

SOURCE WATER ASSESSMENT PROGRAM REPORT

Carlisle Borough Municipal Authority

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (USEPA) established a new requirement under Section 1453 of the 1996 Safe Drinking Water Act. The Act requires each state to develop a Source Water Assessment Program (SWAP) to evaluate the drinking water sources that serve public water systems. The Carlisle Borough Municipal Authority (CBMA) operates a drinking water intake on the Conodoguinet Creek. This SWAP report: (1) delineates the critical area for the surface-water source; (2) provides an inventory of existing and potential sources of regulated and some unregulated contaminants in the assessment area; and (3) determines the susceptibility of the public water source to contamination. The information in this SWAP report is to be used as a basis for building voluntary, community-based barriers to drinking water contamination.

The methods used for the assessment are outlined in the Pennsylvania Department of Environmental Protection's (Pa. DEP) approved SWAP Program Plan, approved by USEPA in March 2000. Based on proximity to the stream and surface water intake, two zones were delineated for the assessment. Zone A represents a 0.25-mile buffer on either side of the stream within a 5-hour time of travel (TOT). Zone B represents a 2-mile buffer on either side of the stream within a 25-hour TOT. The data analysis concentrated on these two zones, and was limited to pre-existing data. Most of the analyses utilized state and federal Geographic Information Systems (GIS) databases.

The primary contaminant issues in the Conodoguinet Creek Watershed are associated with agricultural activities. Excessive nutrients and sediment from runoff have caused water-quality impairments in the Conodoguinet Creek and many of its tributaries. Urban runoff also has led to contaminant problems in the watershed. To a lesser degree, petroleum and metals have been a documented water quality problem.

There are several efforts within the watershed being led by local government and citizen groups to address these problems. The use of Best Management Practices (BMP) both in agricultural and urban areas could greatly reduce runoff. Riparian buffers and streambank stabilization measures could filter contaminants and impede sediment runoff in problem areas. Increased education about protecting drinking water sources would also enhance public support for SWAP activities.

1.0 INTRODUCTION

The intent of Congress in requiring source water assessments of raw water quality was to inform the water suppliers, municipalities, and the public of the threats to public drinking water, and to generate support for the voluntary development of local source water protection plans. The SWAP program expands on Pennsylvania's Wellhead Protection Program (WHPP), extending protection to all public drinking water supplies under the Safe Drinking Water Program.

Upon completion of the assessments, public meetings are held to discuss the results and recommendations. The assessments also identify ways to develop and enhance local source water protection plans. Copies of the assessment reports can be obtained from the Pa. DEP, Bureau of Water Supply Management.

1.1. New Requirements under the Safe Drinking Water Act

The USEPA established a new requirement under Section 1453 of the 1996 Safe Drinking Water Act. The Act requires each state to develop a SWAP to evaluate the drinking water sources that serve public water systems. The SWAP report will: (1) delineate wellhead protection areas for ground-water sources and critical areas for surface-water sources; (2) provide an inventory of existing and potential sources of regulated and some unregulated contaminants in these areas; and (3) determine the susceptibility of the public water sources to contamination. The information in the SWAP report is to be used as a basis for building voluntary, community-based barriers to drinking water contamination.

Pennsylvania submitted its SWAP document to the USEPA for approval on June 17, 1999. The USEPA approved Pennsylvania's SWAP Plan in March 2000.

To avoid duplication of effort and increase efficiency, Congress urged the states to make use of existing state WHPP's. Pennsylvania's WHPP was submitted to the USEPA in March 1999 and serves as the cornerstone of the SWAP.

Information is obtained primarily from existing data, including GIS datasets, as well as information gathered from meetings with water suppliers, local officials, and the public. The procedures for performing these tasks are identified in Pennsylvania's SWAP document. Pennsylvania expects to complete all source water assessments by 2003.

2.0 THE DRINKING WATER SYSTEM AND THE WATERSHED

2.1. The Drinking Water System

The Carlisle Borough Municipal Authority (CBMA) office is located in Carlisle, Cumberland County, Pennsylvania. The treatment plant serves a population of approximately 20,000 residents of the Carlisle area. The CBMA withdraws water from the Conodoguinet Creek (Figure 1).

The CBMA purchased the water system in 1931 to handle the increasing water resource needs of the Carlisle area. The water treatment facility was most recently upgraded in 1995. The rehabilitation project increased the plant capacity to 7 million gallons per day (mgd).

The CBMA intake is located within a headrace that diverts water to the plant from the Conodoguinet Creek. Water is pumped from the headrace into the plant. The average daily withdrawal from Conodoguinet Creek is approximately 3.8 million gallons.

The raw water first passes through a screen on the raw water intake to prevent larger items from entering the system. The raw water is then treated with potassium permanganate and activated carbon to improve taste and odor, as well as remove any organic material. Alum and polymer are then used as coagulants to bind smaller particulate matter together. After moving through the coagulation and flocculation process, the particulates are later removed in sedimentation basins. Following filtration, the water is then sent to a clearwell for distribution to the finished water system.

2.2. Watershed Protection Area

Conodoguinet Creek Watershed is located in Cumberland and Franklin Counties, south-central Pennsylvania (Figure 1). The size of the watershed is approximately 506 square miles. The designated uses for the watershed are water supply, recreation, and aquatic life. The aquatic life uses for the mainstem are predominantly warm water fishes. From the headwaters region to Trout Run, located just downstream of Letterkenny Reservoir, the mainstem is designated cold water fishes. The remaining tributaries to the Conodoguinet are designated a mix of cold water fishes, warm water fishes, trout stocking, high-quality waters, and exceptional value waters.

