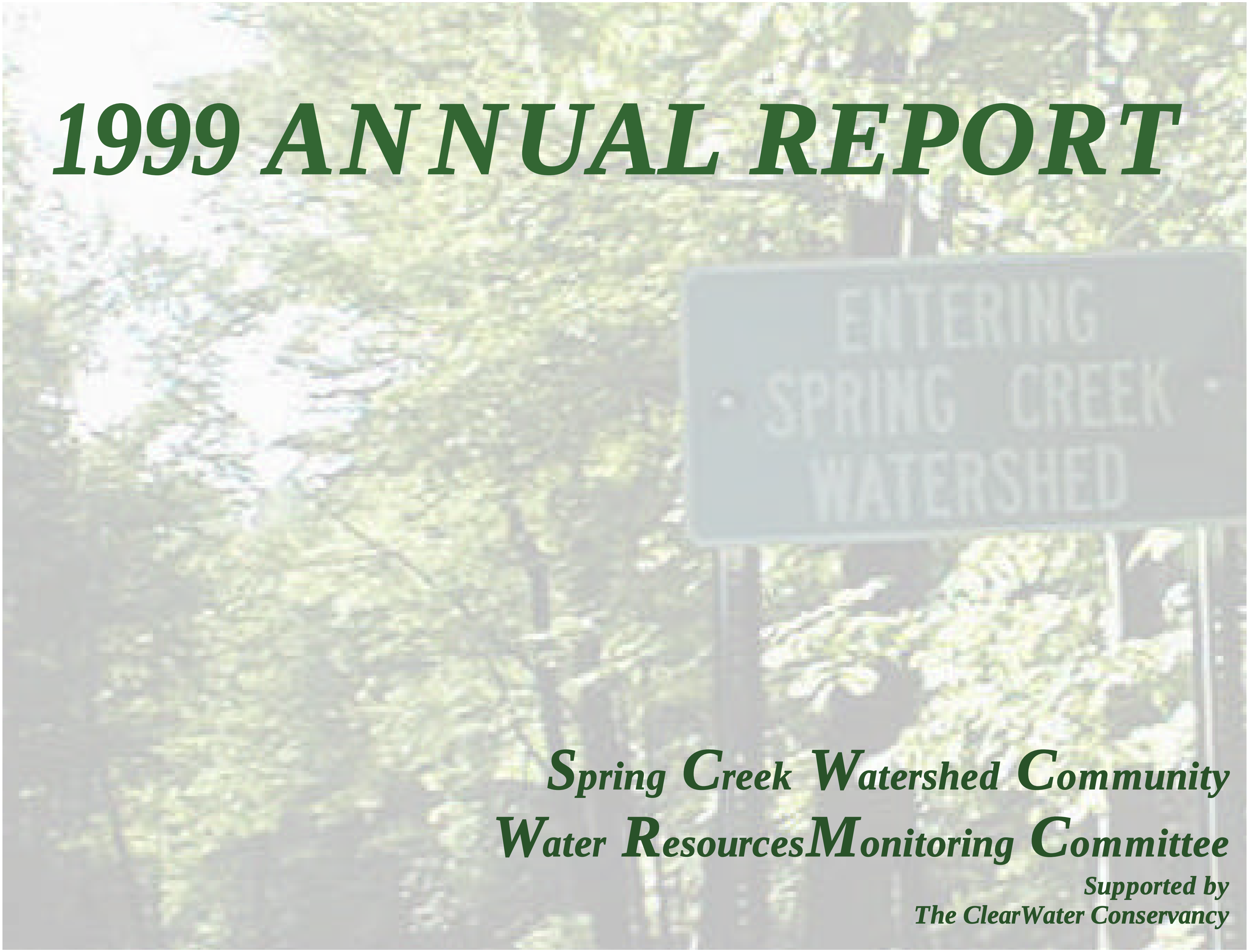
1999 ANNUAL REPORT



Spring Creek Watershed Community

Water Resources Monitoring Committee

Supported by

The ClearWater Conservancy

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ATTACHMENTS

- Photographs
- Sample Laboratory Reports
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EXECUTIVE SUMMARY

The Water Resources Monitoring Project is a project of the Spring Creek Watershed Community (SCWC), a stakeholder initiative staffed and supported by the ClearWater Conservancy. The Water Resources Monitoring Committee (WRMC) of the SCWC, a group of volunteers, designed and oversees the project, which completed its first year of operation in 1999. The goals of the WRMC in initiating the project were to:

1. Provide a description of the quantity and quality of surface waters;
2. Provide the means to detect changes in quantity and quality of surface and ground waters;
3. Provide sufficient measurement sensitivity to permit assessment of these changes.

This project is critical because the Spring Creek Watershed, encompassing 175 square miles in Centre County, houses one of the most rapidly growing regions in the state of Pennsylvania. Changing land use patterns threaten to impact the overall health of Spring Creek and its tributaries by decreasing the volume of ground water recharge into the stream and potentially increasing the volume of pollutants that enter it. Establishing a baseline relationship of stream flows and water quality is highly desirable before further substantial land use changes occur. This project is an effort to establish a continuous comprehensive monitoring network for collecting critical baseline data.

The major accomplishments for 1999 were the completion of a network of twelve monitoring stations throughout the watershed and beginning the data collection that will form the baseline measurement. Stilling wells, staff gages and continuous water level/temperature recorders are in place at all 12 sites. The locations of the monitoring stations are important in that they provide data from a variety of land use types that could be useful in future comparisons and predictions. The sites have been strategically established in the following locations:

- Spring Creek (four sites),
- Buffalo Run (two sites),
- Logan Branch (two sites),
- Slab Cabin Run (two sites),
- Thompson Run,
- Cedar Run.

Data are collected from all twelve stations on either a continuous or monthly basis. Data are collected a) continuously through in-stream monitors for water levels (flow data) and temperature and b) monthly through sampling and testing for water quality. The samples are tested for eleven quality parameters that are designed to determine non-point source influences on water quality. The sampling methods and protocol follow the Department of Environmental Protection's accepted procedures and the testing follows the approved laboratory procedures of the Environmental Protection Agency. Currently the WRMC is working on the design and implementation of a computer database, which will be the central repository for all of the data. The database will be accessible to the public and will include forms, script and reports for data entry, mathematical calculations, basic statistical analysis, and graphing data.

Baseline data collection began in 1999. Without an established baseline study, verifiable conclusions and comparisons related to changes in land use are not possible. The collection of the eleven quality variables, temperature, and continuous flow data will create an accurate account of the quality and quantity of the water resources of the Spring Creek Watershed over time. Data collected over time will be valuable to anyone who may want to identify water quality trends, monitor species limitations, or understand the complexity of the watershed and its resources.

Other accomplishments of the Water Resources Monitoring Project in 1999 include:

1. **A searchable database has been completed** that compiles all studies on Spring Creek and its tributaries. The bibliographic database includes a total of 267 documents organized in the following categories: conference proceedings, dissertations, journal articles, maps, reports, video recordings, and web pages. This database is searchable by author, journal, title, type of document, and a list of keywords. Examples of searchable words and resource entries are included in the Attachments. The database is accessible at the ClearWater office using Procite, a searchable database; hard copies are available upon request. The searchable database contains references by conference proceedings, dissertations, journal articles, maps, reports, video recordings, and web pages.

2. **Producing the Spring Creek Watershed Water Sampling Protocol**. The WRMC worked with the Leonard Center for Technical Writing Initiative of the Pennsylvania State University to produce the Spring Creek Watershed Water Sampling Protocol. This step-by-step sampling and analysis protocol ensures a high level of consistency in collection methodology from sampling period to sampling period by outlining the necessary steps in the process for students, interns, and volunteers assisting with the project who may not have a scientific background. The written protocol thus makes it possible to promote involvement of the members of the Spring Creek Watershed Community.

3. **Establishing a computer database for the data collected during the monitoring program**.

The future work of this project will provide consistent and reliable watershed data that will be made available to any interested individual. These data will document long-term changes to Spring Creek and its tributaries and provide the basis for future watershed projects. This project also has the potential to foster inter-municipal cooperation and encourage a watershed-based approach to water quality.

Plans for 2000 include:

- Continue monthly sampling and laboratory analysis of surface water from all 12 monitoring stations. Continue collecting flow and temperature data from the 12 stations.
- Complete design and development of the monitoring database by October 2000.
- Develop rating curves for all twelve monitoring stations, dependent on the availability of high flow events to capture steam measurement readings at each monitoring site. (completed by October 2000)
- Pending a grant request to DEP under the Growing Greener grants, initiate storm event sampling to characterize the watershed response to storm events.
- Also pending the grant request to DEP, compile geomorphic classification data on eight sites within the monitoring network (to include all the tributary sites).

