STRESSED STREAM ANALYSIS OF

North Gully and Southwest Creeks In the Conesus Lake Watershed

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Cover Photo: Southwest Creek (Site SW2) on Maple Beach Road.

SUMMARY

For two consecutive years, SUNY Brockport has monitored the major tributaries of Conesus Lake. A prioritization based on loading of nutrients and soil to Conesus Lake revealed that North Gully and Southwest Creek were identified as contributing the second and fifth largest amount of phosphorus per day, respectively. Phosphorus is of concern because it is a limiting factor of plant growth in streams and lakes. The other tributaries that rank in the top five (Hanna's, Long Point Gully and No Name) have had Stressed Stream Analysis performed on them previously. With this report, we provide evidence suggesting the location and the intensity of pollution sources in the North Gully and Southwest Creek subwatersheds.

North Gully

Figure 1 provides the location of sampling sites while Figure 5 is a visual summary of the results. Several sources of nutrients and soil in the watershed were identified. The area of the subwatershed between Site NG3 on South Livonia Road downstream to NG2 on Decker Road is a source of total phosphorus (TP), soluble reactive phosphorus (SRP), nitrate, total Kjeldahl nitrogen (TKN), total suspended solids (TSS) and coliform bacteria to North Gully. This area was targeted for additional sampling during the analysis to further pinpoint the sources of nutrients and soil loss. Several sources that were identified include a relatively large ditch that runs south to north behind a junkyard on South Livonia Road, the agricultural fields that border smaller tributaries and drainage from a flooded woodlot west of this area.

The large area of the North Gully watershed that lies between Decker Road and East Lake Road is a source of nutrients, soil and bacteria. During hydrometeorological events increases of greater than 100% were found for phosphorus, nitrate, total suspended solids and total coliform bacteria. Additional sampling in this area during an event found that the sources are associated with an agricultural field and the steep topography in this area. Also, an area below/downstream appears to be a source of nutrients. Since access was not possible to this area, it was not possible to locate the actual source.

Curiously high concentrations of phosphorus and bacteria were found near the origin of the stream at Site NG5 on Federal Road. Access to further sample this area was not granted by landowners.

identified which allowed livestock direct access to the stream.

The highest concentration of total coliforms was found near the origin of the stream at Site NG5 on Federal Road.

Southwest Creek

Figure 2 provides the location of sampling sites while Figure 6 is a visual summary of the results. Stream samples taken in the vicinity of Rosebrugh Road consistently had the highest concentrations of total phosphorus (TP), soluble reactive phosphorus (SRP), total suspended solids (TSS), total Kjeldahl nitrogen (TKN) and bacteria (both total coliforms and *E. coli*) by an order of magnitude or greater compared other sites sampled on Southwest Creek. Additional sampling identified a drain tile outlet and agricultural fields in this area as the sources of this pollution. Coliforms were incredibly high at the drain tile site (SW5) with total coliforms reaching a high of >160,000 colonies /100mL and *E. coli* at 30,000 colonies/mL during the 29 April 2002 event.

During the 27 March 2002 event, all sites sampled on Southwest Creek except the drain tile outlet, had nitrate concentrations over 10 mg/L (range = 10.55 to 14.98 mg N/L), the cutoff for safe drinking water. Ten mg N/L is a significant threshold in that it is the maximum contaminant level for nitrate in drinking water set by the U.S. Environmental Protection Agency in the Safe Drinking Water Act. Highest concentration was observed in the headwaters of this watershed (Site SW6), which also had the highest concentration of SRP (96.0 μg P/L).

Six additional sites were added to the sampling regime during the event on 3 April 2002 between Sites on Rosebrugh Road and Morris Road as permission was granted to access the property off of Morris Road. No significant sources of nutrients were found in this area that included direct drainage as well as drain tile outlets from agricultural fields and the outlet from a small woodlot.

RECOMMENDATIONS AND BEST MANAGEMENT PRACTICES

Most of the sources discovered during this Stressed Stream Analysis are agricultural in nature. In general, a review of the agricultural practices in the targeted areas is warranted.

Recommendations:

1. A review of the agricultural practices in the North Gully and Southwest Creek subwatersheds should be undertaken. In cooperation with the Livingston County Soil and Water Conservation District, soil testing should be instituted at the sites in agriculture to evaluate fertilizer application rates and timing. This would be analogous to a Tier Three evaluation in the Agricultural Environment Management Program (AEM). It is possible that a reduction in fertilizer application rates is possible that would reduce costs and maintain yields to the agriculture community while reducing nitrate losses to downstream systems.
2. The high concentrations in the Rosebrugh Road area suggest that a livestock operation may be the source. There are several small, but economical practices, such as barnyard runoff management and manure storage facilities that may reduce the losses of these compounds. Soil testing should be instituted and fertilizer (inorganic and manure) application rates and timing should be reviewed
3. Wells used for human water supply in the Southwest Creek watershed should be tested for nitrate. Nitrate concentrations above 10 mg N/L in drinking water can cause a disease called methemoglobinemia in infants.
4. Further investigations into coliform bacteria sources and their mitigation should be initiated.

INTRODUCTION

For two consecutive years, SUNY Brockport has monitored the major tributaries of Conesus Lake (1,2). A prioritization based on loading of nutrients and soil to Conesus Lake indicated that North Gully and Southwest Creek were contributing the second and fifth largest amount of phosphorus per day, respectively. The other tributaries that rank in the top five (Hanna's, Long Point Gully and No Name) have previously been identified (3, 4, 5). With this report, we provide evidence suggesting the location and the intensity of pollution sources in the North Gully and Southwest Creek watersheds.

The Approach:

Point and non-point sources of nutrients, soils and salts were identified through a process called stressed stream analysis or segment analysis (6). For an entire watershed such as Conesus Lake, this approach identifies impacted sub-watersheds and their associated streams (6,7,8,9,10). Within a subwatershed, stressed stream analysis is an approach for determining how and where a stream and its ecological community are adversely affected by a pollution source or other disturbances. Stressed stream analysis is an integrative, comprehensive approach for determining the environmental health of a watershed and its constituent streams. It is a technique that identifies the sources, extent, effects and severity of pollution in a watershed. In its fullest use, it combines elements of the sciences of hydrology, limnology, ecology, organismal biology and genetics in an integrated approach to analyze cause and affect relationships in disturbed stream ecosystems.

Within a sub-watershed, the stream(s) is used to monitor the "health" of the watershed. Because nutrients are easily transported by water, they can be traced to their source by systematic geographic monitoring of the stream. Stressed stream analysis is a technique that divides the impacted sub-watershed into small distinct geographical units – segment analysis. Samples are taken at the beginning and end of each unit of the stream to determine if a nutrient source occurs within that reach. At completion, the cause and extent of pollution have been identified. If needed, the severity of the pollution within the impacted sub-watershed and or the entire watershed can then be evaluated by spatial analysis of the quantity and quality of biological indicators, such as fish and invertebrates, and by biological examination of structural and functional changes in individual organisms and populations in affected communities. Once biological sources in two previously identified impacted subwatersheds, North Gully and Southwest Creeks.

DEFINITIONS

Total Phosphorus- A measure of all forms of the element phosphorus. Phosphorus is an element required for plant growth on land or in water. In lakes, phosphorus is often the limiting factor of phytoplankton growth and is the cause of eutrophication, or overproduction, of lakes. Phosphorus may enter a watershed in soluble or organic form from several sources including sewage, heavy-duty detergents, fertilizer and agricultural waste. Some forms of phosphorus are more available to, and cause more immediate activity in, plants.

Soluble Reactive Phosphorus- A measure of the most available and active form of phosphorus.

Nitrate + Nitrite- A measure of the soluble forms of nitrogen used readily by plants for growth. Sources of nitrates in the environment are many and include barnyard waste and fertilizer.

Total Kjeldahl Nitrogen- The Kjeldahl method is a convenient method of analysis for nitrogen but cannot be used for all types of nitrogen compounds. It is, however, a good measure of organic nitrogen, including ammonia. Manure, for example, contains a large amount of organic nitrogen.

Sodium and Chloride- A measure of the mineral, most commonly found as sodium chloride (NaCl), dissolved in water. NaCl naturally occurs in deep layers of local bedrock. Mined, it is stored and spread as a de-icing agent on roads and other pavements.

Total Suspended Solids - A measure of the loss of soil and other materials suspended in the water from a watershed. Water-borne sediments act as an indicator, facilitator and agent of pollution. As an indicator, they add color to the water. As a facilitator, sediments often carry other pollutants, such as nutrients and toxic substances. As an agent, sediments smother organisms and clog pore spaces used by some species for spawning.

Drainage Tile - In moderately and poorly drained soils, "tiles" or drains are subsurface drainage systems designed to improve subsurface drainage and lower the water table in a field improving the ability to plant and grow crops. Tile drainage systems collect seepage water and discharge it at a point in a ditch, stream, or road ditch. Unless a surface water discharge has been added to the drain tile system, the water the drain tile carries is water that has percolated through the soil. Thus the possibility exists that excess nutrients from excessive fertilization or other sources (e.g., septic system) could be transported by the ground water draining from the field into a stream.

Total Coliform - The coliform group is made up of several genera of bacteria from the illness. The group is defined by all aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria that ferment lactose with gas and acid formation within 48 h at 35°C.

Escherichia coli - *E. coli* is a member of this group that ferments lactose or mannitol at 44°C with acid production within 24h and produces indole from tryptophan and is used as a primary indicator of fecal contamination. Some strains of *E.coli* (O157:H7, for example) produce a toxin, called Shiga-like toxin (SLT), sometimes called, Vero toxin. The toxin is a protein that causes severe damage to intestinal epithelial cells (the cells that line the wall of the intestine). The damage is so severe that if we acquire this bacterial strain, we lose water and salts, blood vessels are damaged, and bleeding or hemorrhaging occurs. This condition is particularly dangerous to small children, the elderly or the infirm.

SAMPLING AND ANALYTICAL METHODS

Segment analysis was performed on five dates each on North Gully and Southwest Creek (20 March, 27 March, 3 April, 29 April and 14 May 2002). Sampling locations are shown on Figures 1 and 2. A total of 75 samples were analyzed for nitrate, soluble reactive phosphorus, total phosphorus, total Kjeldahl nitrogen, sodium, and total suspended solids. The Livingston County Department of Health Watershed Inspector took coincidental total coliform and *E. coli* samples at the majority of sites. All samples were taken under hydrometeorological event conditions.

Initially, six sites each on North Gully and Southwest Creek were sampled. After the identification of sources of pollution and securing landowner permission, additional sites were sampled to further pinpoint those sources. All samples were generally taken within 180 minutes at each watershed. Specific locations of all sampling sites are shown in Figures 1 and 2. All sampling bottles were routinely cleaned with phosphate free RBS between sampling dates and pre-coded to ensure exact identification of the particular sample. Containers were rinsed prior to sample collection with the water being collected. In general, all procedures followed EPA standard methods (11) or Standard Methods for the Analysis of Water and Wastewater (12). Sample water for dissolved nutrient analyses (SRP, nitrate + nitrite) was filtered immediately with 0.45-μm MCI Magna Nylon 66 membrane and either frozen or analyzed within 24 hours of collection.

Nitrate+Nitrite: Dissolved nitrate+nitrite nitrogen was performed by the automated (Technicon autoanalyser) cadmium reduction method (12).

Soluble Reactive Phosphorus: Sample water was filtered through a 0.45-μm membrane filter.

colorimetrically at 880nm.

Total Phosphorus: The persulfate digestion procedure was used prior to analysis by the automated (Technicon autoanalyser) colorimetric ascorbic acid method (12).

Total Kjeldahl Nitrogen: Analysis was performed using a modification of the Technicon Industrial Method 329-74W/B. The following modifications were made:

- In the sodium salicylate-sodium nitroprusside solution, sodium nitroprusside was increased to 0.4 gm/L.
- The reservoir of the autoanalyser was filled with 2M H_2SO_4 instead of distilled water.
- Other reagents were made fresh prior to analysis.

Sodium: Atomic absorption spectrometry was utilized for sodium analysis. (12).

Total Suspended Solids: APHA (12) Method 2540D was employed for this analysis.

Coliform bacteria: Total coliform and *E. coli* were determined by Wayland Laboratory Services (ELAP# 11338, EPA Lab# NY01315) using the chromogenic substrate coliform test, APHA Method 9223 (12).

QUALITY CONTROL

The Water Chemistry Laboratory at SUNY Brockport is State and Nationally certified through the New York State Department of Health's Environmental Laboratory Approval Program (ELAP - # 11439) and the National Environmental Laboratory Accreditation Conference. This program includes bi-annual proficiency audits, annual inspections and good laboratory practices documentation of all samples, reagents and equipment (Table 1).