The watershed area assessed for the CBMA includes over half of Cumberland County and a portion of Adams County. A list of townships and boroughs located within the assessment area can be found in Table 1.

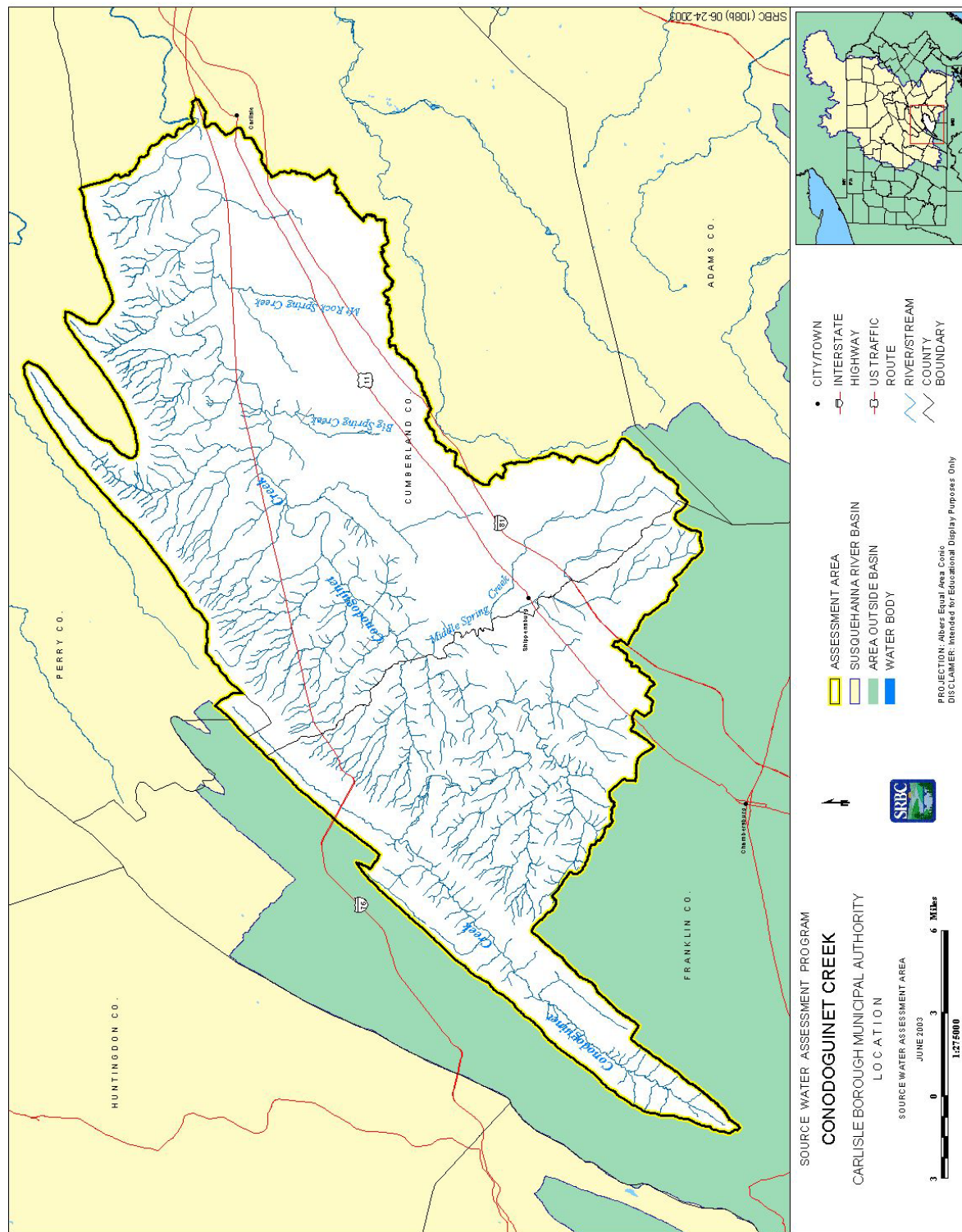


Figure 1. Location Map for the CBMA Intake

Table 1. List of municipalities located within CBMA Assessment Area of the Conodoguinet Creek Watershed

Municipality	County
Lower Mifflin Township	Cumberland
Upper Mifflin Township	Cumberland
Lower Frankford Township	Cumberland
Upper Frankford Township	Cumberland
North Middleton Township	Cumberland
West Pennsboro Township	Cumberland
Carlisle Borough	Cumberland
Hopewell Township	Cumberland
South Middleton Township	Cumberland
North Newton Township	Cumberland
Dickinson Township	Cumberland
Newville Borough	Cumberland
Penn Township	Cumberland
Newburg Township	Cumberland
Southampton	Cumberland
South Newton	Cumberland
Shippensburg Township	Cumberland
Shippensburg Borough	Cumberland
Fannett Township	Franklin
Lurgan Township	Franklin
Metal Township	Franklin
Letterkenny Township	Franklin
Southampton Township	Franklin
Orrstown Borough	Franklin
Greene Township	Franklin
Hamilton Township	Franklin
St. Thomas	Franklin
Peters Township	Franklin
Tyrone Township	Perry
Toboyne Township	Perry
Southwest Madison	Perry
Jackson Township	Perry
Spring Township	Perry

The stream originates in Horse Valley along the Kittatinny Mountain in Franklin County. From there, the Conodoguinet Creek flows approximately 90 miles to the CBMA Intake outside of Carlisle. The Conodoguinet Creek flows into the Susquehanna River at West Fairview. The watershed is predominantly rural, although development has increased in areas surrounding Carlisle and Shippensburg.