1.0 PROJECT BACKGROUND

The Water Resources Monitoring Project started in January 1998 as part of the strategic planning process effort of the Spring Creek Watershed Community. The Spring Creek Watershed Community is a broad based stakeholders project of the ClearWater Conservancy. It consists of numerous stakeholders throughout the watershed, including private business and industry, municipalities, elected officials, government agencies, the farming community, land owners, developers, other non-profit organizations, and individual citizens who have a desire to preserve and protect the integrity of the Spring Creek Watershed. The Watershed Community is made up of approximately 2,000 stakeholders interested in carrying out its mission and strategic goals listed below.

The Watershed Community is the largest organization in Centre County that is exclusively watershed-focused in its activities. It provides a public forum for discussion in which all viewpoints are welcomed. The Water Resources Monitoring Project directly relates to the second strategic goal of the SCWC listed below. The Watershed Community works closely with its sponsoring organization, the ClearWater Conservancy, on numerous projects and activities in the watershed. Since the Spring Creek Watershed Community is not incorporated, ClearWater Conservancy administers grants on behalf of the community and provides staffing for the organization. The Spring Creek Watershed Community also works closely with the Spring Creek Watershed Commission, an organization of government officials from the fourteen watershed municipalities and the Centre County Board of Commissioners.

1.1 MISSION STATEMENT

The Spring Creek Watershed Community promotes actions that protect and enhance the quality of life, the environment, and the economy throughout the watershed while maintaining and improving the high quality of Spring Creek and its tributaries.

1.2 STRATEGIC GOALS

1. *Maximize involvement and participation in Spring Creek Watershed Community actions.*
2. *Measure watershed quality and set goals for improvement.*
3. *Develop a vision for the future and implement it.*
4. *Increase public awareness of watershed issues through education and communication.*
5. *Increase intergovernmental and interorganizational cooperation.*

1.3 WHY IS THIS MONITORING TAKING PLACE?

The Spring Creek Watershed is a vital resource in Centre County. Recently recognized by the State of Pennsylvania as a “high quality, cold water fishery”, Spring Creek is a natural resource that is essential to protect.

A healthy stream is a busy place. By studying the watershed and its hydrologic features, individuals can learn more about the effect of human uses of land and water on the quality and quantity of water in Spring Creek and its tributaries. Human activities shape and alter many stream characteristics. Such activities may include: damming up water, diverting water, straightening streams, dredging streams, dewatering, discharging to streams, restoring streams, building roads, parking lots, new homes, offices, and factories, and farming practices in the watershed. Some of these activities may dramatically affect parts of the stream environment within the watershed.

Every watershed is composed of smaller geographic unit called sub-watersheds. The monitoring stations are located in different sub-watershed. Influences of various factors on water quality and hydrology can be more readily observed at the sub-watershed level. By studying different sub-watersheds, changes may be less difficult to isolate than on a larger scale. The Spring Creek watershed has a network of smaller stream channel; its tributaries. Tributaries such as Slab Cabin Run, Buffalo Run, Cedar Run, and Logan Branch are critical sites to monitor because they are vulnerable to watershed development and dominate the landscape by their sheer number and collective length. An event occurring in the local landscape can affect tributary streams that will in turn affect the main stem of Spring Creek. The baseline water quality and quantity data generated from this project will provide valuable information for planning the future of Centre County.

Specifically, this volunteer monitoring project is designed to:

- Develop baseline characterization data of Spring Creek and its tributaries.
- Document water quality & quantity changes over time.
- Screen for potential water quality problems.
- Provide a scientific basis for making decisions on the management of the watershed.
- Educate the local community to encourage pollution prevention.

1.4 WHO MIGHT USE THE MONITORING DATA?

- Schools
- Industries
- Sewer and water authorities
- Universities
- Environmental groups
- Local planning agencies
- Developers
- Municipalities
- Spring Creek Watershed Commission
- State agencies
- Recreational users and groups.

1.5 THE WATER RESOURCES MONITORING COMMITTEE

The activities of the Water Resources Monitoring Project are overseen by a group of volunteer committee members made up of technical and environmental experts who meet regularly to discuss all aspects of the project. In initiating the project, the goals of the Water Resources Monitoring Committee were to:

1. Provide a description of the quantity and quality of surface waters,

2. Provide the means to detect changes in quantity and quality of surface and ground waters,

3. Provide sufficient measurement sensitivity to permit assessment of these changes.

The members of the Water Resources Monitoring Committee are:

NAME	BACKGROUND	AFFILIATION
David Smith	COMMITTEE CHAIR; Assistant Director	University Area Joint Authority
Scott Harrison	Environmental Scientist & Chemist	Centre Analytical Laboratories
Robert Carline, Ph.D.	Adjunct Professor and Leader	Pennsylvania Cooperative Fish & Wildlife Research Unit, Pennsylvania State University
Andrew Cole	Research Associate	PSU School of Forest Resources
Gene Proch	Manager of Regulatory Affairs	Corning Asahi Video Products
Jim DeWolfe	Environmental Engineer	The Sear Brown Group
John Sengle	Water Quality Specialist	Pennsylvania Department of Environmental Protection
Rick Wardrop	Hydrogeologist, Industrial Contamination Specialist	US Filter
Jason Wert	Environmental Engineer	Herbert, Rowland, and Grubic
Albert Lavan	Process Engineer	Corning Asahi Video Products
Mark Ralston	Hydrogeologist	Converse Consultants
Steve Foard	Environmental Safety Manager	Murata Electronics North America, Inc.
Beth Thoma (staff)	Watershed Coordinator	ClearWater Conservancy
Roxanne Shiels (staff)	Vision 2020 Project Director (former Watershed Coordinator)	ClearWater Conservancy

FIGURE 1. WATERSHED MONITORING COMMITTEE MEMBERS

2.0 PROJECT FUNDING

Financial support for the monitoring project comes from a variety of stakeholders--industries, institutions, municipalities, authorities, and foundations. In 1998, the Water Resources Monitoring Committee raised $54,000, which paid for start-up costs, operating costs for year one and partial operating costs for subsequent years. In 1999, securing pledges to complete the funding for years 2 and 3 was a major goal of ClearWater's fund-raising activities in order to meet a challenge grant from the Centre County Community Foundation (CCCF). With the donation of testing from PA's Dept. of Environmental Protection, the Conservancy was successfully in obtaining the needed pledges, thus gaining an additional $5,000 in support from the CCCF.

Start-up Year, 1998: Foundation monies largely supported the start-up of the project. Start-up costs included primarily the purchase of needed equipment and supplies, and the staff time needed to install the monitoring sites. Project start-up activities extended into the first and second years of operation.

First year of operation, 1999: Ten municipalities, agencies, authorities, and other organizations donated more than $24,000 to perform water quality and quantity sampling and analyses for 1999, the project's first year of operation. During this year, installation of the monitoring sites was completed (as part of the start-up).

Years two and three of operation, 2000 and 2001: The ten municipalities that funded the first year of operation made a commitment to partially fund years 2 and 3, as well as the State College Water Authority and the University Area Joint Authority. In 2000, completing the design of the monitoring database is the remaining project start-up activity left to do (meaning it is a one-time activity).

A goal of the monitoring committee is to secure long-term funding commitments from local industries, municipalities, sewer and water authorities, and other major stakeholders in the watershed.

Year	**Income**	**Expenses**
1998 (start-up year)	$20,000	$ 6,305
1999: Year One of operating	$24,386	$26,165
2000: Year Two	$23,361* (expected)	$35,000 (budgeted)**
TOTALS	**$67,747**	**$67,471**

FIGURE 2. ANNUAL FUNDING SUMMARY

*Includes COG funding of $7,215
**Includes costs for designing monitoring database

2.1 FINANCIAL CONTRIBUTORS TO THE WATER RESOURCES MONITORING PROJECT

Centre County Community Foundation
Corning Foundation
Heinz Endowments
Penn State Office of Physical Plant
State College Borough Water Authority
Trout Unlimited
University Area Joint Authority
Centre Region Council of Governments (College, Ferguson, Halfmoon, Harris, and Patton Townships, and State College Borough)
Benner Township
Bellefonte Borough
Milesburg Borough
Spring Township

2.2 IN-KIND CONTRIBUTORS TO THE WATER RESOURCES MONITORING PROJECT

Pennsylvania Cooperative Fish and Wildlife Research Unit, Penn State University

Corning Asahi Video Products

Converse Consultants

Pennsylvania Department of Environmental Protection, Bureau of Laboratories[1]

3.0 ACCOMPLISHMENTS TO DATE

Since the inception of this project in January 1998, numerous milestones have been accomplished toward meeting the project objectives. These include:

1. **Develop a monitoring work plan (1998):** Based on the objectives of this project, the WRMC decided what should be sampled to effectively characterize the changes in water quality and quantity likely to result from changing land use patterns. They also determined that monthly sampling at normal flows was sufficient to create a baseline database.
2. **Raise funds for startup and operating capital (1998 and 1999):** Approximately $54,000 was raised in 1998 to establish the monitoring network and to perform water quality and quantity sampling and analyses for 1999. The remaining 1999 financial needs were met by in-kind contributions from various sources. Additional monies have been pledged toward the operation of the project for the years 2000 and 2001.
3. **1998 Annual Report (1999):** This report, completed in April 1999, informed supporters and stakeholders of the Water Resources Monitoring Project of the progress, activities, and accomplishments during the start up year of the project, 1998.
4. **Complete the network of 12 monitoring stations through the watershed (1999):** Locations for 12 monitoring sites that best characterize the Spring Creek watershed in the most cost efficient way were selected. The sites have been strategically established to provide data representative of the entire watershed. Stilling wells, staff gages and continuous water level/temperature recorders are in place at all 12 sites.
5. **Begin monitoring (1999):** Monthly water sampling began in April 1999 at 11 stations, with the final station coming online in August. Monthly grab samples are taken at all twelve sites and sent to a DEP lab for analysis; each site's pH and dissolved oxygen levels are also monitored on a monthly basis. Water level and temperature data are continuously recorded at all twelve monitoring stations, with the data downloaded monthly.
6. **Complete and publish the searchable bibliographic database (1999):** A searchable database has been completed that compiles all studies on Spring Creek and its tributaries. The bibliographic database includes a total of 267 documents organized in the following categories: conference proceedings, dissertations,

[1] The DEP laboratory is performing free analytical services, limiting the expenses of this project. These data, provided by a community monitoring effort, cannot be used for enforcement actions, regardless of the laboratory performing the testing

journal articles, maps, reports, video recordings, and web pages. This database is searchable by author, journal, title, type of document, and a list of keywords. Examples of searchable words and resource entries are included in the Attachments. This database is accessible at the ClearWater office using Procite, a searchable database; hard copies are available upon request.

7. **Complete and publish the water quality monitoring protocol (1999):** A document entitled "The Spring Creek Watershed Water Sampling Protocol" was completed in November 1999. This was a collaborative effort of the Leonard Center for Technical Writing of Penn State University, the Department of Environmental Protection, and the Water Resources Monitoring Committee. The document provides step-by-step instructions for the monthly sampling including: materials needed for sampling, collection of data, standardized methods for preparing and filtering water samples, calibrating and reading equipment, instructions for downloading of the data, reading and recording data, and packaging and shipping of samples. The protocol will provide consistency for students, interns, and volunteers assisting with the monitoring project who may not have a scientific background, thus promoting involvement of the members of the Spring Creek Watershed Community.

8. **Create a monitoring database (1999):** The database is the central repository for all the data collected from the monitoring stations. (Microsoft Access® was chosen as the software because of its widespread availability.) Currently there is a ClearWater staff person designing a user-friendly system, able to perform queries and statistical analysis with the monitoring data. When completed, this database will be accessible to the public, eventually to be placed on the Internet. The design work is scheduled to be completed by Fall, 2000.

4.0 PROJECT IMPLEMENTATION

4.1 BASELINE DATA COLLECTION

The National Environmental Policy Act (NEPA; 1970) was enacted to promote the management of environmental impacts of man's activities upon the natural environment. One of the recognized tools for the assessment of environmental impact that is utilized under NEPA is the collection of baseline (or background) data. Baseline data can be used to evaluate the present condition of an environmental resource, as well as to assess changes or trends in the condition of the environmental resource.

Water quality measurements are deliberately being made under base flow[2] conditions in order to minimize the potential for ambiguity that could exist if the water quality data were significantly influenced by stormwater events or overland flow of surface water.

The collection of baseline data is critical to a watershed study. Without an established baseline study future predictions and comparisons could not be justified. The collection of the eleven quality variables, temperature, and continuous flow data will create an accurate account of the

[2] Base flow is the natural flow of the stream in the absence of any recent precipitation or surface runoff. Base flow is, in fact, ground water that has reached the stream channel to become surface water.

SOURCE - Base map and land use information; Centre County Planning Office, Geographic Information System (GIS) data.

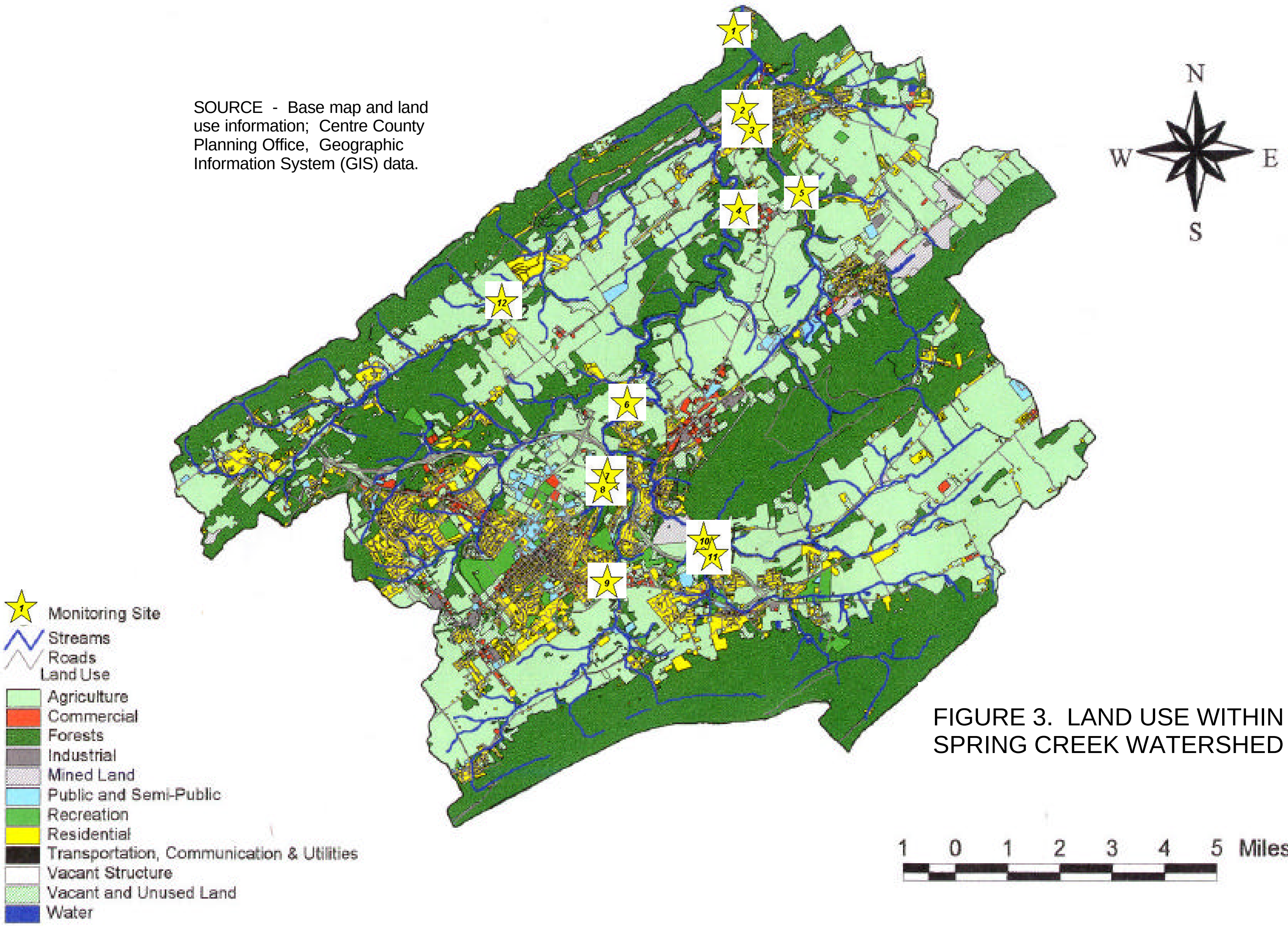


FIGURE 3. LAND USE WITHIN THE SPRING CREEK WATERSHED

quality and quantity of the water resources of the Spring Creek Watershed. Data collected over time will be valuable to anyone who may want to identify water quality trends, monitor species limitations, specific pollutants of concern, or understand the complexity of the watershed and its resources.

1999 was the year in which baseline data collection for this project commenced. Data collection began in April 1999 at 8 sites, with all 12 sites on-line by October 1999.

4.2 SITE SELECTION AND SPECIFIC SITES

The primary goal in establishing the water resource monitoring network was to divide the watershed into sub-basins that were approximately equal in size, characterized by either a certain land use type such as largely urban, largely agricultural, or a combination of land uses.

Site selection was also influenced by existing gaging stations operated by the U. S. Geological Survey and by inactive gaging stations which would be easily reactivated and for which some historical flow data were available.

Specific Sites (municipality and installation date)

Figure 4: Station 1. Spring Creek at Milesburg (Boggs Township, USGS station): This station is located about 100 feet downstream of McCoy Dam. The U. S. Geological Survey operates this station.

Figure 4: Station 2. Lower Buffalo Run (Spring Township, August 1999): This station is located approximately 50 feet upstream of the Township Route 942 bridge. This gaging station measures nearly the entire flow from the Buffalo Run sub-basin. There are increasing amounts of development and mining activities in the lower portion of the basin.