RESULTS

North Gully- Chronological Account of Stressed Stream Analysis

20 March 2002 (Figure 1, Table 2, Appendix 1)

The initial sampling occurred during event conditions caused by rain the previous night extending into the sampling period. The goal of this sampling was to initiate the program and to determine the variability of nutrient concentrations along sections of North Gully. Six stations were sampled in the North Gully sub-watershed and results are presented in Table 2 and Appendix 1 (See Figure 1 for a Sampling Site Map). Several potential sources of nutrient loss solids (TSS) and total coliforms. Nitrate and total Kjeldahl nitrogen (TKN) also increased between NG2 and the Base site at East Lake Road. The area between Niver Road (NG4) and South Livonia Road (NG3) showed losses of TP, TSS and TKN as well as the largest increase in total coliforms (1213 to 8482 colonies/100mL). The highest SRP and second highest TP concentrations and third highest concentration of total coliforms were found near the origin of the stream at Site NG5 on Federal Road.

27 March 2002 (Table 2, Appendix 2)

A rain and snowmelt event was sampled on 27 March 2002. The same six stations were sampled and had higher concentrations of TP (40.3 μg P/L), SRP (22.1 μg P/L), nitrate (1.78 mg N/L) and TKN (680 μg N/L) than in the event sampled the previous week. As in the previous event, the area from Site NG3 on South Livonia Road downstream to Site NG2 on Decker Road was a source of TP, SRP, nitrate, TKN, soils and total coliforms to North Gully. Additionally, the area between Site NG2 and the Base site on East Lake Road was a source of TP (98% increase), SRP (84% increase), nitrate (212% increase), TKN (39% increase) and total coliform (137% increase). The highest concentration of total coliforms was found near the origin of the stream at Site NG5 on Federal Road.

3 April 2002 (Table 2, Appendix 3)

A rain event of 0.83 inches (National Weather Service at Avon, NY) was the third sampling event. The large area of the North Gully watershed that lies between Decker Road and East Lake Road continued to be a source of nutrients and soil during this event. Total and soluble reactive phosphorus increased 125 and 176 percent, respectively between these two sites. Additionally, nitrate increased 219 percent, total suspended solids increased 428 percent and total Kjeldahl nitrogen increased 21 percent. Sources that had been evident during previous events between South Livonia Road and Decker Road were not observed during this event with the exception of total coliforms, which increased a minimum of 93%. Total coliforms were high (8482 colonies per 100mL or higher) during this event at all stations monitored (Table 2). This tributary is delivering coliform bacteria to the lake.

29 April 2002 (Table 2, Appendix 4)

There was 1.21 inches of rain as measured at Avon, NY during the period 28 to 29 April 2002 causing a runoff event. The area between South Livonia Road and Decker Road was targeted for additional sampling (four additional samples) during this event (Figure 3). The area on the west side of South Livonia Road has agricultural fields on either side of North Gully behind the homes that border the road. The main tributary was sampled where the agricultural fields ended (NG3A, Fig. 1). Additional smaller tributaries that feed into the main channel were sampled also. NG3B represents a relatively large ditch that runs south to north behind a junkyard on South Livonia Road. The water was very turbid but discharge was minimal; only a trickle of water flowed into the main channel on 29 April. NG3C was an additional tributary that like the main channel runs west from South Livonia Road through agricultural fields. The discharge at NG3C was estimated to be 25% that of the main channel during the 29 April event. NG3D was a tributary that runs from a flooded woodlot a field west of the agricultural areas, the discharge from this tributary was estimated to be 75% of the main channel on 29 April.

High concentrations of TP (119.2 µg P/L), TSS (44.5 mg/L) and TKN (1110 µg N/L) were found at NG3B. Although this tributary was not contributing a large amount of discharge (trickle) during the 29 April event, this drainage ditch could be a source of these nutrients and soil during larger events. Site NG3C had the highest concentration of nitrate (1.06 mg N/L) in North Gully during the 29 April event. The source of this nutrient is undoubtedly the agricultural fields bordering the channel. Elevated concentrations of total phosphorus (25.4 µg P/L) and total Kjeldahl nitrogen (710 µg N/L) were observed at the flooded woodlands area (Site NG3D). This loss of organic nutrients is consistent with that land use category.

Soluble nutrients were being lost from the watershed in the area between Decker Road and East Lake Road during the 29 April event. Nitrate went from 0.19 to 0.73 mg N/Land SRP went from 8.9 to 22.9 µg P/L between sites NG2 and the North Gully Base site. This area was targeted during the subsequent event.

An additional sample (NG4A) was taken just downstream from Niver Road, an area that livestock were allowed direct access to the stream. Increases of nitrate (non-detectable to 0.03

14 May 2002 (Table 2, Appendix 5)

The area of North Gully between Decker Road (NG2) and East Lake Road (Base) was explored further during this rain event (1.62 inches of precipitation, 12 to 14 May, airport in Wellsville, NY). Between these sites increases of 126% for TP, 220% for nitrate, 289% for TSS and 252% for SRP were found. Three additional sites were sampled between site NG2 and the Base site area during the 14 May event. Sites NG2A, 2B and 2C are characterized by very steep topography, a ravine, associated with adjacent agricultural areas. Access to the stream was gained by old logging roads that descended to the stream.

Elevated concentrations of total phosphorus, nitrate, total suspended solids and soluble reactive phosphorus were observed at downstream sites NG2B and NG2C compared to upstream sites NG2A and NG2. Sites NG2B and NG2C are within the area in agriculture while NG2A and NG2 are upstream out of the area in agriculture. The elevated concentrations of nutrients and soil below site NG2C observed at the Base site on East Lake Road indicate that losses are occurring between the sites. We were not able to identify sources, as access was not possible.

Chronological Account of Stressed Stream Analysis – Southwest Creek:
20 March 2002 (Figure 2, Table 3, Appendix 6)

The stations in the uppermost portion of this subwatershed experienced the greatest losses of nutrients and soil over the study period. Site SW4, the main channel as it crosses Rosebrugh Road, and SW5, the ditch that parallels the south side of Rosebrugh Road, had the highest concentrations of total phosphorus (TP), soluble reactive phosphorus (SRP), total suspended solids (TSS), total Kjeldahl nitrogen (TKN) and bacteria (both total coliforms and *E. coli*) by an order of magnitude or greater compared to other sites sampled on Southwest Creek. There was also a source of nitrate between Site SW4 downstream to SW3 on Morris Road and sodium increased over 500% from Morris Road down to Maple Beach Road (SW2).

27 March 2002 (Table 3, Appendix 7)

2002. Nitrate was extremely high at all stations sampled in the Southwest Creek subwatershed, with the exception of SW5. Every other station's nitrate concentration was over 10 mg/L (range = 10.55 to 14.98 mg N/L), the cutoff for safe drinking water. Ten mg N/L is a significant threshold in that it is the maximum contaminant level for nitrate in drinking water set by the U.S. Environmental Protection Agency in the Safe Drinking Water Act. High concentrations can cause a disease called methemoglobinemia in infants. The highest concentration of nitrate was observed in the headwaters of this watershed (Site SW6), which also had the highest concentration of SRP (96.0 µg P/L). A source of SRP and nitrate exists in this area around site SW6.

The roadside ditch (SW5) on Rosebrugh Road had the highest concentrations of TP (449.5 µg P/L), TSS (174.3 mg/L), TKN (4710 µg N/L) and *E. coli* (1213 colonies / 100mL).

3 April 2002 (Table 3, Appendix 8)

Six additional sites were added to the event sampling between Sites on Rosebrugh Road and Morris Road (Figure 4). No significant sources of nutrients were found in this area that included direct drainage as well as drain tile outlets from agricultural fields (Sites SW3C and SW3D) and the outlet from a small woodlot (site SW3E).

Site SW5, the roadside ditch on Rosebrugh Road had the highest concentrations of TP (324.9 µg P/L), SRP (141.6 µg P/L) and TKN (2090 µg N/L). High concentrations of nitrate (range = 2.85 [woodlot drainage SW3E] to 16.55 mg N/L [SW3A – roadside ditch along Morris Road]) persisted throughout the entire subwatershed again during the 3 April event.

A view of the Southwest Creek subwatershed taken from Rosebrugh Road. The tile drain outlet (SiteSW5A) is located in the bottom right corner.

DISCUSSION

People influence the quality and quantity of runoff from a watershed into a stream. The amount of runoff is determined by the amount of excess precipitation, that which neither sinks into the ground nor is stored at the surface. Precipitation excess is determined primarily by climate, vegetation, infiltration capacity, surface storage and land use by people. Impervious landscapes (e.g., parking lots), removal of wetlands and vegetation in general, storm sewers, blockage of streams by debris, etc., all contribute to rapid rises in stream level and potential flooding. Similarly, land usage contributes to the quality of the water in the stream and ultimately Conesus Lake. For example the spreading of manure on the land, if done properly, can be a reasonable practice to enrich the soil. If not done properly, the result may be elevated levels of fecal coliform bacteria and increased levels of phosphorus, organic nitrogen and nitrates that cause health concerns or cause eutrophication of downstream systems. Land use practices initiated by downstream and lake effects.

Agricultural Environmental Management

AEM was developed by farmers, state, federal and local governments and farm conservation professionals to enhance the protection of important environmental resources, such as the state's rivers, lakes and streams, while maintaining a healthy agricultural economy. Agricultural land makes an important contribution to the economy, diversity and beauty of the Conesus Lake watershed.

In general, the primary pollutants to Conesus Lake to be addressed through AEM (Agricultural Environmental Management) are nutrients, sediments/soils, and pathogens. Agricultural sources/activities identified as potential sources of nutrients, sediments/soils and pathogens are barnyards, lack of proper manure storage, fall plowing, silage and milking parlor waste. Soil and Water Conservation Districts have suggested the following Best Management Practices to mitigate various sources of pollution:

- Comprehensive nutrient management plan (CNMP) implementation ;
- Soil testing
- Fencing off streams and other environmentally sensitive areas;
- Filter strips;
- Access road improvement;
- Pasture management;
- Barnyard runoff management;
- Streambank protection;
- Manure storage system;
- Short duration grazing system;
- Alternative water supply;
- Pesticide management;
- Diversion systems;
- Fuel storage containment;
- Silage leachate management.

The Conesus Lake Watershed Management Plan is a work in progress as evidenced by the work of the various sub-committees on the subject of protecting and improving the watershed. The Conesus Lake Watershed Management Plan Policy Committee has recently voted to include stream bank stabilization and restoration, road ditch remediation, the limitation of impervious

Watershed Management Plan. The Conesus Lake Watershed Management Plan Agricultural Committee is currently taking up the issues of Best Management Practices including riparian buffer zones.

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WADSWORTH CENTER
NEW YORK STATE DEPARTMENT OF HEALTH
ENVIRONMENTAL LABORATORY APPROVAL PROGRAM

Test Report

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WATER LAB LENNON HALL
BROCKPORT, NY 14420
USA

t 250 Non Potable Water Chemistry
t Date: 28-Jan-2002

Non Potable Water	Sample ID	Result	Mean/Target	Satisfactory Limits	Method	Score
Residue						
led reported results.	5002	46.9	44	38.8–49.1	SM18 2540D	Satisfactor
Organic Nutrients						
otal reported results.	5004	7.72	7.8	6.29 - 9.3	EPA 351.3	Satisfactor
reported results.	5004	1.29	1.26	1.07 – 1.45	SM18 4500-PB,E	Satisfactor
Inorganic Nutrients						
reported results.	5007	24.0	25.3	22 – 28.7	SM18 4500-NO3 F	Satisfactor
') reported results.	5007	0.84	0.883	0.786 – 0.981	SM18 4500-P F	Satisfactor
Metals I and II						
reported results.	5011	15.22	15.2	13.8 – 16.5	ASTM D-1688-95 C	Satisfactor

Table 2. Results of segment analysis on North Gully. SRP = soluble reactive phosphorus, TP = total phosphorus, TSS = total suspended solids, TKN = total Kjeldahl nitrogen and CFU = colony forming unit