2.3. Geology

The Conodoguinet Creek Watershed lies within the Great Valley Section of the Ridge and Valley Province (Figure 2). It is composed of 64 percent carbonate, 26 percent sandstone, and 10 percent igneous/metamorphic rock (Berg, 1980).

The sandstone and shale ridges are located almost exclusively along the northern boundary of the watershed. Most of the streams draining into the Conodoguinet from the north originate from these lithologies. The carbonate rocks, predominantly limestone and dolomite, are located along the valley floor. A majority of the tributaries entering the Conodoguinet Creek from the south flow through this type of geologic terrain. The igneous/metamorphic rock found in the watershed is located on South Mountain, mostly within the Gum Run Watershed.

Geology can play a significant role in influencing water quality within a watershed. Substances in ground water can be removed through several different processes, including precipitation, biodegradation, and sorption onto mineral grains or organic carbon. As a result, some contaminants will move slowly through the ground. In general, depending on the type of contaminant, the slower the travel time, the more likely the contaminant is to naturally degrade (Fetter, 1992).

The movement of ground water in bedrock is controlled largely by two factors, porosity and permeability. Porosity represents the amount of void space in rock material, while permeability represents the interconnectedness of that void space. Two geologic processes, weathering and fracturing, increase overall porosity and permeability. Igneous and metamorphic rocks typically have low porosity and permeability, resulting in longer travel times for ground water. Ground-water flow through sedimentary rock depends on the type and location of the rock formation. Water can generally flow with greater ease through limestone than through sandstone and shale. Ground-water flow in carbonate rock, commonly referred to as karst terrain, may be fairly rapid because cavities and fractures, caused by dissolution, serve as conduits for flow. Sandstone and some metamorphic rock also can be fracture influenced in areas of Pennsylvania specifically parallel and perpendicular to the ridge lines. Any contaminants flushed into these cavities or fractures by runoff or streamflow could pose a potential threat to a drinking water source.

2.4. Topography

The Conodoguinet Creek Watershed is bounded to the north and the south by Blue Mountain and South Mountain, respectively. Blue Mountain ranges in elevations up to approximately 1,600 feet. The lower elevations in the watershed are near the confluence with the Susquehanna River. The elevation at the confluence is approximately 300 feet. Average yearly precipitation for the watershed is approximately 38 inches.

2.5. Soils

Soils located along the sandstone ridges are predominantly of the Hazleton-Dekalb-Buchanan series. This soil association is predominantly moderately deep and well drained, with low moisture availability. It is primarily suited for woodlands. Soils in the Great Valley section are predominantly the Berks-Weikert-Bedington and Hagerstown-Duffield-Clarksburg series.

Berks-Weikert-Bedington soils form from weathered shale and sandstone. The soils tend to be well drained, but with a low to moderate available water capacity. Land uses associated with this soil series are cropland, pasture, and woodland. The Hagerstown-Duffield-Clarksburg soil series formed from limestone rock. These soils are also well drained. Due to their occurrence in karst terrain, these soils are susceptible to ground water contamination.

The Murrill-Buchanan-Laidig series, located along the base of South Mountain, was formed from colluvial material (mix of conglomerate, sandstone, limestone, and quartzite). These soils are typically well drained, though some areas may have a seasonal high water table.

The other two soil series, the Chenago-Pope-Holly and the Athol-Penlaw-Dunning, make up a small portion of the watershed. The Chenago-Pope-Holly series is primarily fluvial soils, while the Athol-Penlaw-Dunning series is associated with soils derived from fault breccias.

Soil units mapped in the watershed trend northeast-southwest. These trends generally mimic the underlying geology. The more erosion resistant soils are found on the sandstone/shale ridges on Blue Mountain. Soil erodibility increases in the Great Valley carbonate section

The K factor is the erodibility of soil under normal conditions and is a factor in the Revised Universal Soil Loss Equation (RUSLE). RUSLE estimates soil erosion due to rainfall and overland runoff. The K factor is impacted by soil properties such as texture, organic matter, structure, and permeability. Soil detachability, infiltration and runoff rates, and eroded sediment transportability determine the K factor. Generally, clay and sandy soils have a low K factor. Clay soils have a low K factor because clay particles are tightly held together and resist detachment. Sandy soils also have a low K factor because of high infiltration rates and their particle size does not allow for easy transport of sediment. Silt soils have the highest K factor given that the particles are easily detached and transported. These soils also have a tendency to crust, which leads to high runoff rates (USDA, 2003).

The permeability and erodibility of the soil coverage impact the rate at which potential contaminants can spread through the watershed. Highly permeable soils transmit fluid with greater ease, while erodible soils increase overland runoff. Runoff ranges vary between soil types, and are often dependent on slope. Soil erosion is an important factor when considering land use practices and their effects on sediment and pollutant transport in streams. Increased soil erosion in agricultural areas can carry contaminants, such as pesticides and fertilizers, to the stream.

The Hazelton-Dekalb-Buchanan soil association is a sandy loam texture with a rapid permeability rate. These soil properties establish a low K factor value for the assessment area. The Berk-Weikert-Bedington soil association is a silt loam creating a medium K factor value. The Hagerstown-Duffield-Clarksburg series is a silt loam underlain by clay which creates a medium K factor value.