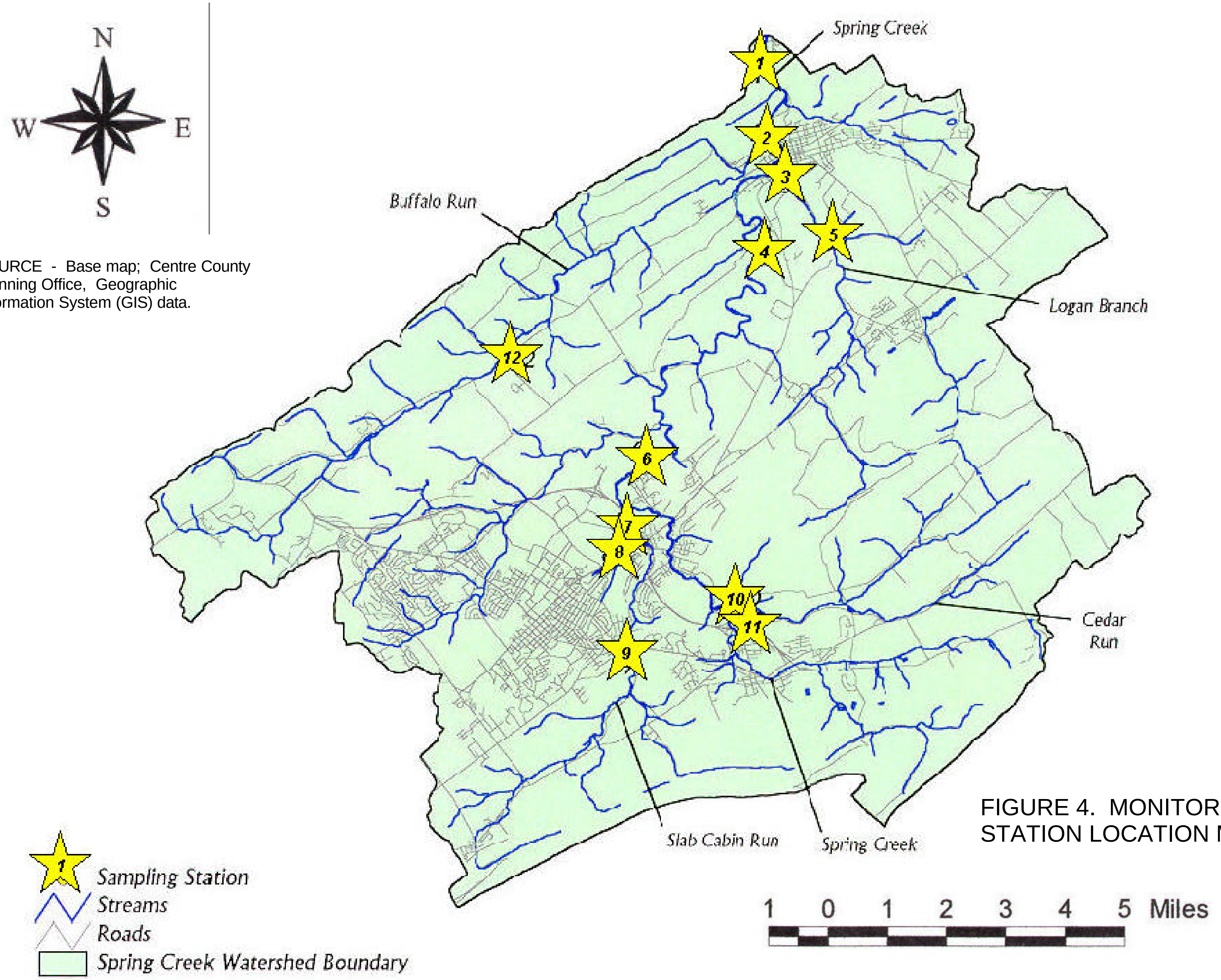
Figure 4: Station 3. Lower Logan Branch (Bellefonte Borough, January 1999): This station is located 100 feet upstream of State Route 150 in Bellefonte, and measures flow at the outlet of the Logan Branch sub-basin.

Figure 4: Station 4. Spring Creek on Spring Creek Road (Benner Township, USGS Axemann station): This station is located about 50 feet downstream of State Route 3001 bridge. The U. S. Geological Survey operates this station.

Figure 4: Station 5. Upper Logan Branch (Spring Township, August 1999): This station is located approximately 50 feet upstream of the Nittany - Bald Eagle Railroad bridge (behind the Independent Order of Odd Fellows) outside of Bellefonte. Land use in this sub-basin includes forests, mining, agriculture, and developed areas.

Figure 4: Station 6. Spring Creek at Houserville (College Township, USGS station): This station is located about 20 feet upstream from the Township Route 365 bridge. The U. S. Geological Survey operates this station.

Figure 4: Station 7. Lower Slab Cabin Run (College Township, January 1999): This station is located approximately 300 feet downstream from State Route 26 (East College Avenue) behind the College Township building. This site was chosen because it is near the confluence with Thompson Run. Much of the watershed basin between Upper Slab Cabin Run and this station is largely urbanized.



SOURCE - Base map; Centre County Planning Office, Geographic Information System (GIS) data.

FIGURE 4. MONITORING STATION LOCATION MAP

Figure 4: Station 8. Lower Thompson Run (College Township, June 1999): This station is located approximately

1500 feet downstream from the junction of Puddintown Road and State Route 26 (East College Avenue) at the Millbrook Marsh Nature Center. This station is located near the confluence with Slab Cabin Run. This sub-basin is mostly urban.

Figure 4: Station 9. Upper Slab Cabin Run (State College Borough, November 1998): This station is located approximately 20 feet upstream of the bridge on State Route Business 322 (South Atherton) near Branch Road. This basin is mostly agricultural though development is increasing. Several years of flow data are available from the gaging station, which was installed and is maintained by the Pennsylvania Cooperative Fish and Wildlife Research Unit.

Figure 3: Station 10. Lower Cedar Run (College Township, November 1998): This station is located approximately 200 feet upstream from the Township Route 333 (Brush Valley Road) bridge at Oak Hall. This station is located near the confluence with Spring Creek and is maintained by the Pennsylvania Cooperative Fish and Wildlife Research Unit. This sub-basin is largely agricultural in land use.

Figure 3: Station 11. Upper Spring Creek (College Township, November 1998): This station is located 100 feet upstream from the State Route 2004 (Linden Hall Road) bridge at Oak Hall. The Pennsylvania Cooperative Fish and Wildlife Research Unit maintains this station. This sub-basin is categorized as a mixture of forestland, agriculture, and urban areas.

Figure 4: Station 12. Upper Buffalo Run (Patton Township, August 1999): This station is located a private road bride approximately 1000 feet west of the junction of State Route 550 and State Route 303 near Filmore. It measures stream flow for approximately one-half of the sub-basin, which is largely agricultural and forested in nature.

The new stations (those with dates behind their names) were equipped with monitoring equipment to measure water level and temperature data on a continuous basis. The equipment included new stilling wells with a water level recorder (WaterLog submersible pressure transducer), a staff gage to manually record water level in meters, and a Ryan Instruments RL100 temperature monitor.

Three stations (Spring Creek at Houserville, Spring Creek at Axemann, and Spring Creek at Milesburg) are maintained by the United States Geological Survey (USGS), where direct systematic observations of hydrologic data are obtained and recorded hourly.

4.3 WATER RESOURCE MONITORING PARAMETERS[3]

Continuous Monitoring

Stream Flow	Water Temperature

Monthly grab sampling

Chlorides	Total organic carbon
Copper	Total petroleum hydrocarbons
Zinc	Total suspended solids
Lead	Turbidity
Nitrates	pH [4]

[3] Throughout this report the term "parameter" is used to refer to a physical or chemical entity that is measured (or, an "analyte"). The term "constituent" is used to refer to a physical or chemical entity that is present in a water body or water sample.

Orthophosphate Dissolved oxygen [4]

Stream Flow

Water level data are recorded every half-hour at nine of the monitoring stations in the watershed. At the three USGS stations (Spring Creek at Axemann, Spring Creek at Houserville, and Spring Creek at Milesburg), flows are recorded hourly. Stream flow is directly affected by precipitation and responds to weather conditions such as the drought of 1999. The velocity of flow is important to aquatic organisms, in part because of effects of the transport of nutrients past those organisms. Natural flow variations are critical to governing the type of ecological system that will develop and survive within a watershed.

Stream flow data are calculated from stream stage (i.e., water level in the stream) using rating curves for each of the identified stations. A rating curve relates stage to flow under varying stage/flow conditions.

Temperature

Temperature monitors are located at all monitoring stations and record data every hour. These data are downloaded monthly and entered into the database. Water temperature affects fish spawning, hatching, metabolism and behavior. Temperature relationships are easily observed for the main stem of Spring Creek and its tributaries. Some species are very sensitive to temperature changes and move in and out of a stream to find their optimal temperature.

[4] Measurements of pH and dissolved oxygen are measured in the field with portable instruments.