.Sample	Date Collected	TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)	Sodium (mg/L)	SRP (µg P/L)	Discharge (m3/sec)	T. Coliform CFU/100ml	*E. Coli* CFU/100ml
N. Gully SSA BASE	3/20/2002	10.2	1.13	6.4	510	42.55	1.6	0.19	325	103
NG1	3/20/2002	7.9	1.11	4.8	310	42.14	2.3	0.19	103	<103
NG2	3/20/2002	100.4	0.75	39.2	330	82.45	13.7	0.14	>8482	325
NG3	3/20/2002	26.5	0.28	17.8	530	74.16	5.5	0.06	8482	325
NG4	3/20/2002	15.7	0.75	9.2	220	58.20	6.2	0.00	1213	447
NG5	3/20/2002	49.4	0.81	11.0	310	46.37	19.2	0.01	2196	<103
N. Gully SSA BASE	3/27/2002	40.3	1.78	5.6	680	40.55	22.1	0.40	8482	<103
NG1	3/27/2002	33.1	1.64	8.0	290	49.20	17.6	0.40	>8482	<103
NG2	3/27/2002	20.4	0.57	5.2	490	54.70	12.0	0.18	3579	<103
NG3	3/27/2002	11.0	0.34	1.3	280	55.80	8.3	0.01	2196	<103
NG4	3/27/2002	8.2	0.10	0.6	170	34.90	6.8	0.02	4393	103
NG5	3/27/2002	22.0	0.05	6.2	240	23.90	7.1	0.01	>8482	103
N. Gully SSA BASE	4/3/2002	58.5	1.66	26.4	510	35.20	25.9	0.61	>8482	<103
NG1	4/3/2002	61.4	1.73	32.7	390	42.80	30.6	0.61	>8482	103
NG2	4/3/2002	25.9	0.52	5.0	420	43.20	9.4	0.28	>8482	325
NG3	4/3/2002	26.5	1.05	17.0	360	47.00	8.0	0.10	4393	103
NG4	4/3/2002	14.3	0.09	2.8	320	32.10	3.5	0.04	4393	103
NG5	4/3/2002	37.3	0.66	21.2	530	12.60	7.3	0.01	8482	211
N. Gully SSA BASE	4/29/2002	24.3	0.73	0.8	510	31.93	22.9	0.35	8482	103
NG2	4/29/2002	17.1	0.19	1.4	510	35.44	8.9	0.79	8482	103
NG3	4/29/2002	12.2	0.10	1.8	340	36.92	9.1	0.05	>8482	325
NG3A	4/29/2002	7.0	0.14	0.4	390	41.97	2.0	0.05		
NG3B	4/29/2002	119.2	0.31	44.5	1110	36.57	3.5	trickle		
NG3C	4/29/2002	21.4	1.06	3.6	550	49.97	2.4	50% of main		
NG3D	4/29/2002	25.4	<.02	1.8	710	31.59	8.0	main branch		
NG4	4/29/2002	9.9	nd	1.4	240	24.94	2.0	0.001	8482	325
NG4A	4/29/2002	8.7	0.03	0.8	520	35.66	4.6	0.001		
NG5	4/29/2002	17.4	<.02	1.5	400	10.72	5.0	0.01	>8482	447
N. Gully SSA BASE	5/14/2002	85.5	1.57	25.3	560	24.92	32.0	0.84		
NG2	5/14/2002	37.9	0.49	6.5	420	27.92	9.1	0.31		
NG2A	5/14/2002	38.5	0.57	9.3	520	25.81	6.9	0.31		
NG2B	5/14/2002	68.8	1.22	-11.8	500	27.09	28.7	0.31		
NG2C	5/14/2002	69.5	1.29	15.7	500	26.79	19.1	0.31		

Table 3. Results of segment analysis on Southwest Creek . SRP = soluble reactive phosphorus, TP = total phosphorus, TSS = total suspended solids, TKN = total Kjeldahl nitrogen and CFU = colony forming unit.

Sample	Date Collected	TP (µg P/L)	Nitrate (mg N/L)	TSS (mg/L)	TKN (µg N/L)	Sodium (mg/L)	SRP (µg P/L)	Discharge m^3/s	T. Coliform CFU/100ml	*E. Coli* CFU/100ml
Southwest SSA BASE	3/20/2002	28.4	5.12	1.6	320	45.43	12.0	0.04	211	<103
SW1	3/20/2002	36.0	7.17	9.0	540	45.12	9.4	0.04	<103	<103
SW2	3/20/2002	67.1	8.89	19.2	790	68.17	15.9	0.02	5696	103
SW3	3/20/2002	73.1	10.22	25.2	820	10.96	16.9	0.01	858	103
SW4	3/20/2002	1835.5	7.83	382.0	6950	21.56	455.2	0.005	>16000	500
SW5	3/20/2002	3336.7	0.45	766.0	14070	30.41	569.0	0.0001	>16000	9000
Southwest SSA BASE	3/27/2002	37.0	10.55	4.5	460	40.85	23.5	0.12	>8482	<103
SW1	3/27/2002	45.3	14.22	4.4	580	33.34	16.9	0.09	>8482	<103
SW2	3/27/2002	55.8	14.32	4.6	680	25.6	20.2	0.01	>8482	<103
SW3	3/27/2002	61.9	12.18	7.2	730	14.76	20.8	0.01	>8482	<103
SW4	3/27/2002	143.4	14.6	28.0	860	14.55	78.1	0.002	4393	211
SW5	3/27/2002	449.5	0.65	174.3	4710	29.98	45.3	Trickle	>8482	1213
SW6	3/27/2002	146.2	14.98	22.6	1040	15.78	96.0	0.01	8482	<103
Southwest SSA BASE	4/3/2002	72.5	11.94	11.2	630	41.8	43.1	0.15	>8482	103
SW1	4/3/2002	103.4	15.29	14.2	850	27.1	61.5	0.14	>8482	211
SW2	4/3/2002	120.2	16.34	15.8	850	20.9	83.5	0.001	>8482	325
SW3	4/3/2002	127.2	15.06	10.7	890	9.5	75.8	0.05	>8482	447
SW3A	4/3/2002	76.0	16.55	33.8	740	71.6	29.5	0.00003		
SW3B	4/3/2002	118.0	12.97	11.4	1010	12.7	73.7	main channel		
SW3C	4/3/2002	135.4	13.58	15	770	13.1	97.2	20% of main		
SW3D	4/3/2002	58.0	5.61	10.7	630	1.9	9.9	0.00004		
SW3E	4/3/2002	68.4	2.85	5	590	3.2	49.7	Trickle		
SW3F	4/3/2002	121.4	12.45	11.4	1170	8.80	76.1	0.05		
SW5	4/3/2002	324.9	10.13	16.2	2090	13.40	141.6	20% of main	>8482	325
SW6	4/3/2002	127.5	15.91	23.0	880	6.50	85.2	0.005	>8482	<103
Southwest SSA BASE	4/29/2002	45.0	4.78	3.0	590	38.84	25.2	0.03	1639	<103
SW1	4/29/2002	41.0	6.59	1.4	760	33.57	17.3	0.01	4393	325
SW2	4/29/2002	52.5	7.55	0.7	1090	27.82	14.3	0.0004	3579	447
SW3A	4/29/2002	59.9	12.80	1.3	880	67.64	10.2	Trickle		
SW3D	4/29/2002	18.0	3.05	0.6	380	2.55	14.7	0.001		
SW3F	4/29/2002	62.8	5.38	2.8	1160	18.44	9.9	main channel		
SW5	4/29/2002	3232.9	0.34	41.8	13390	66.13	1434.0	Trickle	>160000	30000
SW6	4/29/2002	53.0	8.54	4.4	1720	8.26	27.8	0.01		
Southwest SSA BASE	5/14/2002	55.0	6.89	6.0	760	31.09	21.3	0.29		
SW1	5/14/2002	82.7	10.09	6.5	1050	24.49	13.9	0.07		
SW3	5/14/2002	120.9	7.93	11.5	1340	11.98	4.3	0.04		
SW3A	5/14/2002	55.6	14.55	1.3	660	37.10	33.0	Trickle+		
SW5	5/14/2002	2057.9	17.40	90.0	16570	31.16	266.8	10% of main		
SW5A	5/14/2002	2420.2	23.52	42.0	19280	21.42	524.5	10% of main		

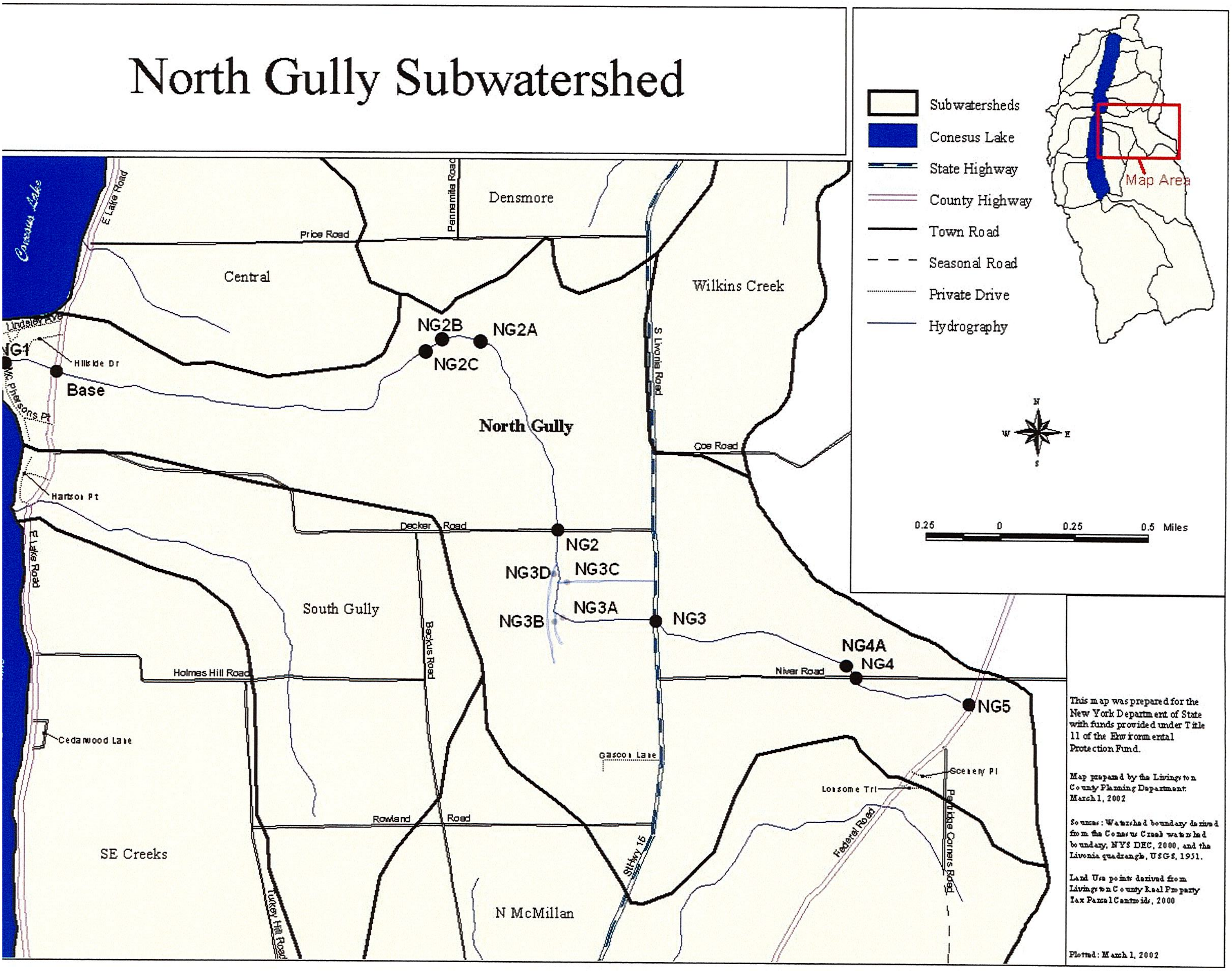


Figure 1. Sampling locations on North Gully, 2002.