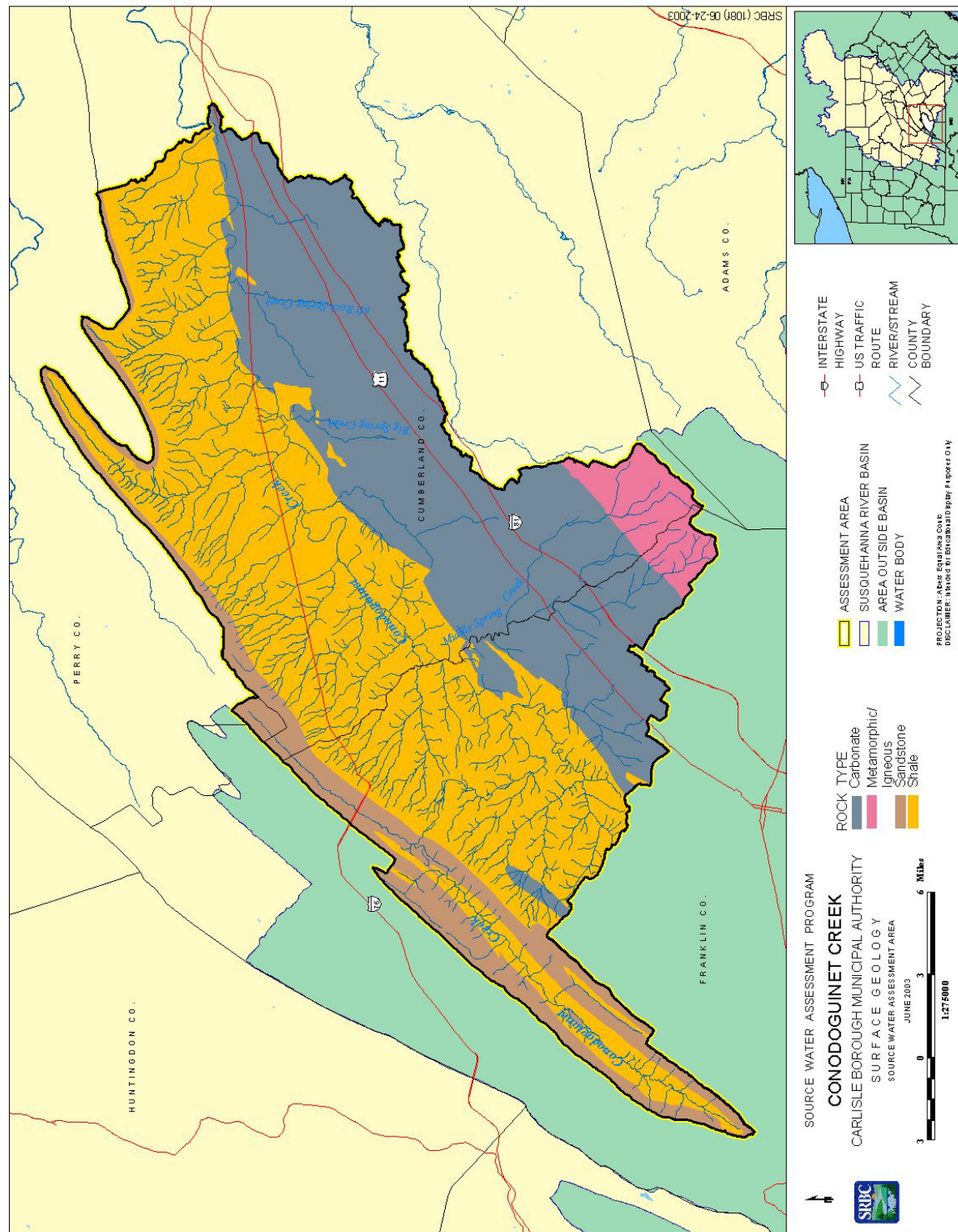


Figure 2. Surface Geology for the CBMA Assessment Area

2.6. Land Use

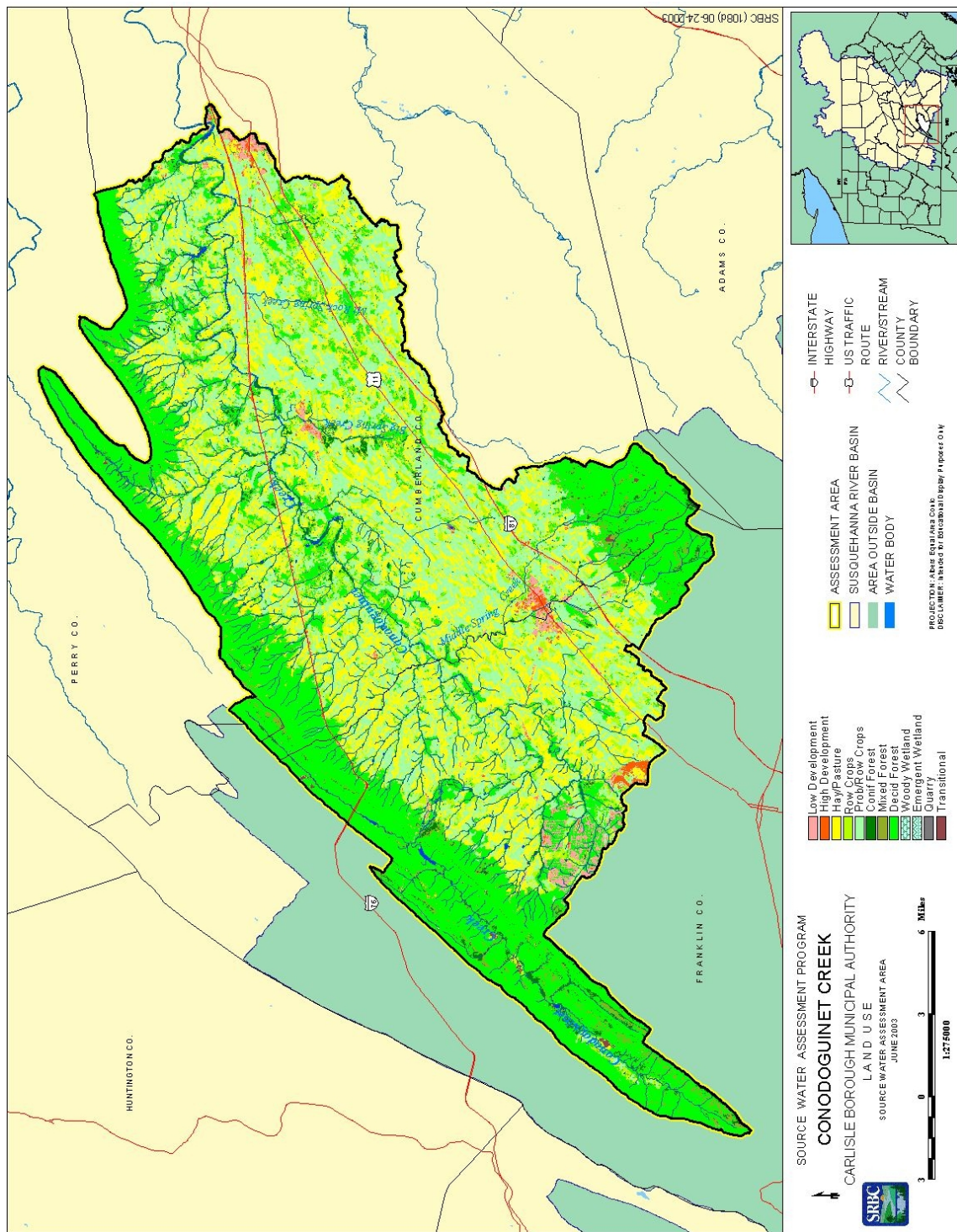
Based on Pennsylvania GIS datasets from the early to mid-1990's, land use values were calculated for each assessment area (Figure 3). Generalized land use in the Conodoguinet Creek Watershed is shown in Table 2. Agriculture represents the primary land use in the watershed (62 percent), consisting of a mix of cropland and pasture. However, development throughout the watershed has been increasing as agricultural lands are converted to residential developments, especially within the assessment area surrounding Carlisle and Shippensburg. Developed lands account for approximately 6 percent of the land area. However, urban runoff has been identified as being a significant problem. The forested portion of the watershed is approximately 31 percent. Most of the forested land is located in the headwaters portion of the watershed, and along the sandstone ridges to the north.

Table 2. General Land Uses in the Conodoguinet Creek Watershed

Classes	Percent of Total	Acres	Square Miles
Developed	5	16,200	25
Agriculture	62	199,000	311
Forested	33	106,000	166
Water	<1	2,600	4
Total	100	324,000	506

Land use can have a significant influence on water-quality conditions within a watershed. Runoff from agricultural lands has the potential to contribute significant amounts of fertilizers, pesticides, and sediment to a stream without the implementation of proper nutrient management plans or BMPs. Runoff from impervious surfaces in developed areas can also contribute a host of contaminants.

Forested lands tend to reduce contaminant transport merely due to the reduced amount of precipitation runoff. Habitat provided from trees also helps to enhance the biological community.



2.7. Raw Water Quality

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be “fishable” and “swimmable.”

The Conodoguinet Creek, as mentioned before, has numerous designations in the Chapter 93 Water Quality Standards from its source to the mouth. Several water-quality surveys have been conducted within the watershed during the past ten years. The U.S. Geological Survey (USGS) conducted a synoptic study in 1994 to assess nutrient and pesticide occurrence in several tributaries. Pa. DEP recently assessed the entire watershed in 1997, using its Unassessed Waters Protocol. Both surveys indicated that agricultural practices were influencing water quality. In addition, area water suppliers have been regularly monitoring a variety of water quality parameters for raw water collected at the intakes.