Chlorides

Testing of this variable is particularly important in the winter when we deal with seasonal runoff from road salts. This parameter can be utilized to assess urban runoff impacts upon a stream.

Copper, Lead, and Zinc

These metals are important because they are toxic to many aquatic organisms. Urbanization and industries may have a large effect on the concentrations of these metals in surface waters.

Nitrates

Excessive amounts of nitrates can dramatically affect aquatic plant life in the stream. Measurement of nitrate levels is critical because nitrates from land sources are readily transported by ground water and surface runoff to streams. Nitrates are a good indicator of the possibility of wastewater or agricultural pollution. A very high concentration of nitrates may be an indicator of either point source or non-point source pollution in the stream.

Orthophosphate

Phosphates are often a limiting nutrient in aquatic systems. High levels of orthophosphates can indicate contamination from sources such as wastewater discharge, lawn runoff, and agricultural runoff. Excessive amounts of phosphates in the stream may lead to excessive plant growth.

Total petroleum hydrocarbons

Measurement of this variable is indicative of possible sources of urban runoff. This is a non-specific test for the presence of any type of petroleum product that is usually associated with urbanization.

Total Organic Carbon (TOC)

TOC typically indicates the amount of biological material that is present in a water sample. Under unusual circumstances, TOC can also indicate the presence of synthetic organic compounds.

Suspended solids

Measurement of suspended solids (solids that are not dissolved) may determine activities that are detrimental to the health of the stream such as construction, paving, wastewater discharge, site clearing, and dredging. These activities may have short- or long-term effects on the water quality of the stream.

Turbidity

Turbidity is a measure of water clarity. Material suspended in the water produces turbidity, and decreases the amount of light able to pass through the water. Turbidity levels in the stream are related to the level of total suspended solids in the system. Turbidity can be useful as an indicator of the effects of runoff from construction, agricultural practices, discharges, and other sources.

pH

The pH of water indicates if it is acidic or basic. The pH scale ranges from 1 (extremely acidic) to 14 (extremely basic). Most natural waters have a pH within the range of 5.0 to 9.0. Water with a pH of 7.0 is neutral. A stream's pH influences the types and numbers of organisms that it will support. Rapid changes in pH may indicate the influence of point source or nonpoint source pollution.

Dissolved Oxygen

This is another critical element for a healthy stream environment, in that most organisms require oxygen in one form or another. DO levels may indicate the suitability of the stream for the growth and reproduction of fish and other organisms. Other factors may affect DO levels such as temperature, wastewater, stream dredging, and construction activities.

4.4 EXAMPLES OF DATA COMPARISONS AND COMBINATIONS

The database is being compiled so as to facilitate the examination and evaluation of data from which relationships in time or space may be significant. Similarly, relationships between individual parameters may also be significant. In the remainder of this Section, examples are given of some of the types of comparisons and evaluations of the monitoring data that may be of interest as the database is compiled.

Temperature

Temperature data collected from the 12 monitoring stations will help us to understand how stream temperatures change seasonally, but more importantly, how they change spatially. Temperatures shown in Figure 6 illustrate how the maximum daily temperature varies among locations throughout the watershed. Springs and groundwater seeps supply water that is about 50° F. This cold groundwater quickly warms during summer so that as this spring travels downstream it gradually approaches prevailing air temperatures. Locations with high temperatures on the map indicate that the influence of warm air temperature has largely overwhelmed the influence of cold spring inputs

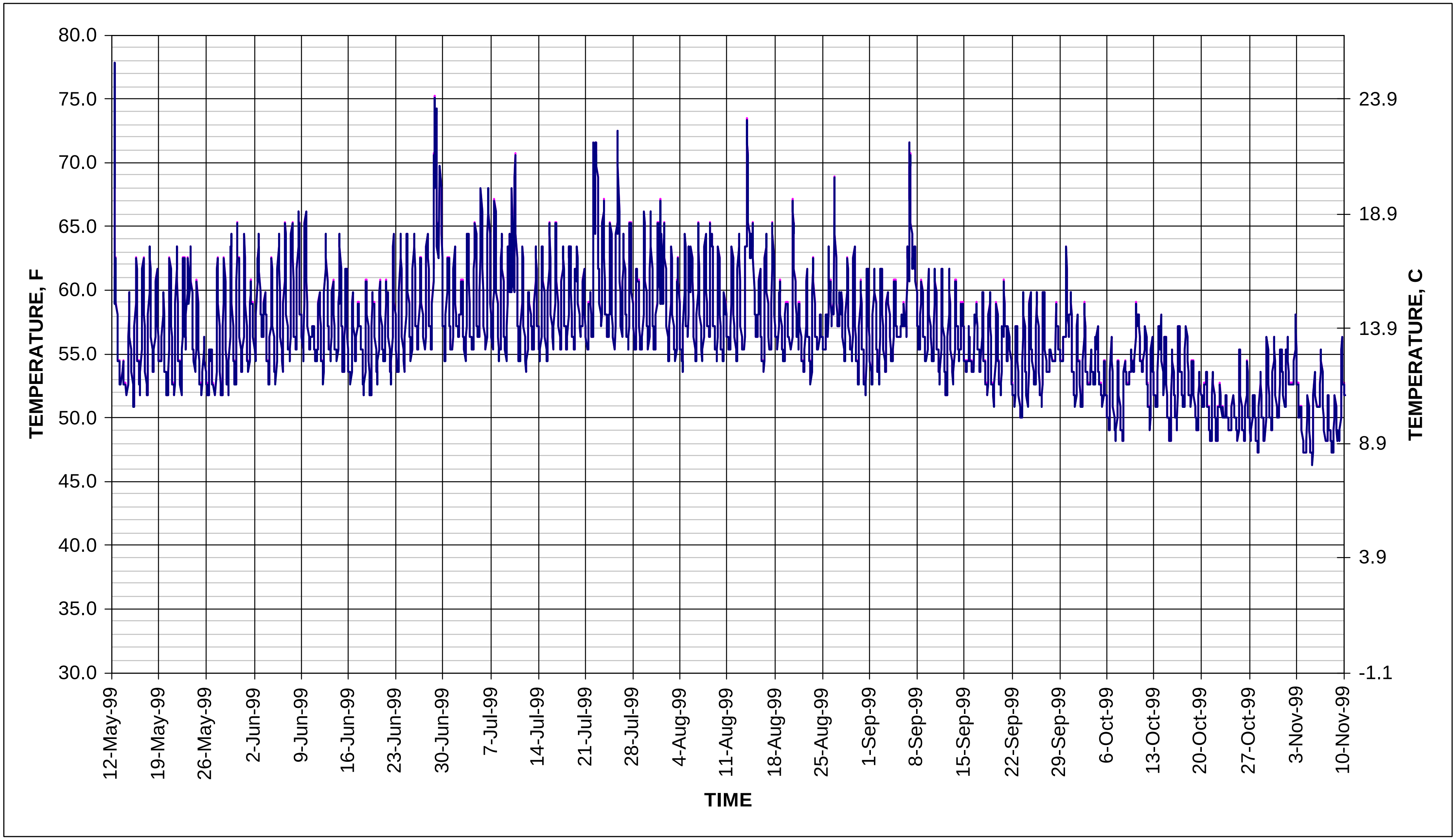


FIGURE 5. EXAMPLE OF CONTINUOUS TEMPERATURE RECORD

SOURCE - Base map; Centre County Planning Office, Geographic Information System (GIS) data.

