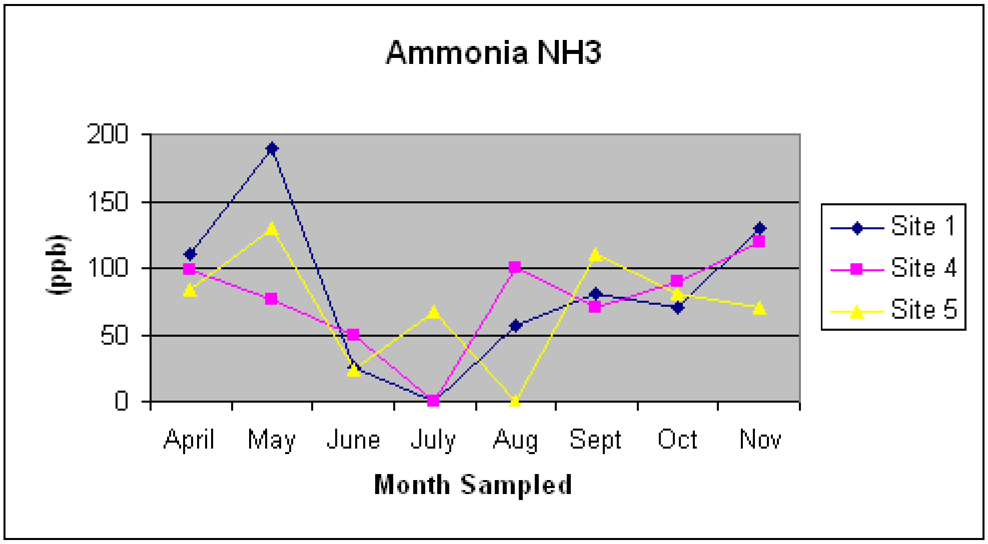
Nitrate NO3 (ppb)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	60	20	20	80	BRL	50	BRL	<10
Site 4	10	40	50	150	BRL	40	BRL	<10
Site 5	160	10	30	120	BRL	60	BRL	<10



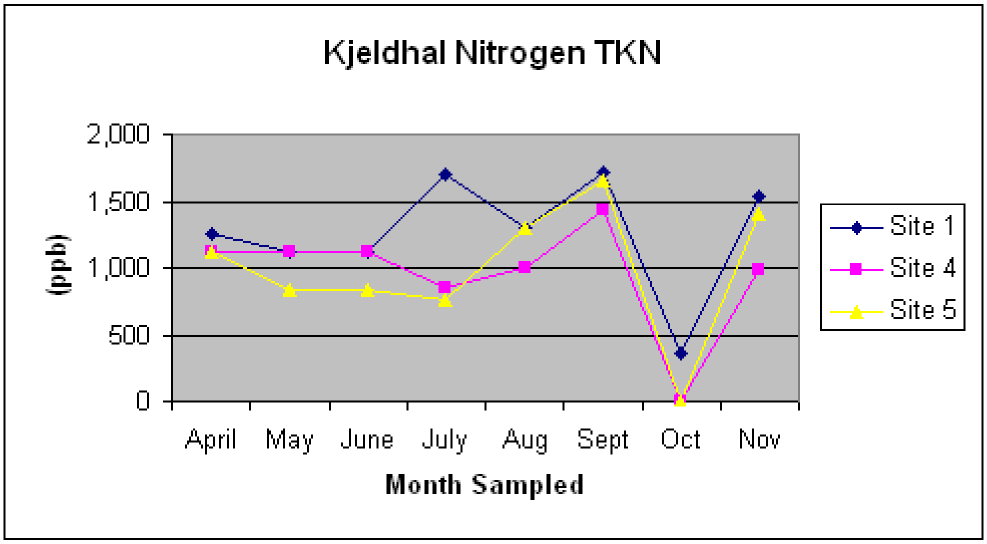
Ammonia NH3 (ppb)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	110	190	25	ND	57	80	70	130
Site 4	98	76	49	ND	100	70	90	120
Site 5	84	130	24	67	ND	110	80	70



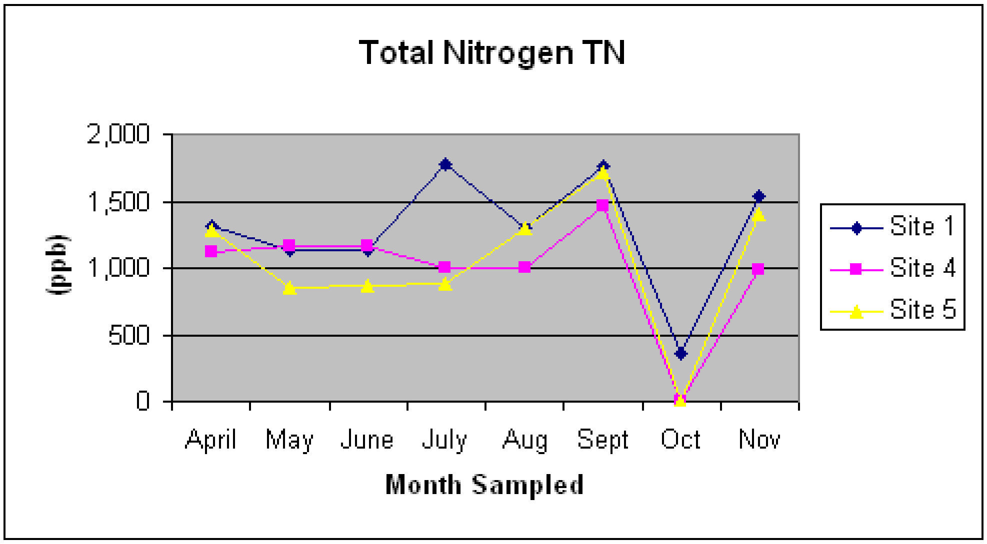
Kjeldhal Nitrogen TKN (ppb)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	1,260	1,120	1,120	1,700	1,300	1,710	360	1,540
Site 4	1,120	1,120	1,120	850	1,000	1,430	BRL	980
Site 5	1,120	840	840	760	1,300	1,650	BRL	1,400