A USGS synoptic survey in 1994 showed the occurrence of pesticides and elevated nutrient concentrations in Burd Run, Middle Spring Run, Big Spring Creek, Letort Spring Run, and Trindle Spring Run. The synoptic study was conducted during dry weather conditions; nutrient and pesticide transport is typically greater during storm events.

Pa. DEP conducted an assessment of the Conodoguinet Creek Watershed during the summer of 1997. The assessment method is a modification of the USEPA Rapid Bioassessment Protocol II (RBP-II). It requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, and dissolved oxygen. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state’s Section 303(d) list with the documented source and cause.

The biological surveys indicated a number of impairments within the watershed. The causes included excessive amounts of sediment/nutrients, organic enrichment, flow/habitat alterations, low dissolved oxygen (DO), and in some cases, excessive amounts of pesticides and priority organics. Agricultural land use in the watershed is the predominant source for the violations of the aquatic life use. Other sources include construction, urban runoff, and land disposal. The list of impaired waters can be found in the appendix.

In addition to the CBMA’s data collection efforts, two water suppliers in the vicinity have monitored raw-water quality. All three datasets indicate turbidity and bacteria to be a problem

during the spring manure application period and storm events. Additionally, organic material is a problem during the fall because of leaves.

Disinfection of drinking water is one of the major public health advances in the 20th century. In the past, typhoid and cholera epidemics were common throughout the United States. Disinfection was the major reason for the reduction in these epidemics, and it is an essential part of drinking water treatment today. However, while disinfectants are effective in controlling many microorganisms, chlorine compound disinfectants react with natural organic and inorganic matter in source water and distribution systems to form potentially harmful disinfection byproducts (DBPs). Many of these DBPs have been shown to cause cancer and reproductive and developmental effects in laboratory animals.