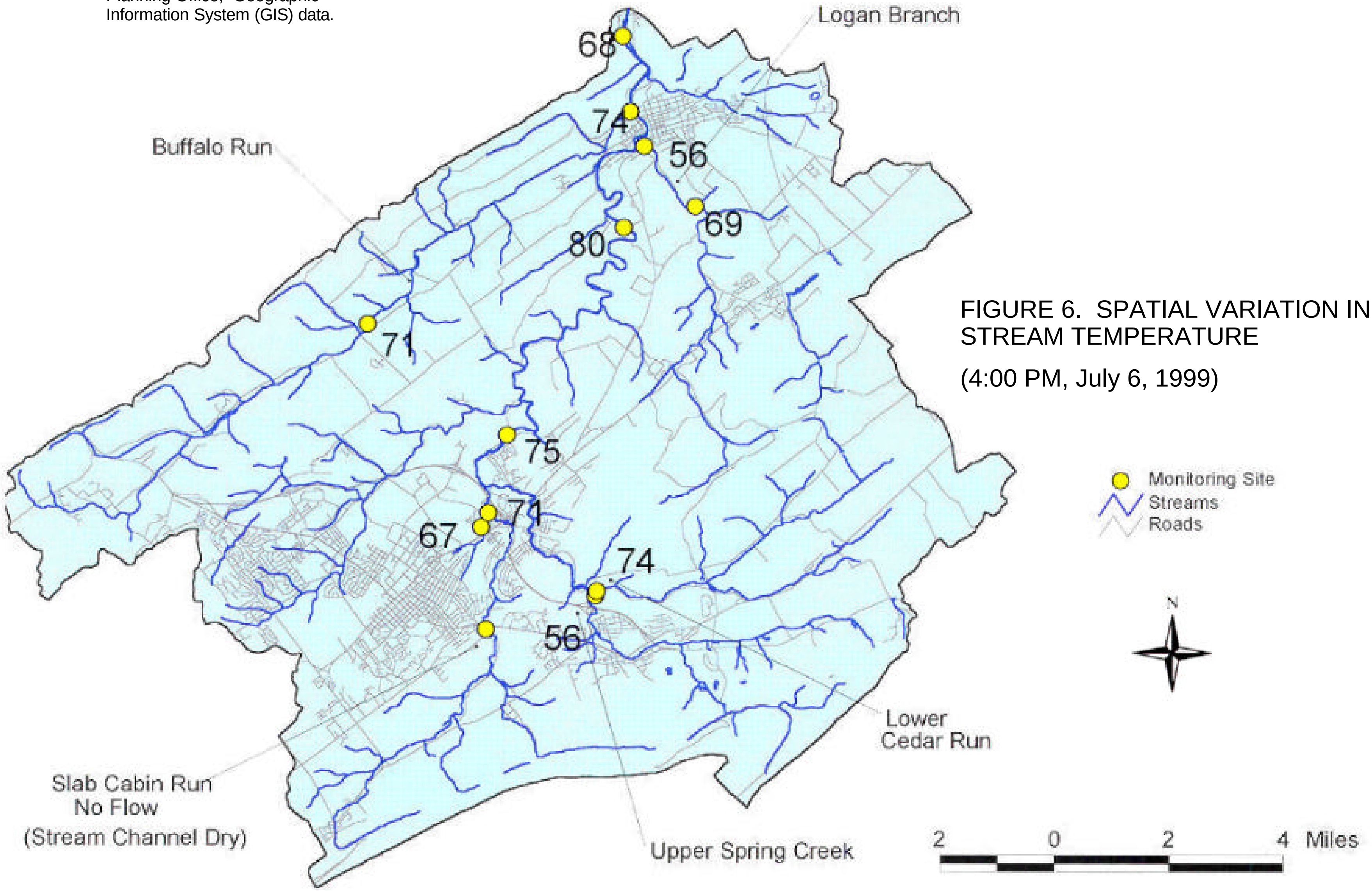


FIGURE 6. SPATIAL VARIATION IN STREAM TEMPERATURE

(4:00 PM, July 6, 1999)

farther upstream. Note that the temperature of Spring Creek at the Axemann USGS station declined from 80° F to 68° F at the Milesburg USGS station. This decline in temperature was mostly due to the large inputs colder water from Big Spring in Bellefonte and Logan Branch. This type of information is essential to being able to predict how streams temperature might change in response to a proposed project that will either add or take water from the stream.

The computer database will be set up so that queries can be made of the data, such as the presentation of :

- Continuous stream temperature data
- Daily average temperatures
- Monthly average temperatures
- Maximum and minimum temperature monthly
- Maximum and minimum temperature hourly

Chemical analysis

Figure 7 illustrates how concentrations of nitrates differ among locations and change through time. At this stage of the monitoring process, it is too early to begin to draw conclusions about sub-basins that are contributing most of the nitrates to Spring Creek. Interpretation of these graphs are a bit complicated by the drought and complete cessation of flow in Slab Cabin Run, which contributed to unusually low nitrate levels in July and August. As we continue to collect these types of data, we can begin to provide better descriptions of how all of the measured water quality variables change seasonally and spatially.

Again, the computer database will be set up so that queries can be made of the data, such as the presentation of :

- Spatially-oriented data
- Time-concentration graphs (to look at data trends and comparisons)
- Water quality data versus DEP in-stream criteria

Combinations of data

The computer database will be developed through the Fall of 2000. As more data become available in the database, it may be useful to enable the database to respond to additional queries, such as:

- Graph of nutrient[5] levels versus flow
- Tabulated mass loading of nutrients and constituents
- Map of mass loading using gradated symbols to represent mass
- Graph of temperature versus dissolved oxygen
- Graph of temperature versus flow
- Graph of pH versus dissolved metals concentrations
- Graph of flow versus precipitation

[5] Examples of nutrients include nitrate and phosphate; concentrations of these constituents can indicate the status of an aquatic environment in the range between nutrient-deficient (growth-inhibiting) and nutrient-enriched (growth-promoting).

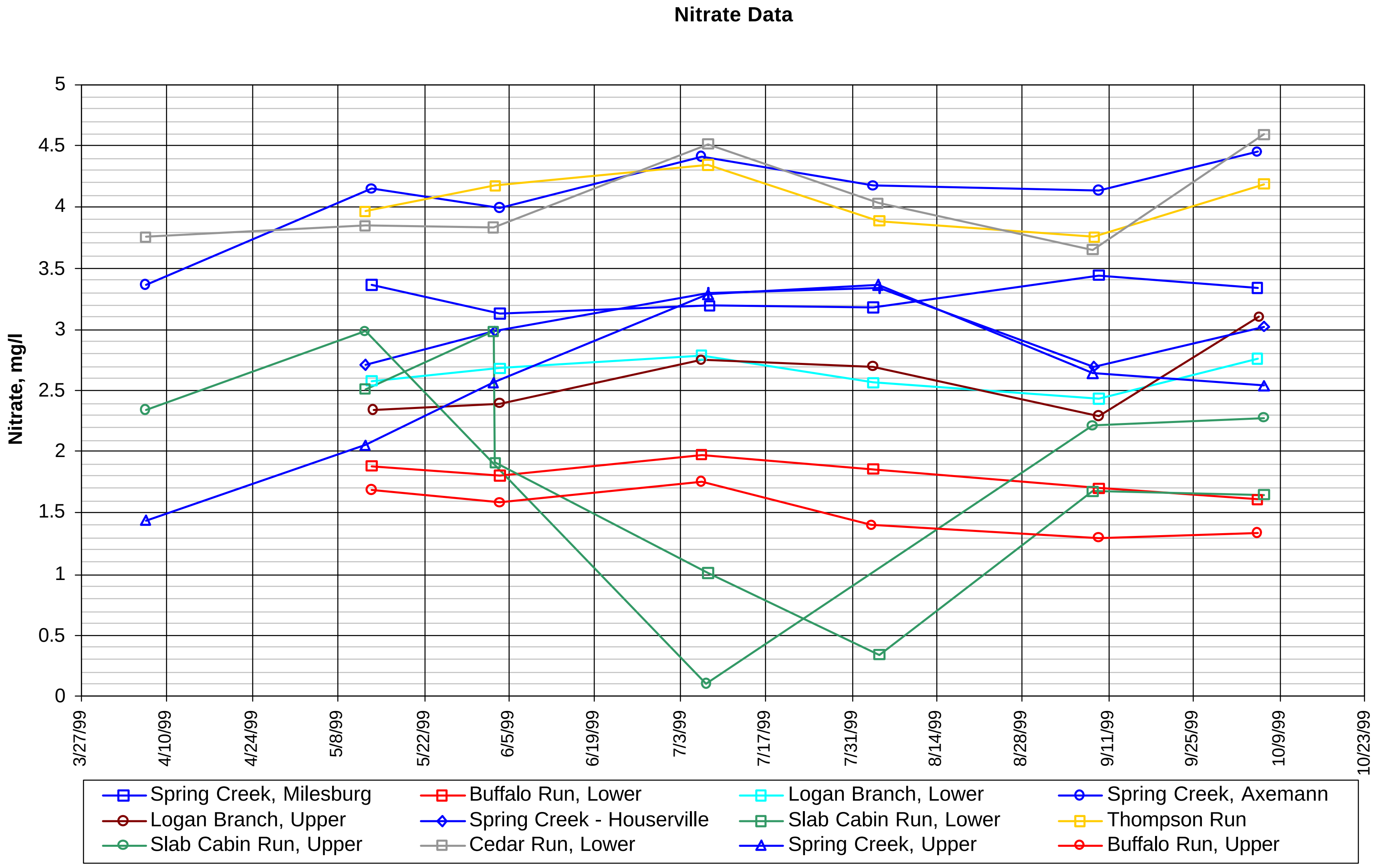


FIGURE 7. NITRATE-NITROGEN VERSUS TIME

5.0 OBSERVATIONS

5.1 CONSTITUENT LOADING

Loading values help us to interpret the sources of various constituents. Loading is the measure of the actual amount in pounds or kilograms of a particular constituent that is delivered over time through the stream channel. For each station, Spring Creek at Houserville (SPH), Spring Creek at Axemann (SPA), and Spring Creek at Milesburg (SPM), the total load of nitrates and chlorides were calculated for those locations. These totals were compiled from data for specific sampling dates in July and December of 1999. The average daily flow in cubic feet per second (cfs) was obtained for the three U. S. Geological Survey gaging stations. These flows were converted to million gallons per day and multiplied by the concentration of the constituent (i.e. nitrate and chloride) to give the loading (in units of mass over time) of that specific constituent. When the rating curves are developed for each station, this type of evaluation can be made for each sub-basin, for each monitoring site location, and for each measured parameter.