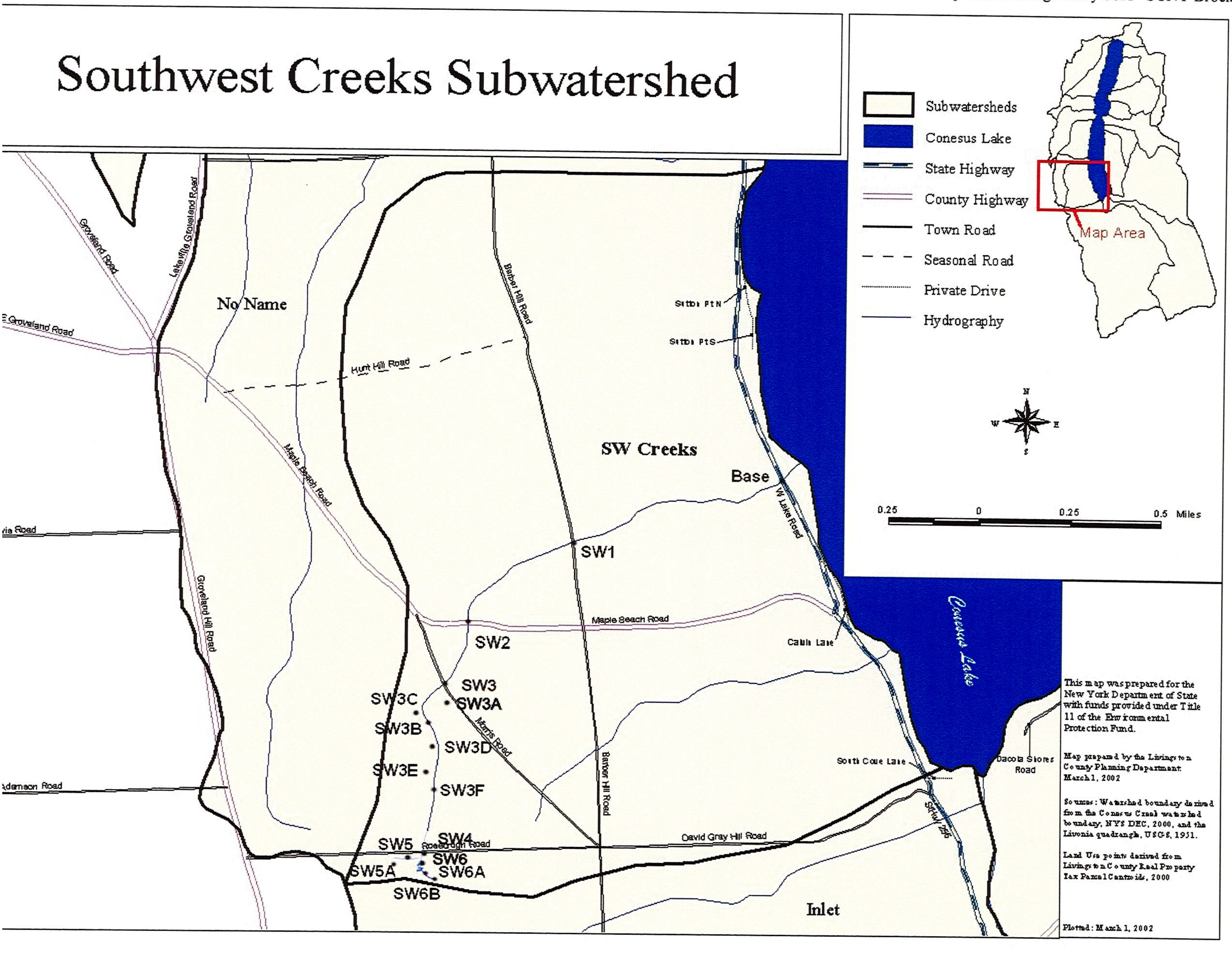
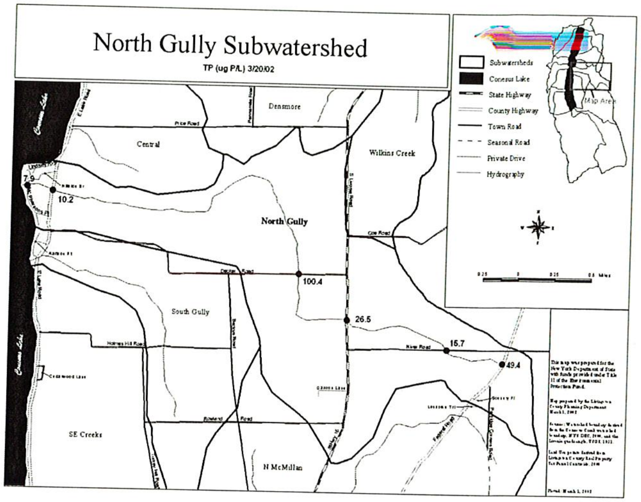
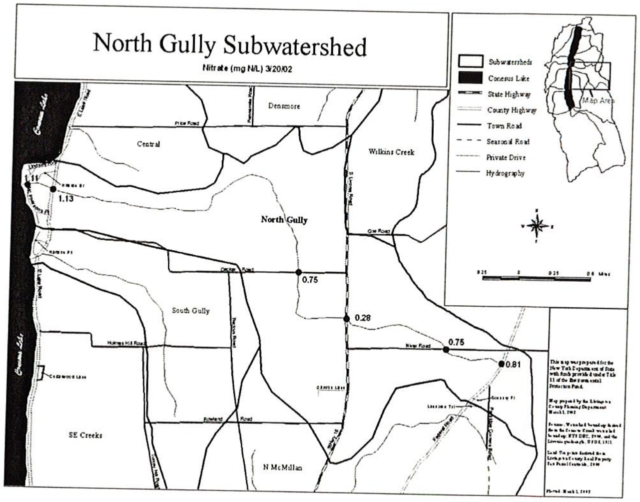
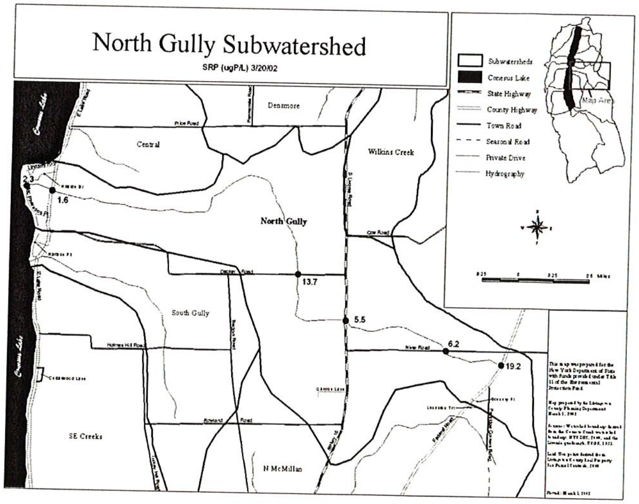
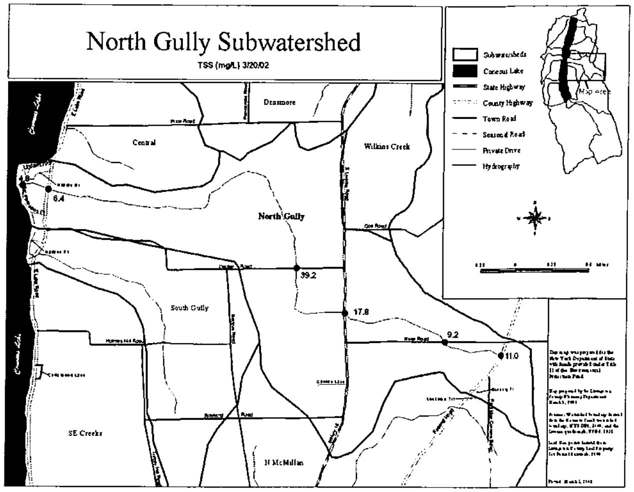


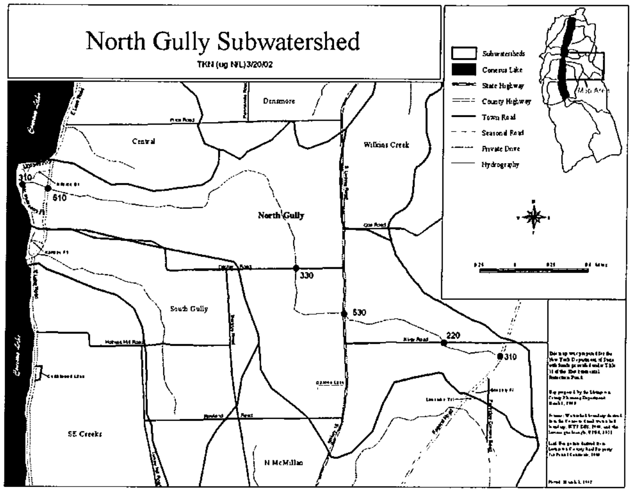
Figure 2. Sampling locations on Southwest Creek, 2002.

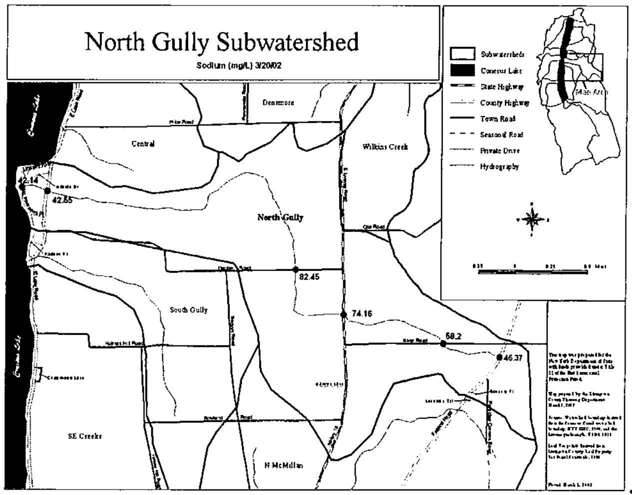

North Gully Subwatershed
TP (ug P/L) 3/20/02
Subwatersheds
Conesus Lake
State Highway
County Highway
Town Road
Seasonal Road
Private Drive
Hydrography
Map Area
Densmore
Central
Wilkins Creek
North Gully
South Gully
SE Creeks
N McMillan
Price Road
Decker Road
Holmes Hill Road
Bowland Road
Cox Road
River Road
7.9
10.2
100.4
26.5
15.7
49.4


North Gully Subwatershed
Nitrate (mg N/L) 3/20/02
Subwatersheds
Conesus Lake
State Highway
County Highway
Town Road
Seasonal Road
Private Drive
Hydrography
Map Area
Densmore
Central
Wilkins Creek
North Gully
South Gully
SE Creeks
N McMillan
Price Road
Decker Road
Holmes Hill Road
Bowland Road
Cox Road
River Road
1.11
1.13
0.75
0.28
0.75
0.81

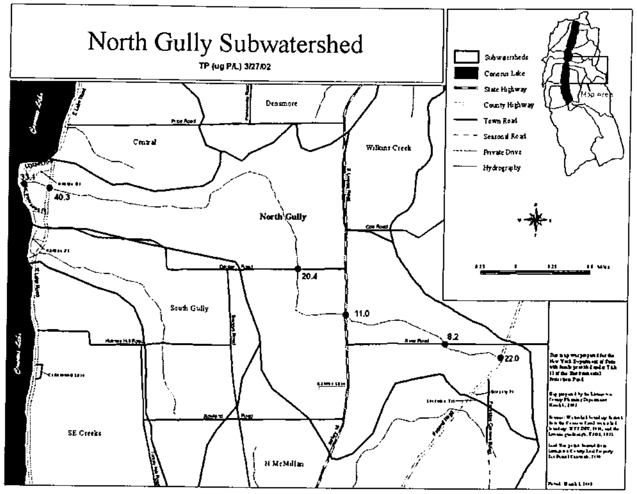

North Gully Subwatershed
SRP (ugP/L) 3/20/02
Subwatersheds
Conesus Lake
State Highway
County Highway
Town Road
Seasonal Road
Private Drive
Hydrography
Map Area
Densmore
Central
Wilkins Creek
North Gully
South Gully
SE Creeks
N McMillan
Price Road
Decker Road
Holmes Hill Road
Bowland Road
Cox Road
River Road
2.3
1.6
13.7
5.5
6.2
19.2

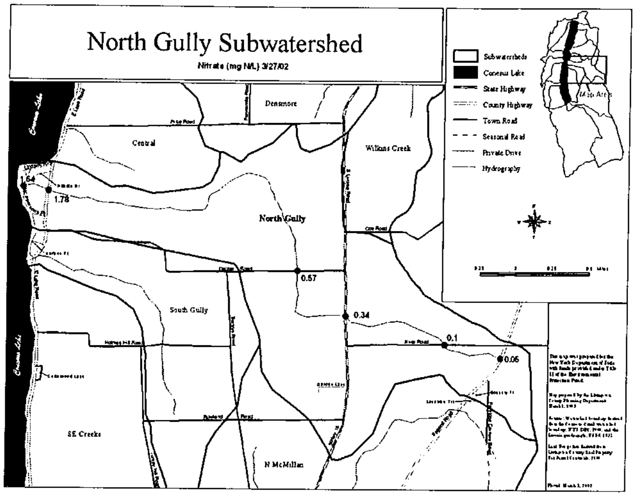


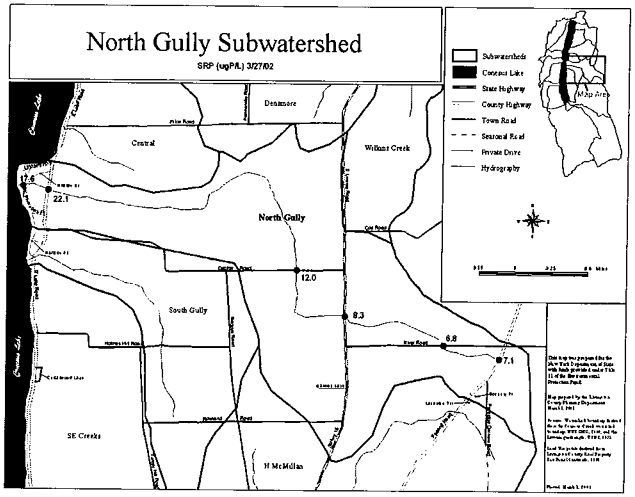




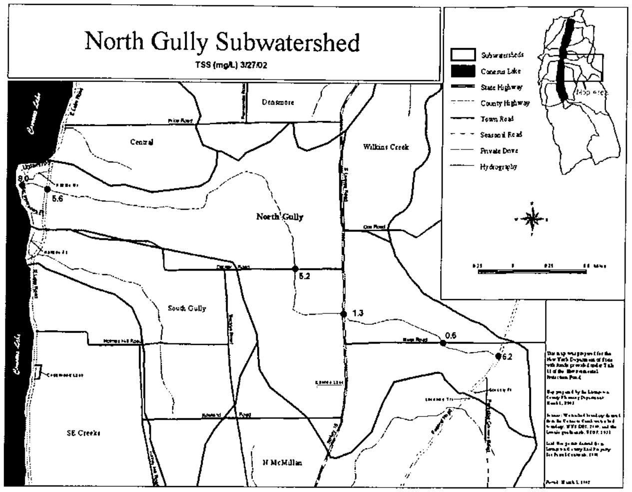
Appendix 1 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended

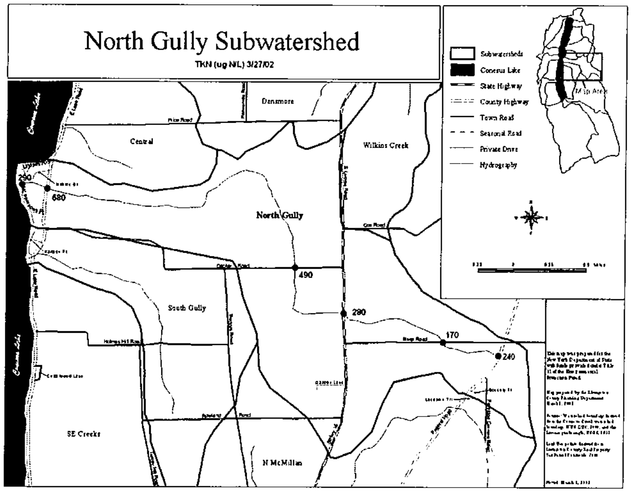


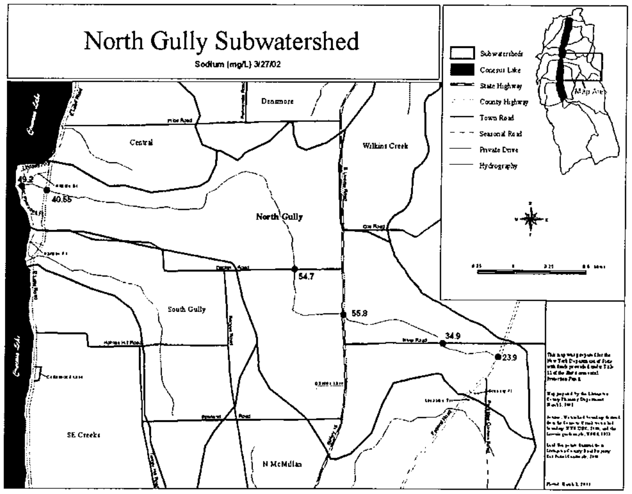




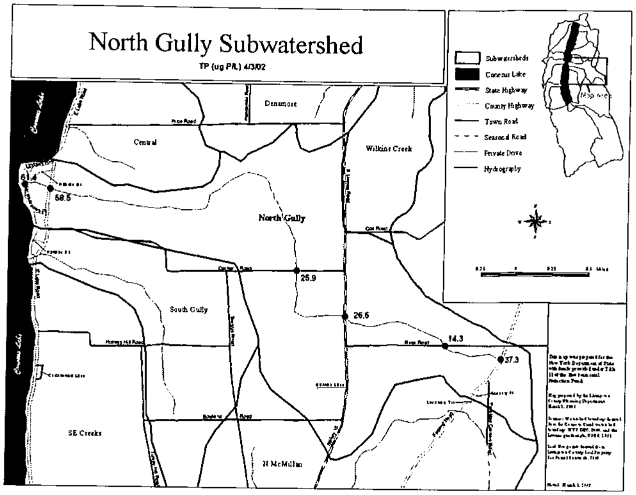
Appendix 2. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total

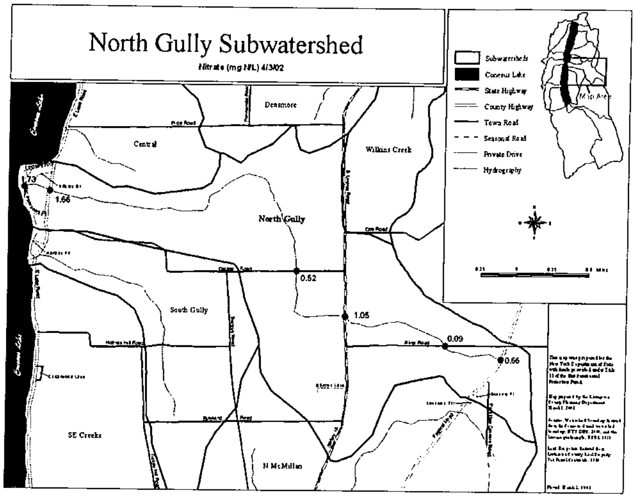


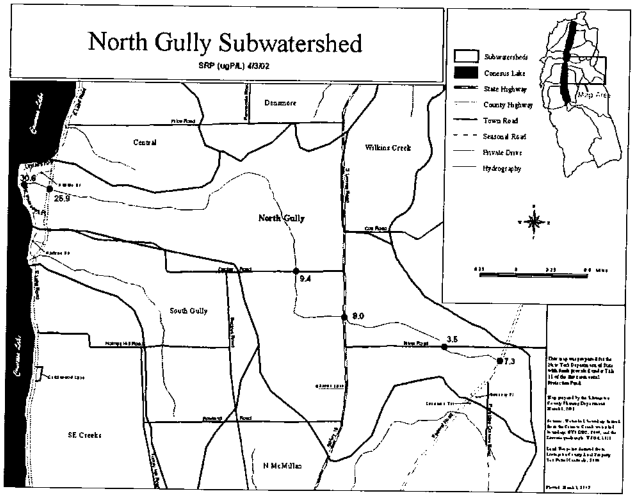




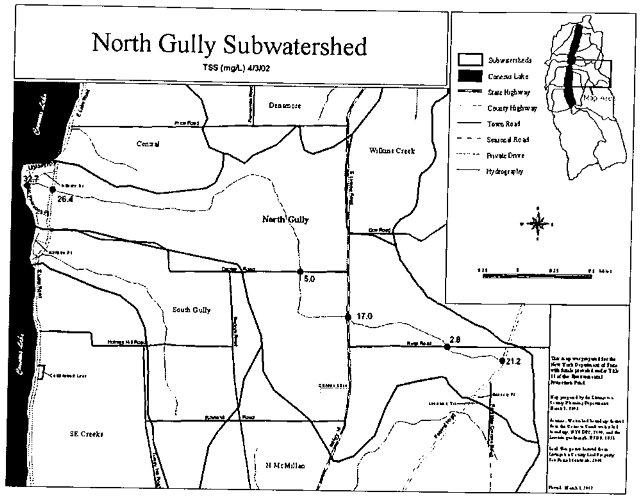
Appendix 2 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended

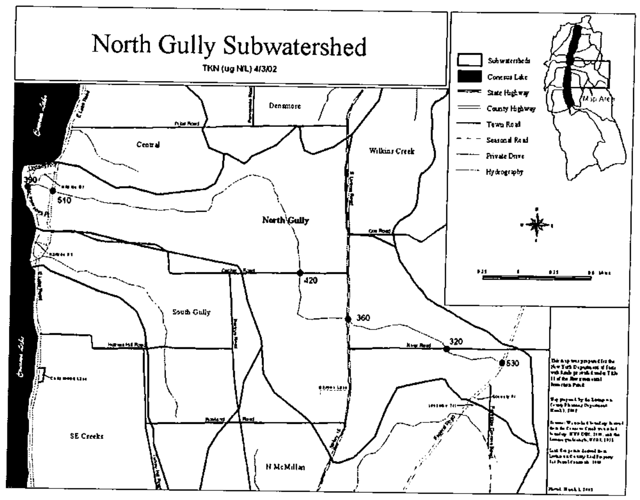


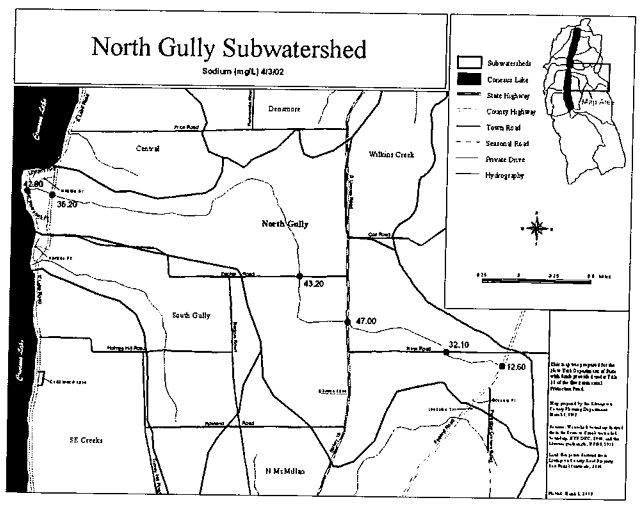




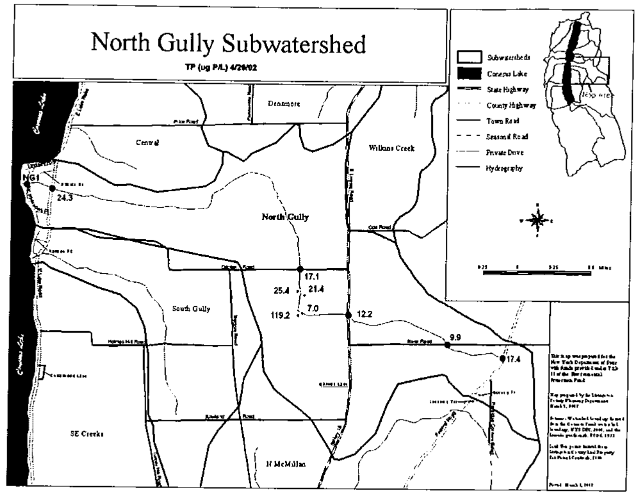
Appendix 3. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total

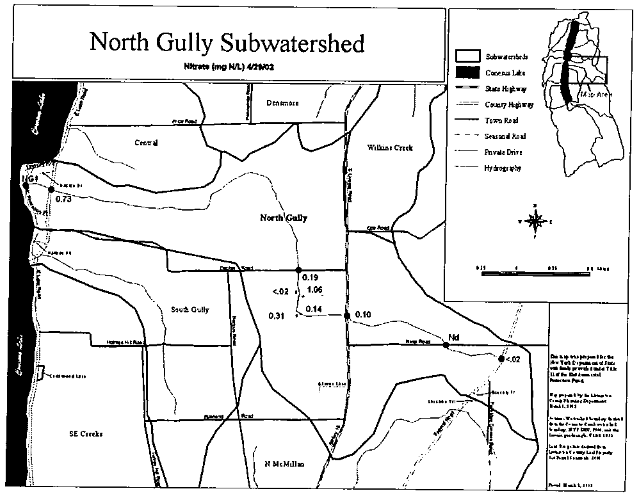


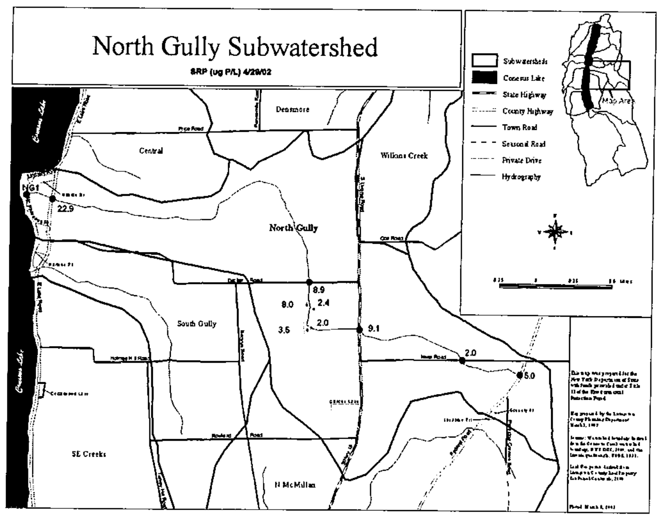




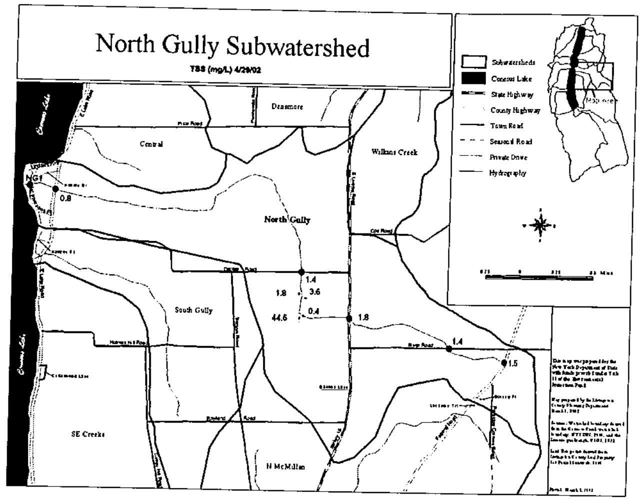
Appendix 3 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on North Gully on 3 April 2002.