Chlorine can combine with natural organic or inorganic materials in raw water to create DBPs such as trihalomethanes (THMs) and haloacetic acids. THMs are known to cause liver, kidney, or central nervous system problems in animals used for testing. Repeated exposure to elevated levels of THMs or haloacetic acids over a long period of time could increase a person's risk of cancer.

The formation of DBPs is a concern for CBWA, based on the nature of the source. Surface water sources are more likely to contain the organic materials that combine with chlorine to form DBPs. Low-flow conditions, particularly in the summer months, can increase the likelihood of DBP formation.

3.0 PUBLIC PARTICIPATION

Involvement of the local officials and community is an important aspect of the SWAP process. A public kick-off meeting was held on Monday, January 22, 2000, to discuss local concerns regarding drinking water quality. Approximately 25 individuals attended representing citizen, municipal, regional, and state interests. Public input from the meeting assisted with the scope and direction of this assessment.

Several entities that assisted with collection of the information presented in this report are the Carlisle Borough Municipal Authority, Carlisle Suburban Authority, PA American Water Company, Conodoguinet Creek Watershed Association, U.S. Geological Survey, Cumberland County Conservation District, and Pa. DEP.

4.0 METHODOLOGY

The SWAP reports are required by the USEPA to address three major components. The assessment must include: (1) a delineation of the source water protection area; (2) a contaminant inventory; and (3) a susceptibility analysis.

The SWAP process also follows USEPA guidelines concerning the use of pre-existing data. No water-quality monitoring was performed for this assessment.

Public participation and public access of completed source water assessments are critical components of each assessment. Kick-off meetings and final public meetings allow for public and water supplier input for each assessment.

4.1. Delineation of Source Water Protection Area

The United States Geological Survey, in cooperation with the Pa. DEP, delineated the boundaries for the 5- and 25-hour travel times of public surface water supply intakes on Pennsylvania streams. These delineated boundaries are based on stream velocities during periods of high flow. Watersheds greater than 100 square miles, with surface water sources, are delineated into three zones. Zone A is a 0.25-mile wide buffer on both sides of the stream, extending 0.25-mile downstream of the intake, to a 5-hour TOT upstream. The 5-hour TOT is an area within the watershed where runoff will take 5 hours or less to reach the intake. Zone B is a 2-mile wide buffer on both sides of the stream extending to a 25-hour TOT upstream. The 25-hour TOT is an area within the watershed where runoff takes 25 hours or less to reach the intake. Zone C includes the remainder of the watershed (Reed and Stuckey, 2001). The CBMA assessment area is encompassed entirely within Zones A and B.

Zone A is approximately 12 percent of the watershed area. The map in Figure 1 shows the zone delineations for Conodoguinet Creek. For this assessment, Zone C was not represented since the watershed size did not exceed a 25-hour TOT.

4.2. Contaminant Inventory

Contaminant source inventories included activities that use, store, transport, or dispose of potential contaminants. An area-wide inventory for both Zones A and B was completed using readily available databases and information obtained from federal, state, and local government, as well as citizen groups. In addition, input from the public meetings was included.

4.2.1. Current and Potential Sources of Water Quality Degradation

4.2.1.1. Point Sources

Point source pollutants generally refer to in-stream discharges that have an identifiable point. The federal or state government often permits these discharges. Examples of point sources include sewage treatment plants and industrial wastewater discharges. In addition to compiling an inventory of point source dischargers, this assessment compiled an inventory of facilities within the watershed that store chemicals that could potentially pose a water-quality threat.

Point sources were identified using GIS datasets provided by the USEPA and Pa. DEP. For determining current pollutant loadings in the Conodoguinet Creek Watershed, data were collected using National Pollutant Discharge Elimination System (NPDES) permits. The permits were reviewed and water quality violations were noted and included in the susceptibility analysis.

Within Zone B, there are 19 NPDES sites. These sites are a mix of sewage and industrial discharges. Three of the 19 sites are within Zone A. The discharge monitoring reports for each

of the NPDES permits were reviewed for the years 1999 and 2000. No violations of significant concern were documented.

Sites requiring permits for storing or using potentially hazardous materials were also included in the assessment. The datasets reviewed were Industrial Facilities Discharge (IFD) sites, Resource Conservation and Recovery Act (RCRA) sites, Toxic Release Inventory (TRI) sites, and the Superfund National Priority List sites (CERCLIS).

Within Zone B, there are 47 sites representing a variety of municipal and industrial facilities. These sites were included in the susceptibility analyses with respect to proximity to the stream and size of the facility. For example, gas stations were given less priority in the analyses than a petroleum storage facility or truck terminal based on the relative volume of material stored on site. The facilities are almost exclusively located within lands designated as “developed”.

The two most critical datasets used in the assessment were the NPDES and RCRA sites. The NPDES and RCRA databases give the most comprehensive view of pollutant discharges and storage facilities, respectively. The sites located within the most critical area, Zone A, are shown in Figure 4.