July 1999			**Nitrate Loading, lbs/day**	**Chloride Loading, lbs/day**
Station	Flow, cubic feet/sec	Flow, million gal/day		
SPH (Spring Creek; Houserville)	23	14.86	409	4,090
SPA (Spring Creek; Axemann)	42	27.14	998	9,510
SPM (Spring Creek; Milesburg)	142	91.77	2,440	23,000

FIGURE 8. LOADING CALCULATIONS, JULY 1999

December 1999			**Nitrate Loading, lbs/day**	**Chloride Loading, lbs/day**
Station	Flow, cubic feet/sec	Flow, million gal/day		
SPH (Spring Creek; Houserville)	45	29.1	655	6,070
SPA (Spring Creek; Axemann)	81	52.3	1,630	14,900
SPM (Spring Creek; Milesburg)	193	125	3,300	23,900

FIGURE 9. LOADING CALCULATIONS, DECEMBER 1999

5.2 MEAN DAILY STREAM FLOWS

Gaging Station	1999 Mean daily flow (cfs)	Average for 1985-1998 Mean daily flow (cfs)	Deviation from 1985-1998 average
Houserville	42.4	71	-40.3%
Spring Cr. Rd. (Axemann)	64.5	103	-37.4%
Milesburg	183.5	233	-21.2%

FIGURE 10. STREAM FLOW SUMMARY

Figure 10 shows the dramatic effect of the drought during 1999 on stream flows at three locations. At the Milesburg station, which represents the entire stream flow from the watershed, stream flow was 21% below the average for 1985-1998. Farther upstream flow reductions were even greater. At the Axemann station along Spring Creek Road, stream flows were 37% below the average and at Houserville flows were 40% below average.

The Spring Creek watershed is unusual in that 86% of its total annual stream flow was ground water before entering the stream channel, and because the actual watershed area is 20% larger than the surface-water watershed area due to ground-water inflows. When ground water recharge is lower than usual due to a drought, the stream flows are also reduced because there is significantly less ground water discharging into the streams and becoming stream flow. Both the water levels in wells and the stream flows are below normal, and hence we will need to receive significantly more rainfall than normal over the next few months to recharge the ground water and return our stream flows to normal.

5.3 STREAMFLOW AND GROUNDWATER OBSERVATIONS

Figure 11 shows the relationship between local stream flow and the groundwater level at a point in the upper Spring Creek Basin (Todd Giddings and Associates, Inc. monitoring well; located in the Cato Industrial Park).

Although the rainfall in 1999 was slightly above normal, it made only a modest contribution to the ground water early in the year. The substantial amount of precipitation in January 1999 recharged ground water as indicated by an approximately 10-foot rise in water at the Giddings well. The groundwater level began a continuous decline until late October when a small recharge was evident. By the end of 1999 the water level in the Giddings well was approximately 12 feet below the level at the beginning of the year. These data indicate that although rainfall in 1999 was slightly above normal, the ground water reservoir declined. This decline in ground water storage may suggest that stream flows in 2000 may be less than average unless rainfall is substantially greater than normal.