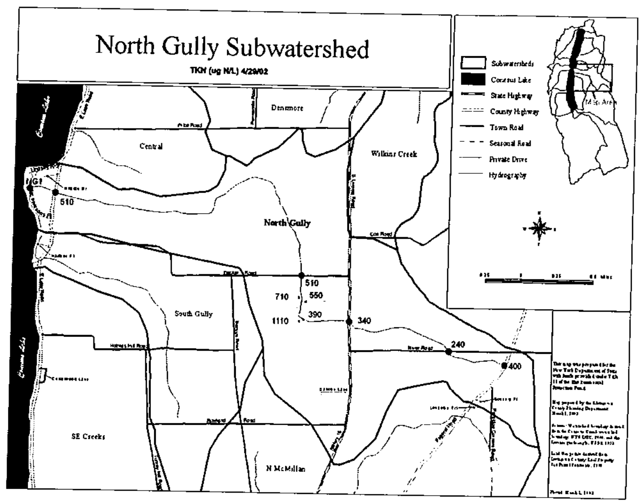


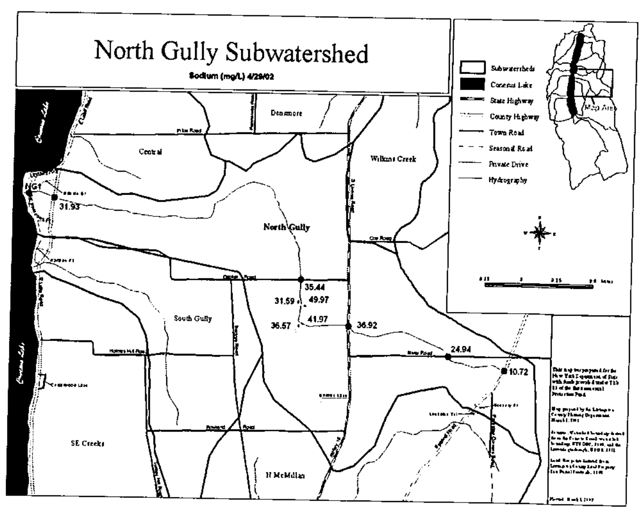




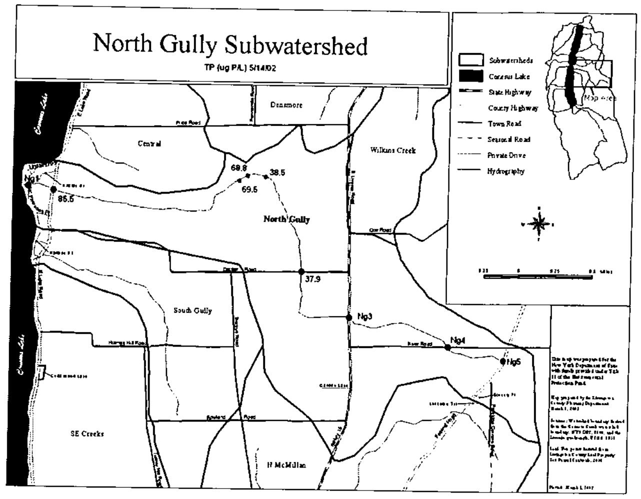
Appendix 4. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on North Gully on 29 April 2002.

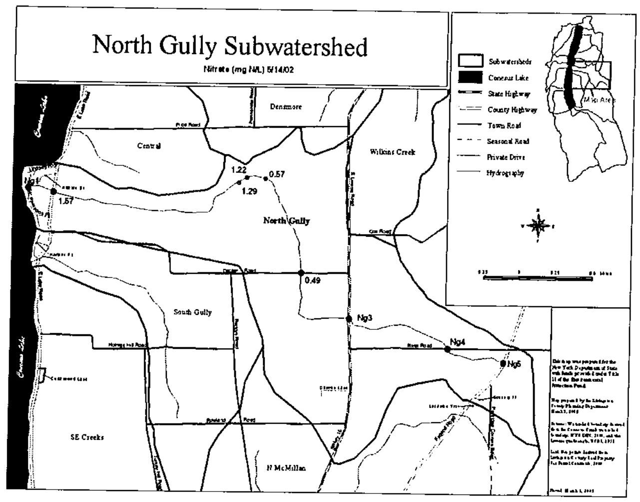


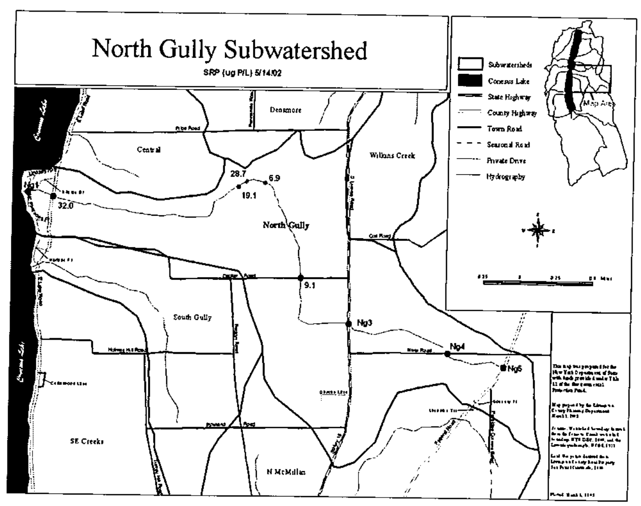




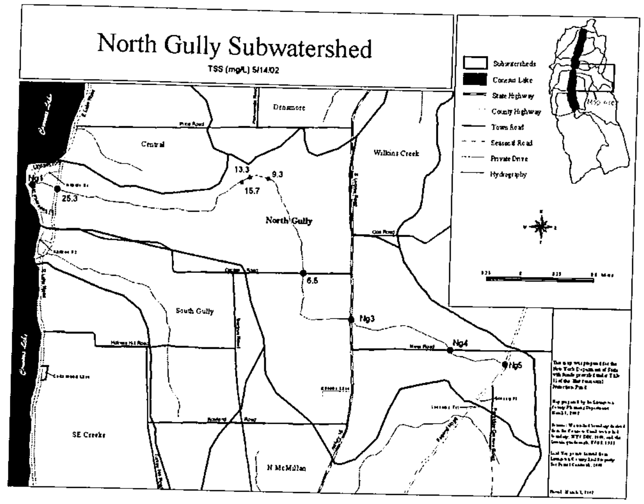
Appendix 4 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on North Gully on 29 April 2002.

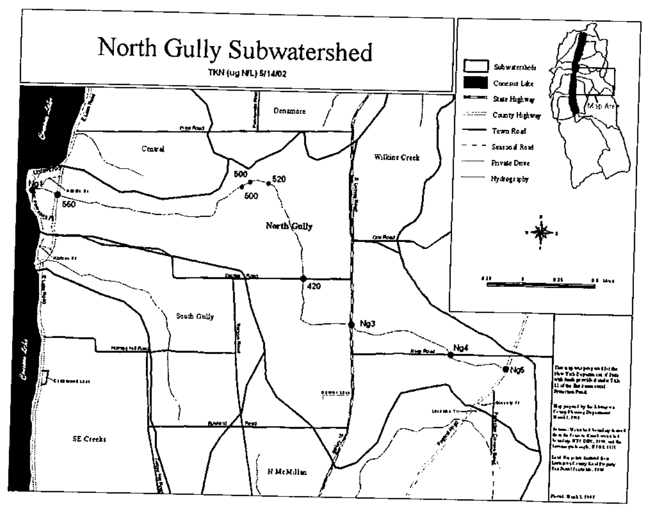


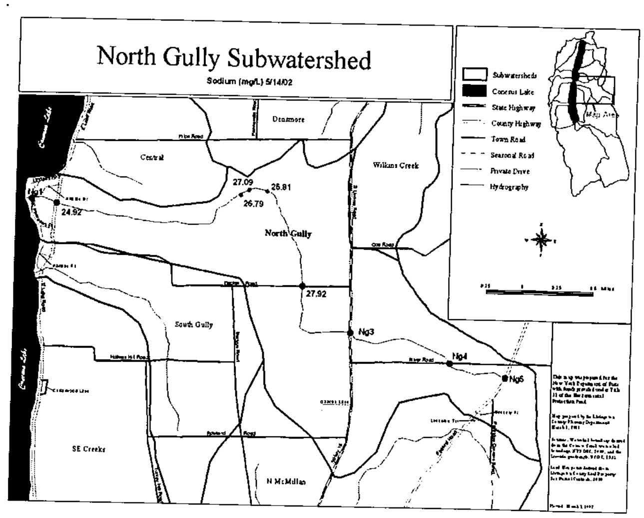




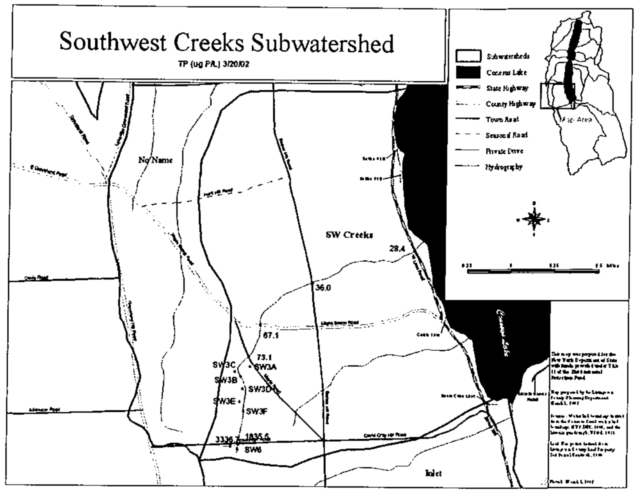
Appendix 5. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on North Gully on 14 May 2002.

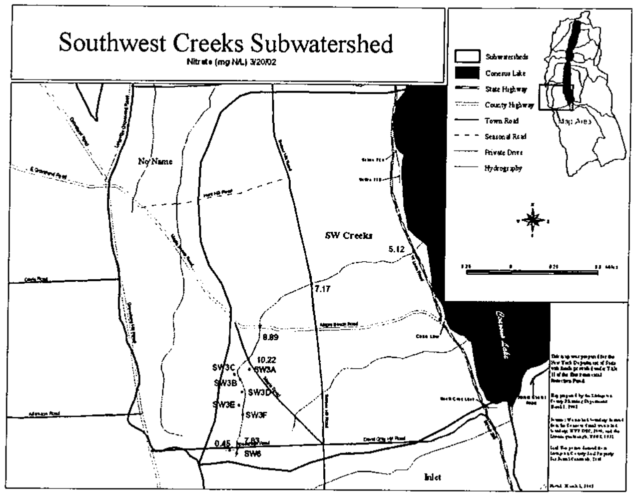


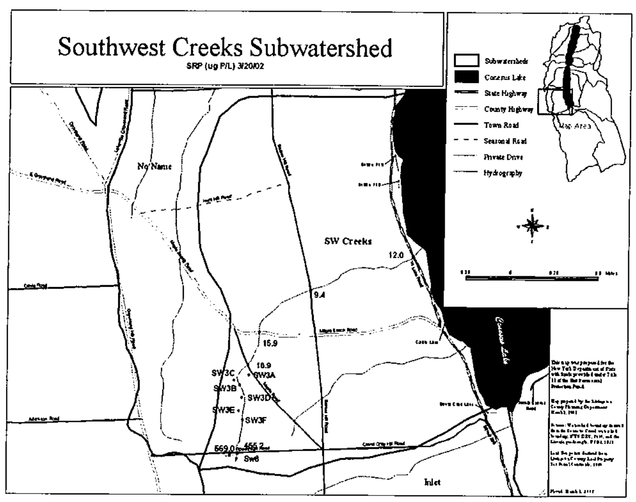




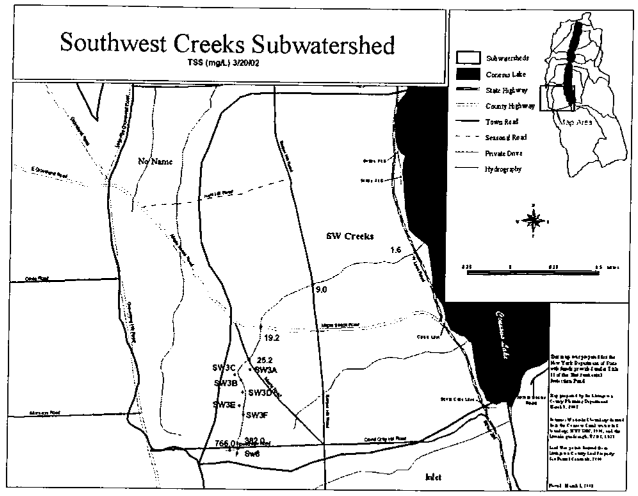
Appendix 5 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on North Gully on 14 May 2002.