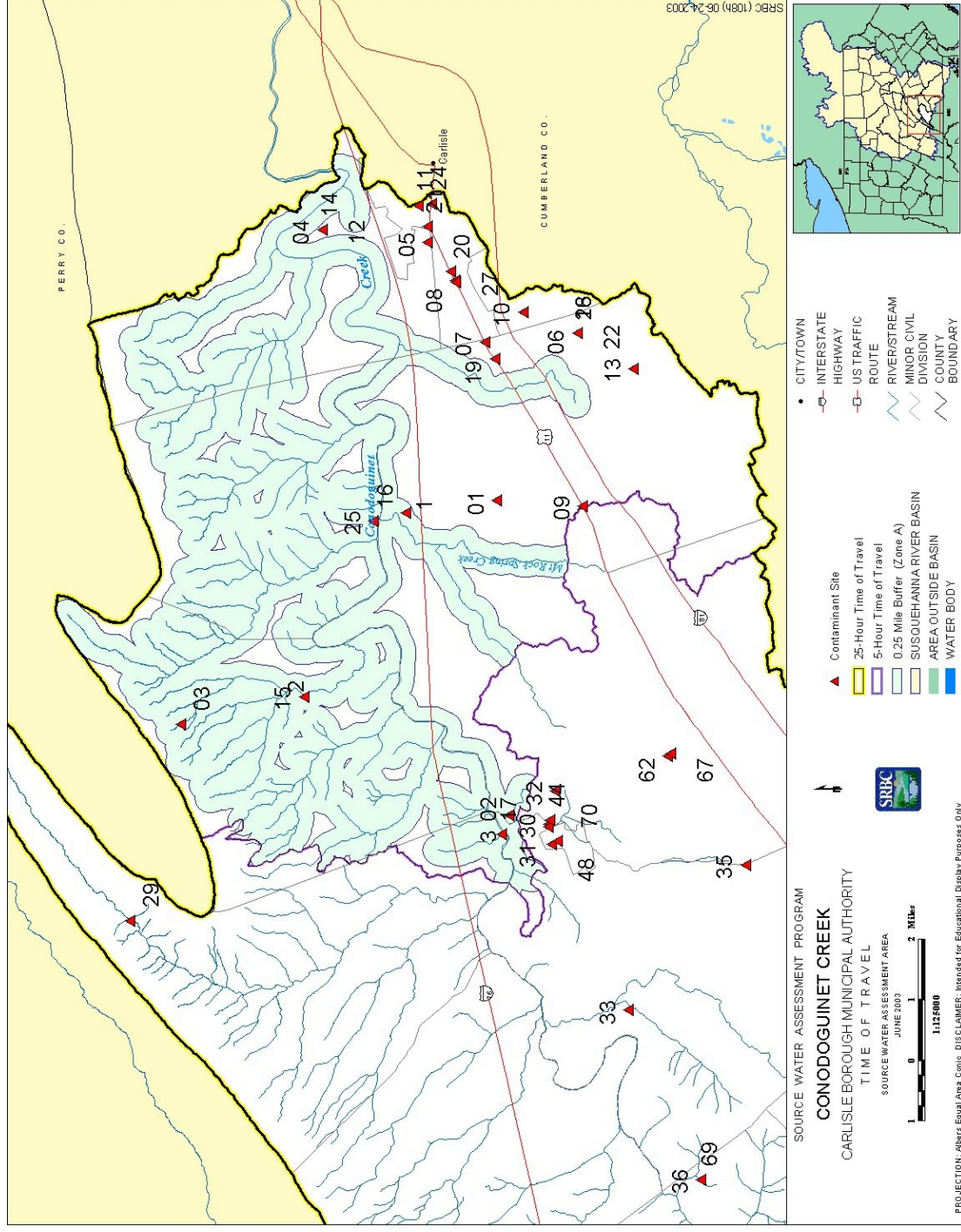


Figure 4. Zone A delineation for the CBMA Assessment Area

4.2.1.2. Nonpoint Sources

Nonpoint pollutants are pollutants that are unable to be tracked to a distinct discharge point. Examples of nonpoint pollutants include: leachate from on-lot septic systems; agricultural and road runoff; streambank erosion; and acid mine drainage.

As indicated earlier, the Conodoguinet Creek was listed as being impaired due to problems associated with nutrient loads and suspended sediments. Excessive nutrients may enter stream systems via runoff from a variety of sources including: crop and grazing related agricultural activities; animal feeding operations; unrestricted livestock access to streambanks; urban/stormwater runoff from impervious sources; golf courses; suburban lawn care; and leaching of private septic tanks. In stream systems, elevated nitrogen and phosphorus loads can lead to increased algal productivity (Novotny and Olem, 1994). As algal productivity increases, so does the demand for oxygen. As oxygen levels decrease to meet demand, fish and macroinvertebrate habitats become stressed, and may result in population decreases.

Siltation can also be an impairment to drinking water quality, as well as recreational use and fish habitat. The small particles clog waterways and decrease water clarity; deposit in pool areas, possibly smothering fish eggs; and can carry pesticides and microbial pathogens into streams. Although filtration of raw water for drinking purposes works to eliminate the health concerns chemical and microbiological contaminants pose, increased turbidity from siltation presents the need for increased treatment, and therefore increased cost. The major contributors of siltation are unmanaged crop and pasture fields, urban/stormwater runoff, runoff from animal feeding operations, and unmanaged construction.

As stated previously, the Conodoguinet Creek and several of its tributaries have been identified on Pennsylvania's 303(d) List of Impaired Waters (Appendix C). Several nonpoint sources have been identified as contributing to water-quality degradation. These sources include runoff from cropland, grazing-related agriculture, and urban/stormwater runoff. Some of the causes of water-quality degradation associated with these sources are excessive nutrients/pesticides, siltation, organic contaminants, and low dissolved oxygen.

4.2.2 Water Supply Contaminant Issues

Water suppliers in the Conodoguinet Creek Watershed had several water quality concerns. The primary concern is associated with agricultural and urban runoff. Storm events, especially during spring application periods, increase turbidity and bacteria levels.