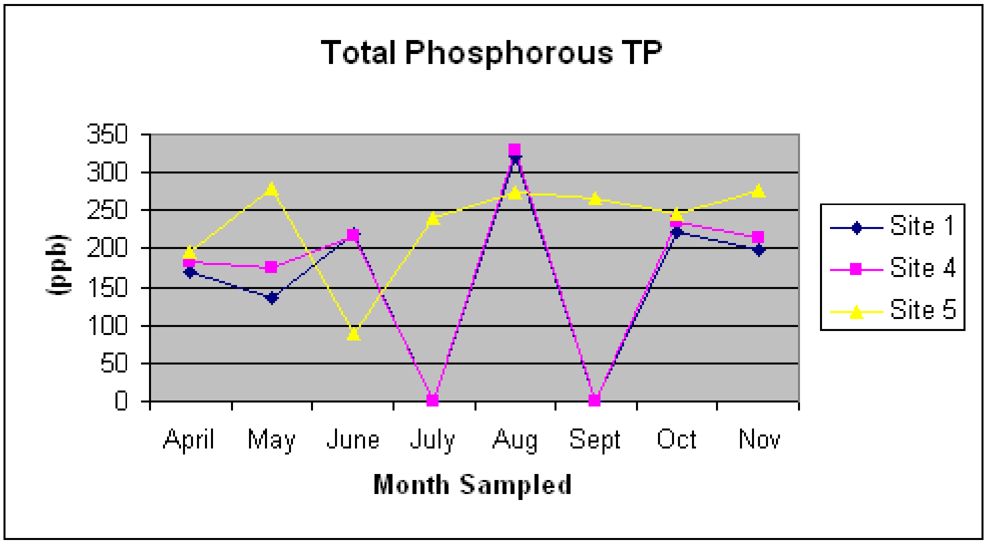
Total Nitrogen TN (ppb)

	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	1,320	1,140	1,140	1,780	1,300	1,760	360	1,540
Site 4	1,120	1,160	1,170	1,000	1,000	1,470	<100	980
Site 5	1,280	850	870	880	1,300	1,710	<100	1,400



Total Phosphorous TP (ppb)

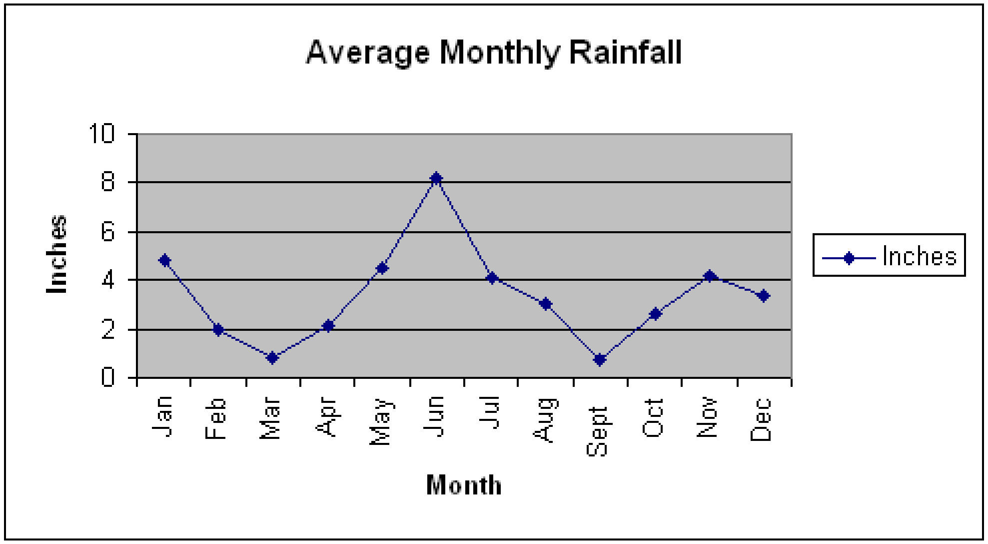
	April	May	June	July	Aug	Sept	Oct	Nov
Site 1	170	137	220	BRL	320	BRL	222	198
Site 4	182	174	217	BRL	328	BRL	235	215
Site 5	197	279	88	240	273	266	245	276



Appendix C

Average Monthly Rainfall
2006

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Inches	4.86	1.98	0.85	2.13	4.5	8.23	4.07	3.05	0.76	2.6	4.19	3.32



Total Rainfall: 40.54 "