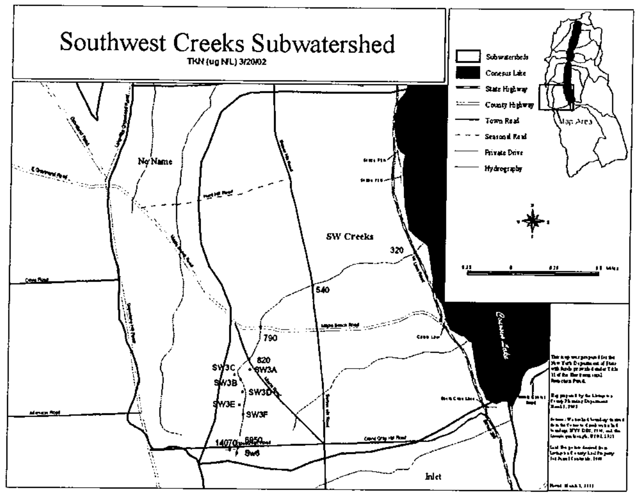


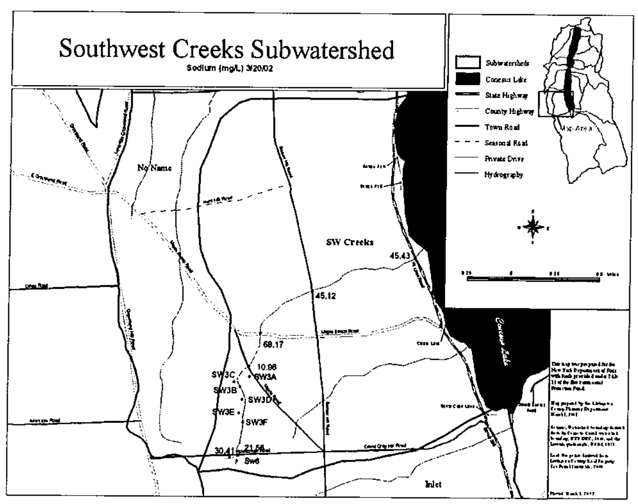




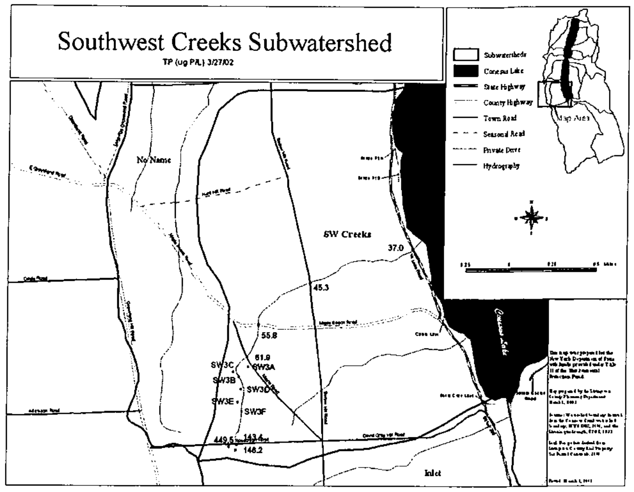
Appendix 6. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 20 March 2002.

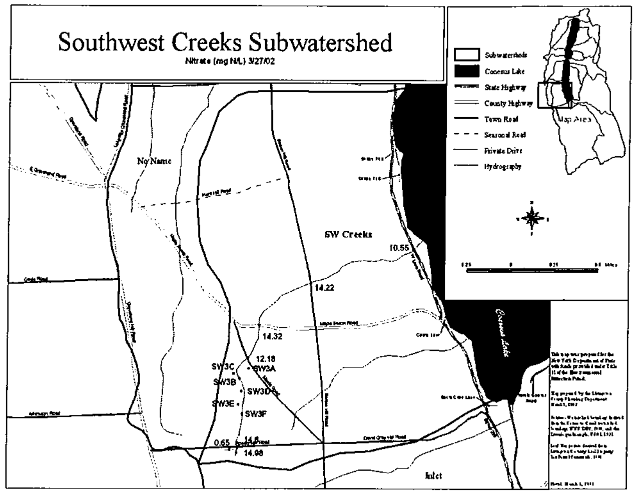


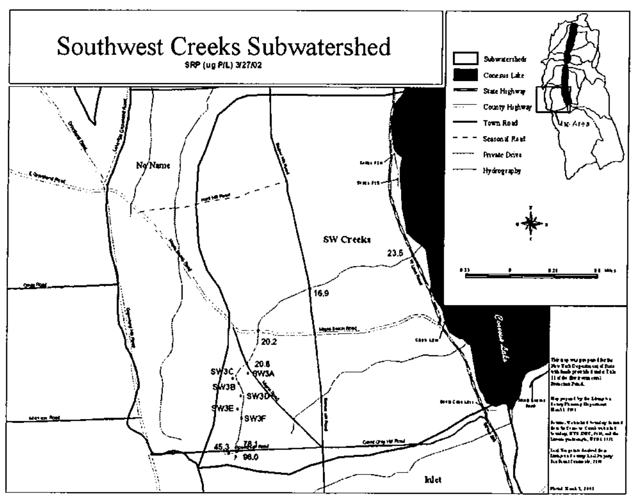




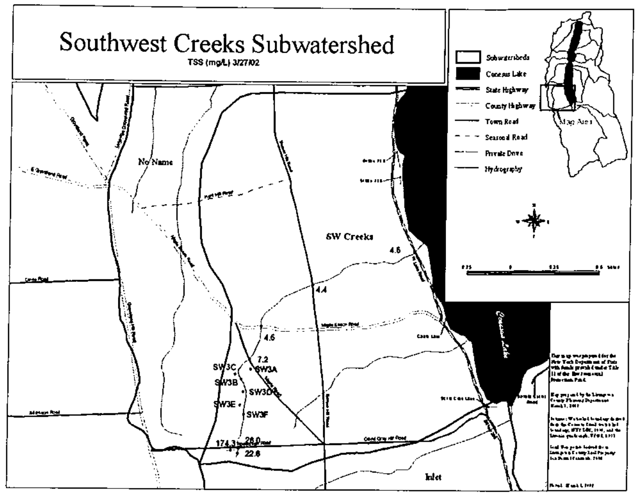
Appendix 6 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 20 March 2002.

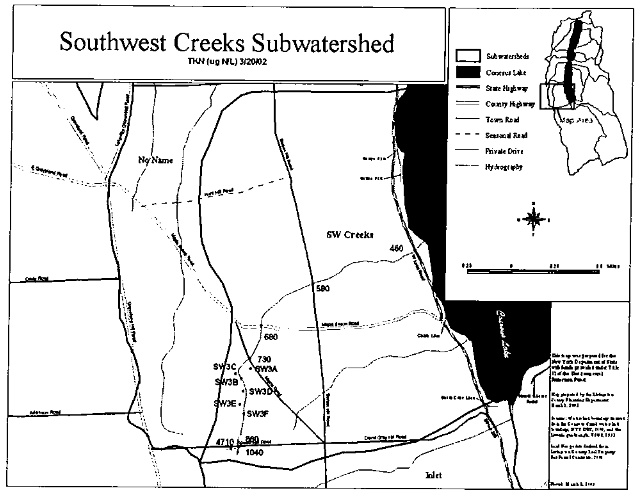




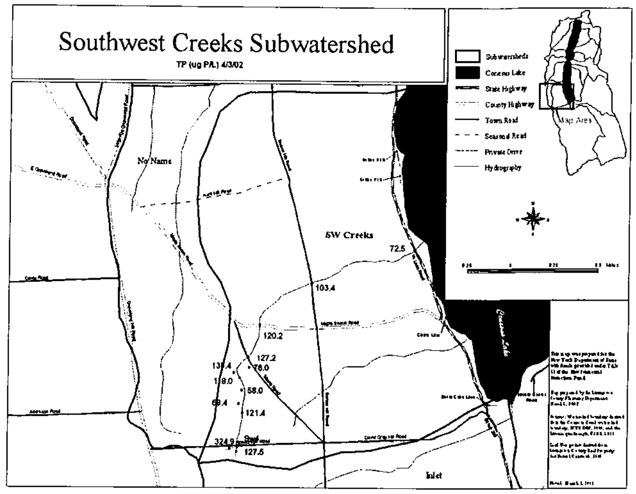


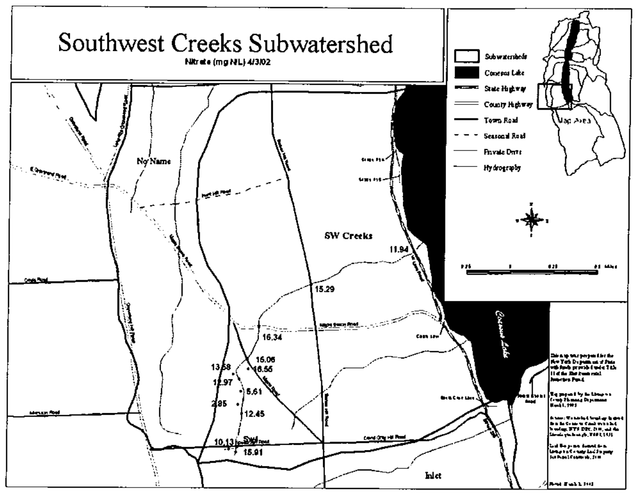
Appendix 7. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 27 March 2002.

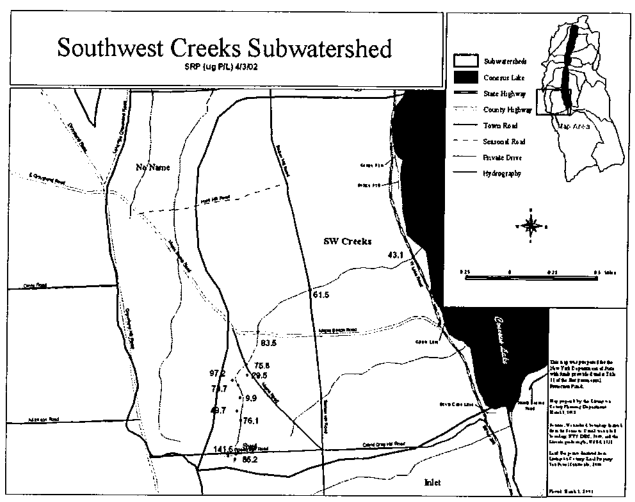




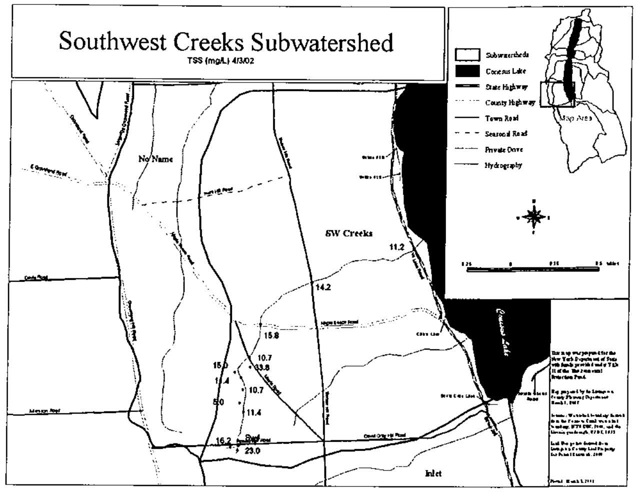
Appendix 7 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 27 March 2002.

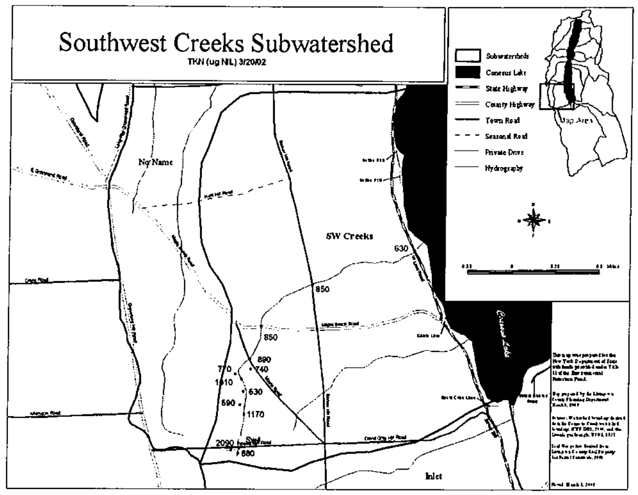


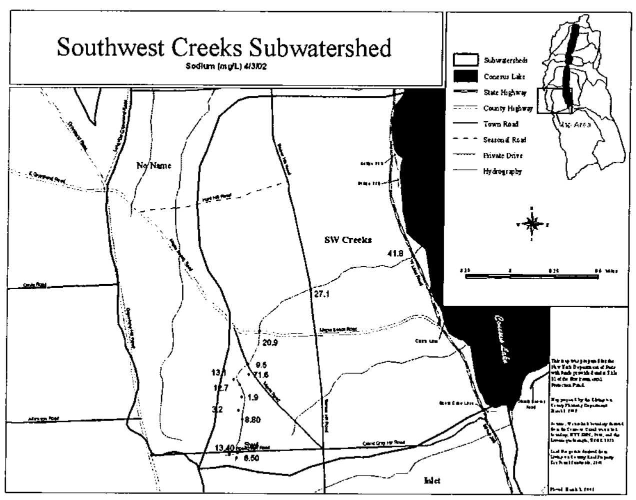




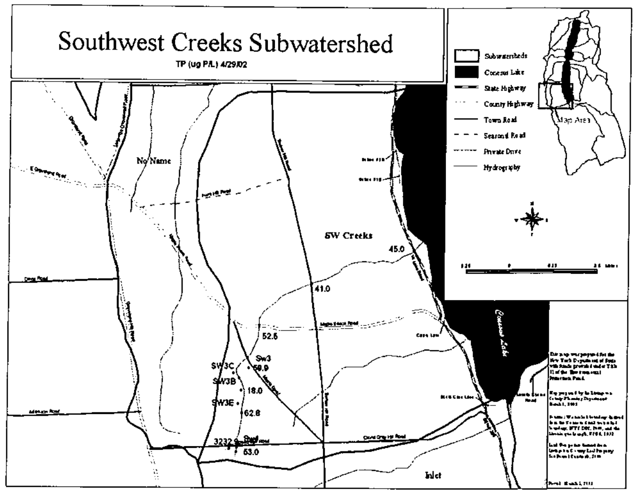
Appendix 8. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 3 April 2002.