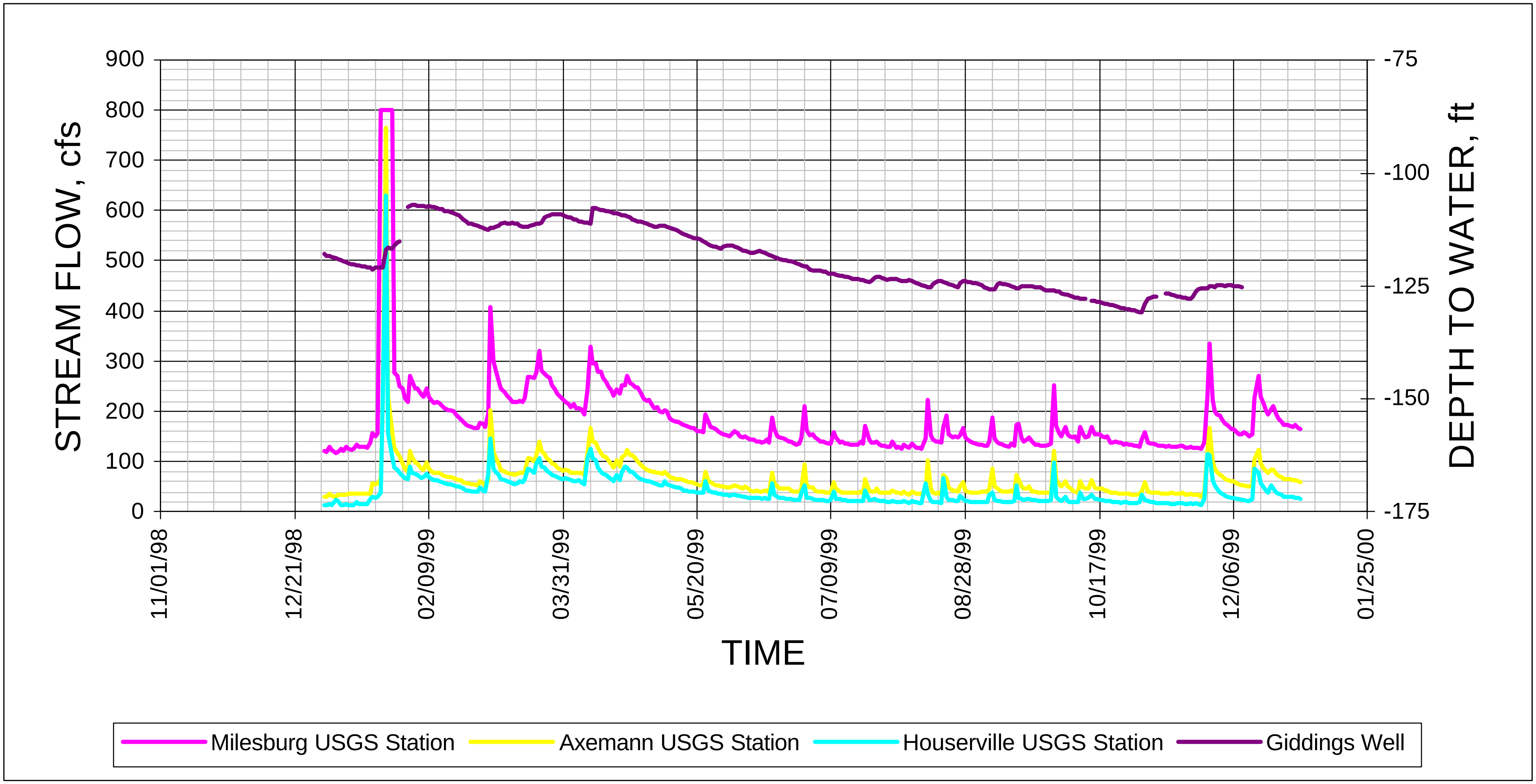


FIGURE 11. STREAM FLOW AND GROUNDWATER LEVEL VERSUS TIME

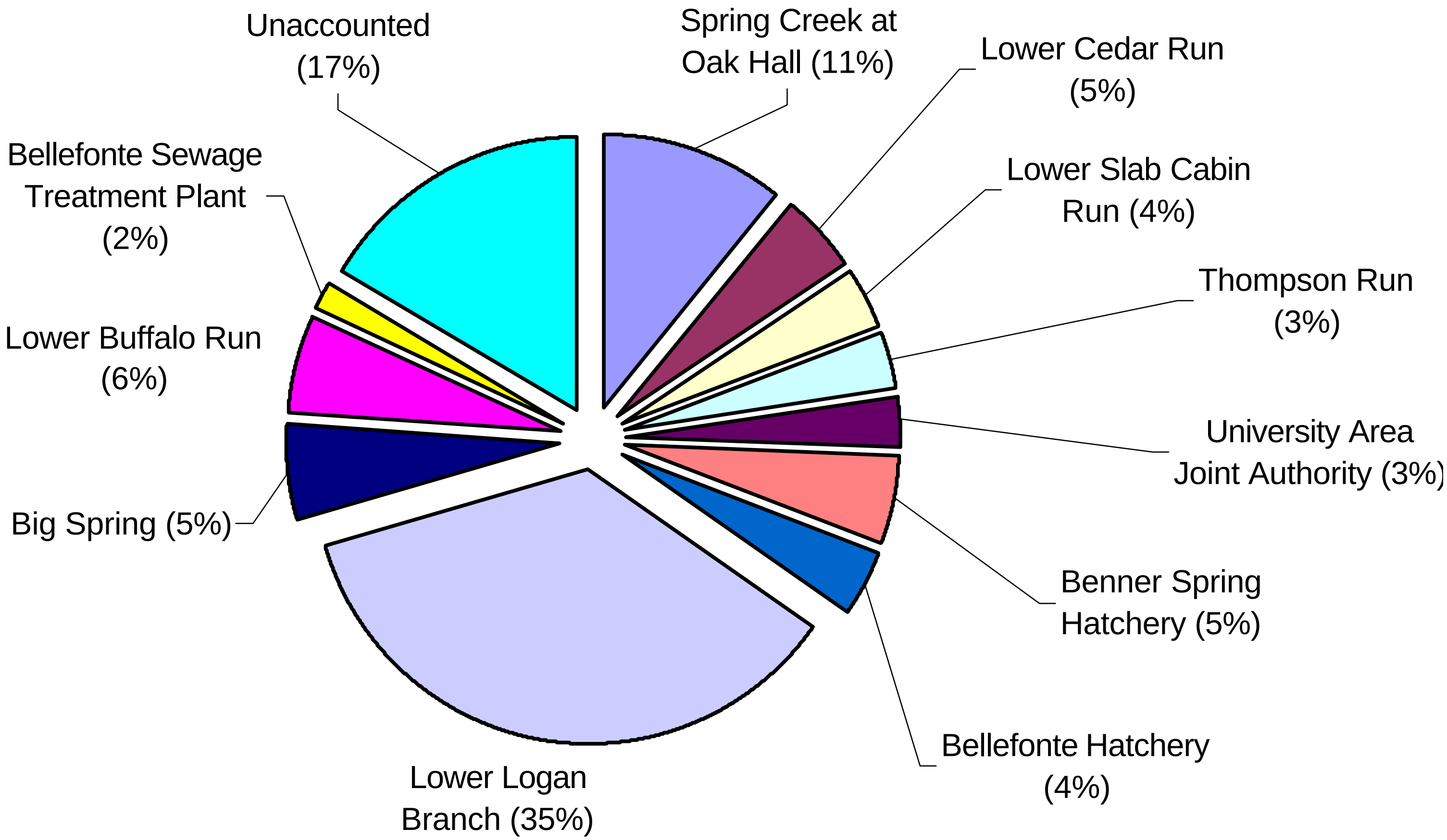


FIGURE 12. FLOW INPUTS TO SPRING CREEK; DECEMBER 16, 1999

5.4 FLOW INPUTS TO SPRING CREEK

The data illustrated in Figure 12 were collected on December 16, 1999 to compare the relative contributions of tributaries and other point sources to the total stream flow in Spring Creek, as represented by the flow at the Milesburg gaging station. The four tributaries in the upper part of the watershed, Spring Creek at Oak Hall, Cedar Run, Slab Cabin Run, and Thompson Run, contributed 22% of the total flow, with the upper Spring Creek sub-basin contributing the most. The next major downstream inputs were the University Area Joint Authority treatment plant (3.0% of the total), the Benner Spring fish hatchery (5.3%), and the Bellefonte fish hatchery (3.9%), which is often referred to as the Fisherman's Paradise hatchery. The next major source was Logan Branch, which is the largest single contributing source to the stream (35.8%). Then Big Spring contributed 5.4%, Buffalo Run 5.9%, and finally the Bellefonte wastewater treatment plant could not be attributed to a point source. Presumably, this water represents the collective contributions of many small springs along Spring Creek.

5.5 PRECIPITATION OBSERVATIONS

	1993	1994	1995	1996	1997	1998	1999	Avg.
Jan	2.4	4.84	3.25	6.56	1.73	3.99	5.31	2.44
Feb	2.6	3.78	1.73	2.04	1.87	4.27	1.42	2.56
March	7.11	6.81	1.29	3.71	3.62	3.32	4.64	3.15
April	7.75	3.84	2.27	2.83	0.96	7.55	3.56	2.91
May	2.19	2.81	3.57	4.1	4.36	3.57	2.7	3.63
June	1.75	3.33	4.16	7.02	2.73	3.96	3.57	4.03
July	2.98	4.75	1.61	5.72	2.31	2.75	2.71	3.63
August	2.84	7.14	0.98	3.18	6.5	3.29	3.87	3.17
Sept	5.18	2.89	1.57	11.03	4.38	1.36	5.37	3.22
Oct	2.74	0.71	6.58	4.74	0.54	2.71	1.37	2.82
Nov	4.78	4.89	3.69	2.76	7.19	0.8	3.17	3.24
Dec	2.18	2.46	2.06	5.55	2.4	0.98	2.08	2.7
Totals	44.5	48.25	32.76	59.24	38.59	38.55	39.77	37.48

FIGURE 13. STATE COLLEGE, PA RAINFALL (inches)

Figure 13 shows the precipitation for the past seven years as related to the average precipitation shown in the last column. Although the rainfall for 1999 was above average it does not take into account that the year 1999 started out with a ground water recharge deficit. It is also important to consider what months received the largest amount of rainfall. In 1999, most of the rainfall occurred from March through September when the rates of evaporation and plant transpiration are the highest. Evaporation and transpiration can have significant effects on the amount of water available that reaches the ground water. Transpiration is the process by which plant roots draw in soil moisture and pump it out to the atmosphere through their leaves. Evapotranspiration is the loss of water from soil through both evaporation and transpiration together.

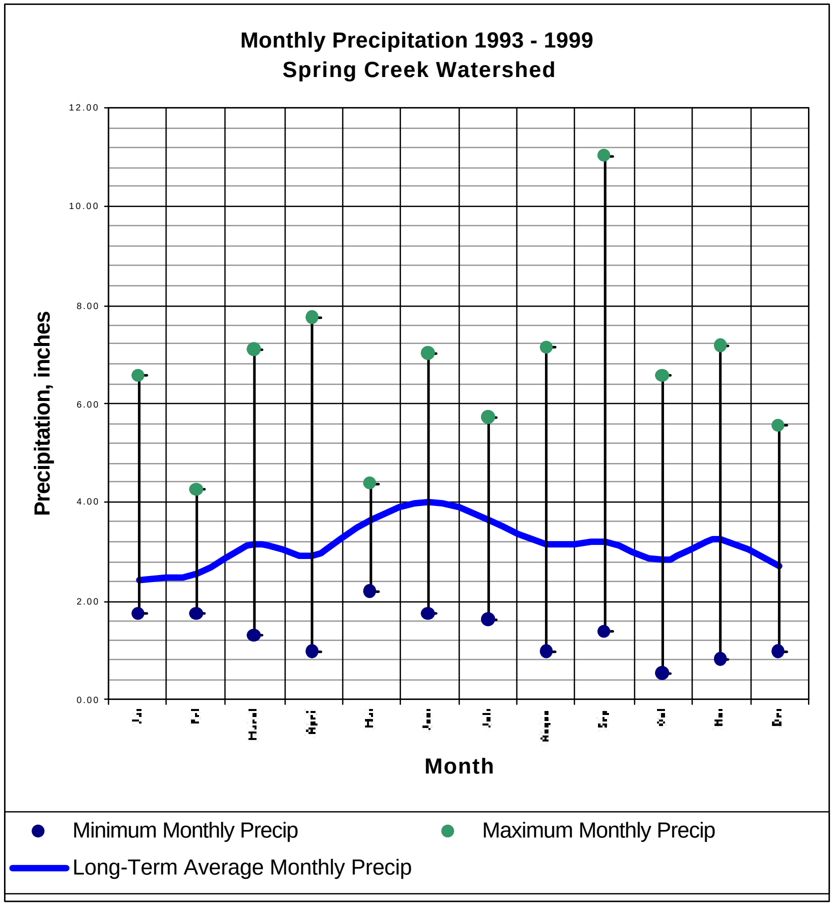


FIGURE 14. MONTHLY PRECIPITATION AMOUNTS (1993 – 1999) AND LONG-TERM AVERAGE PRECIPITATION

Evapotranspiration has a major impact on the amount of precipitation that remains available for use as a water resource, because the water is returned to the atmosphere and cannot be used as recharge. The most critical time to receive precipitation is from November through February when the ground water supply can be replenished.

Figure 14 graphically presents the range of precipitation that is tabulated in Figure 13.

6.0 PLANS FOR THE YEAR 2000

The goals for the year 2000 for the Water Resources Monitoring Project, as established by the Water Resources Monitoring Committee are as follows:

- Continue monthly sampling and laboratory analysis of surface water from all 12 monitoring stations. Continue collecting flow and temperature data from the 12 stations.
- Complete design and development of the monitoring database by October 2000.
- Develop rating curves for all twelve monitoring stations, dependent on the availability of high flow events to capture steam measurement readings at each monitoring site. (completed by Fall 2000)
- Pending a grant request to DEP under the Growing Greener grants, initiate storm event sampling to characterize the watershed response to storm events.
- Also pending the grant request to DEP, compile geomorphic classification data on eight sites within the monitoring network (to include all the tributary sites).

Attachments

Downloading stream level data at the Lower Buffalo Run Station. Stream stage data will be used to compile a continuous record of stream flow.

Collecting water quality samples

Measuring dissolved oxygen

"Ryan Instruments" submersible temperature monitor

Downloading stream temperature data.

Typical station instrumentation and setup (Slab Cabin Run Station)

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