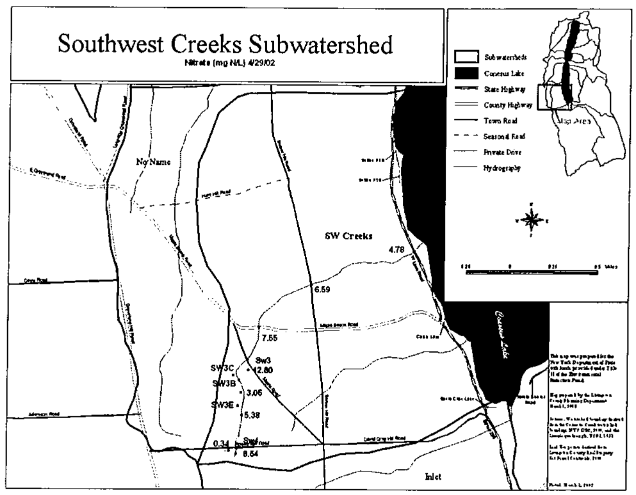


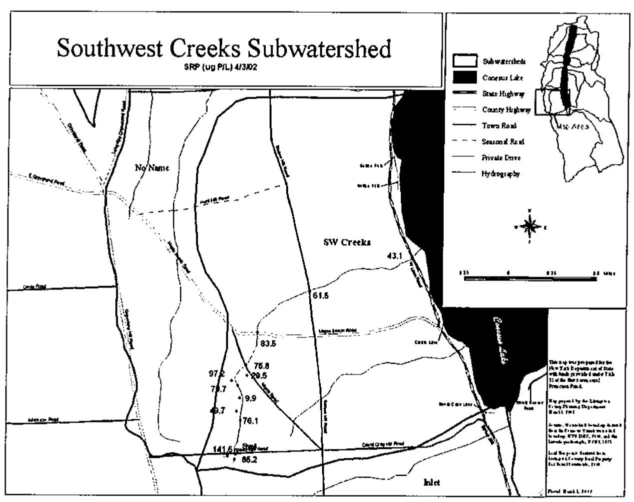




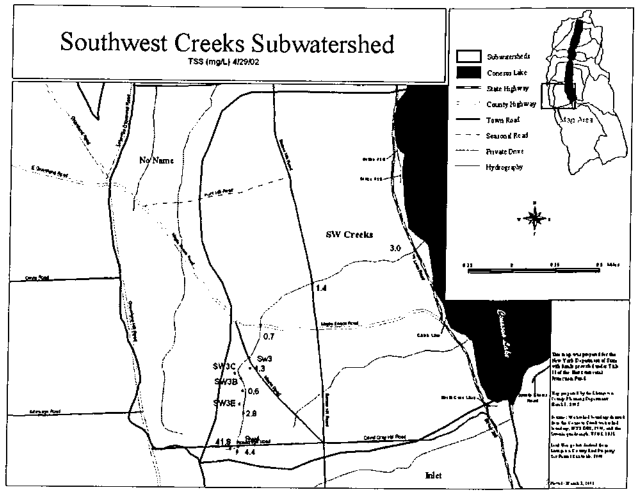
Appendix 8 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 3 April 2002.

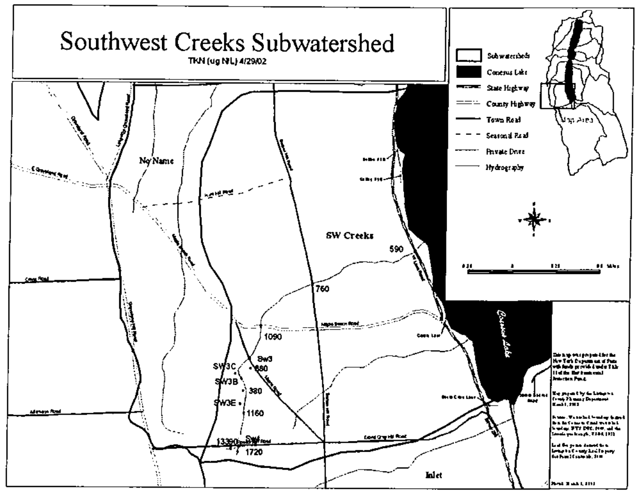


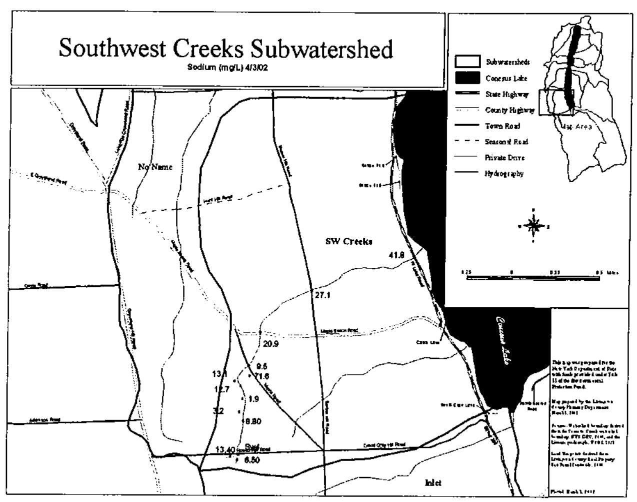




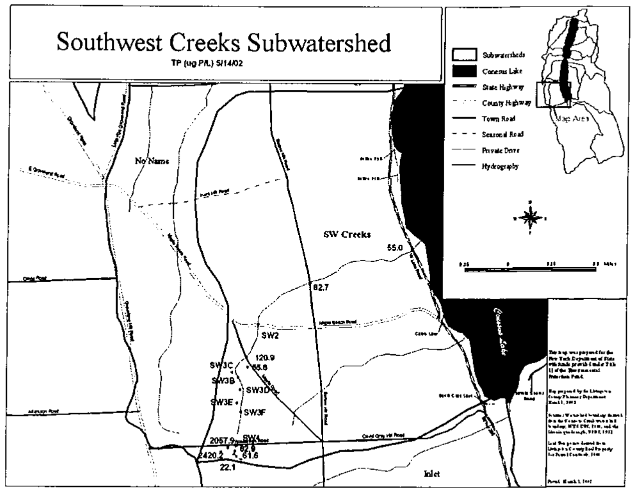
Appendix 9. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 29 April 2002.

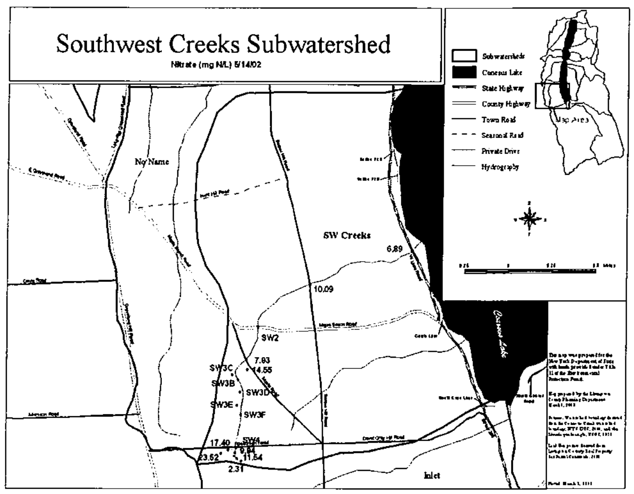


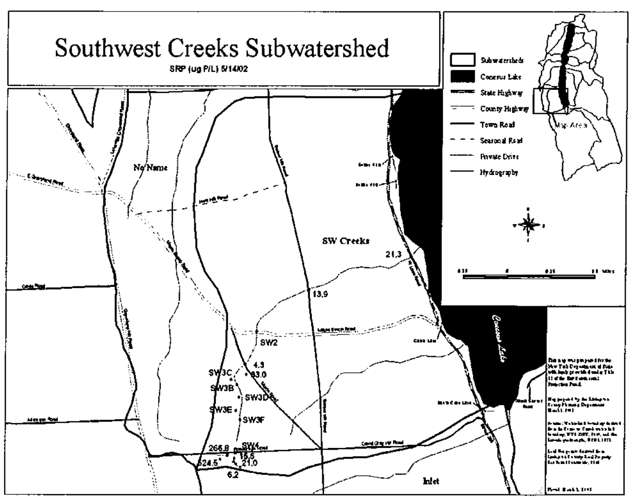




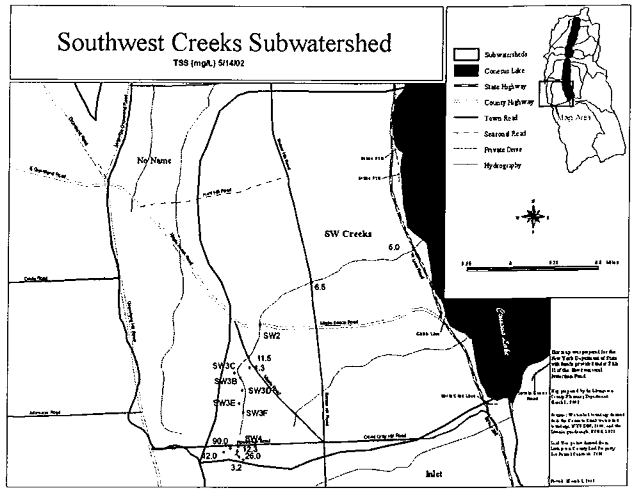
Appendix 9 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 29 April 2002.

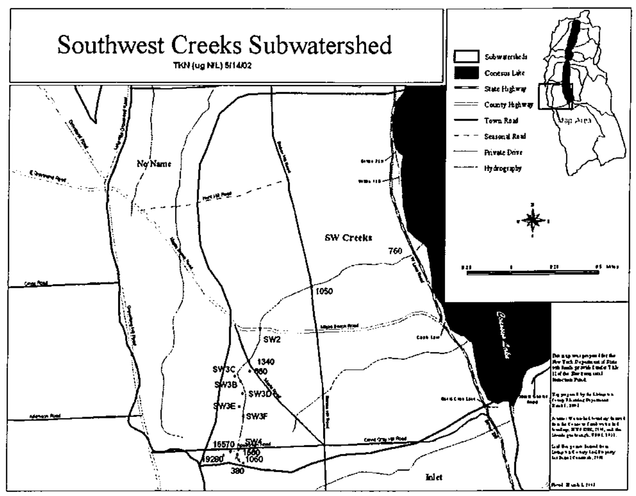


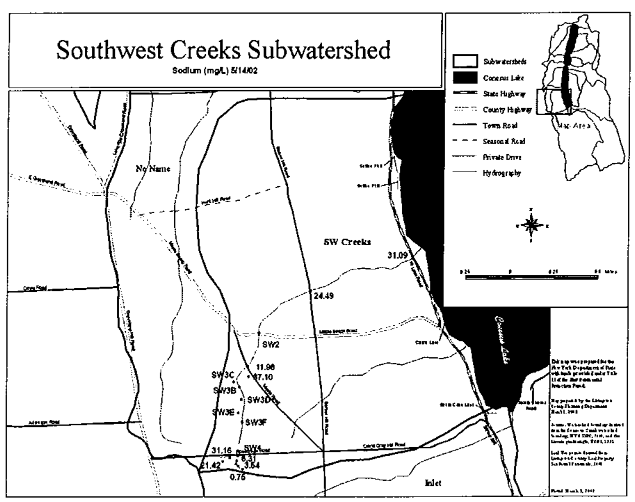




Appendix 10. Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 14 May 2002.







Appendix 10 (cont). Total phosphorus, nitrate, soluble reactive phosphorus, total suspended solids, total Kjeldahl nitrogen and sodium concentrations on Southwest Creek on 14 May 2002.