4.3. Susceptibility Analysis

The potential for a public drinking water supply to draw contaminated water is determined by the susceptibility analysis. The susceptibility analysis utilizes a series of matrices that evaluate the time of travel, quantity, persistence and potential for release of the inventoried contaminants. The susceptibility rating is then used to rank protection priorities for the potential contaminant sources compiled in the inventory. The protection priority rankings are high for A-B, medium for C-D, and low for E-F. It is important to note that the goal of the assessments is to provide a summary of possible priority contaminants, and not to account for all sources of contamination.

For additional information, Pennsylvania's SWAP program document provides a detailed outline of the methods. The complete matrices for the CBMA assessment are shown in Appendix B.

Based on the susceptibility analysis for the CBMA Assessment Area, the protection status is shown in Table 3.

Table 3. Protection Priority Ranking for the Carlisle Borough Water Authority Assessment Area

Source of Contaminants	Protection Priority
Agriculture – crops	A
Agriculture - livestock	A
Urban runoff	A
Industrial discharges	B
Transportation Corridors	C
Sewage treatment facilities	C
Residential / Golf courses	C
On-Lot Septic	D
Petroleum storage tanks, gas/service stations	D
Landfills	E

5.0 DISTRIBUTION AND AVAILABILITY OF SOURCE WATER ASSESSMENTS

Copies of the final SWAP report will be available from Pa. DEP.

6.0 SUMMARY

The assessment identifies the primary contaminant issues to be associated with agricultural and urban runoff. Contaminant issues of less concern are industrial discharges, sewage related pollution, lawn chemicals, and landfills. The water supply also has water-quality problems from natural conditions, associated with leaves in the fall.

The Conodoguinet Creek Watershed is predominantly agricultural, with approximately 62 percent of the area associated with cropland or pasture. Within Zone A, agricultural lands increase to 68 percent. The need to address problems associated with this source is a priority. Two tributaries identified within Zone A as having water-quality impairments due to runoff from agriculture are Alexanders Spring Creek and Mount Rock Spring. A streambank stabilization project was recently completed on a reach within the Mount Rock Spring Watershed. In addition, both tributaries are identified as priorities for USEPA 319 funded projects.

Although a little more than 1 percent of the land area within Zone A is developed, urban runoff is fairly significant due to the concentration of flow during storm events. Runoff from residential lots, parking lots, and transportation corridors contributes pesticides/fertilizers, metals/petroleum

products, and road salts. As mentioned before, the only point sources located within Zone A are three small sewage treatment facilities with no documented permit violations of concern.

The remaining portion of the assessment area is predominantly agricultural. Problems associated with this area are linked mainly to agricultural practices, and are greatly outweighed by problems associated with other potential contaminant sources. Subwatersheds identified through the Total Maximum Daily Loads (TMDL) process have also been given priority for restoration activities within Zone B. These subwatersheds include Center Creek, Back Creek, Green Spring Creek, Bulls Head Branch, Newburgh Run, and Middle Spring Creek.

Protection efforts should continue to concentrate on dealing with problems associated with nonpoint runoff, both from agricultural and developed lands. For the most part, regulated discharges contribute little in comparison. Riparian buffers would greatly diminish nutrient runoff from agricultural fields, and help to filter contaminants flushed from developed areas. Streambank stabilization will also reduce siltation, resulting in decreased turbidity during storm events.

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8.0 APPENDICES

APPENDIX A. List of Acronyms

BMP	Best Management Practice
CCR	Consumer Confidence Report
CERCLIS	Superfund National Priority List Sites
CWF	Cold Water Fishes
D	Disinfectants
DEP	Pennsylvania Department of Environmental Protection
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information Systems
HM	Heavy Metals
IFD	Industrial Facilities Discharge
M	Metals
MGD	Million gallons per day
MP	Microbiological Pathogens
NN	Nitrate/Nitrite
NPDES	National Pollution Discharge Elimination System
PH	Petroleum Hydrocarbons
RCRIS	Resource Conservation and Recovery Information Systems
SDWA	Safe Drinking Water Act
SOC	Synthetic Organic Compound
SWAP	Source Water Assessment and Protection
T	Turbidity
TOT	Time of Travel
TRI	Toxic Release Inventory
TSS	Total Suspended Solids
VOC	Volatile Organic Compound
WHPP	State Wellhead Protection Program
WWF	Warm Water Fishes

APPENDIX B. Susceptibility Analyses for the Conodoguinet Assessment Area

Source of Contaminants	Contaminant	Matrix A (TOT vs. Persistence)	Matrix B (Matrix A vs. Quantity)	Matrix C (Contamination Potential vs. Sensitivity)	Potential for Release	Matrix D (Susceptibility Rating)
Livestock	MP	High	High	High	High	A
	SOC	High	High	High	Medium-High	B
	M	High	High	High	High	A
	NN	High	High	High	High	A
Crops	MP	High	High	High	High	A
	SOC	High	High	High	High	A
	NN	High	High	High	High	A
Urban Runoff	MP	High	High	High	High	A
	NN	High	High	High	High	A
	VOC	High	High	High	High	A
	HM, M	High	High	High	High	A
	SOC	High	High	High	High	A
	PH	High	High	High	High	A
	T	High	High	High	High	A
Industrial Discharges	VOC	High	High	High	Medium-High	B
	HM, M	High	High	High	Medium-High	B
	SOC	High	High	High	Medium-High	B
	PH	High	High	High	Medium-High	B
	T	High	High	High	Medium-High	B
Petroleum storage tanks, gas/service stations	VOC	High	High	High	Low	D
	HM, M	High	High	High	Low	D
	SOC	High	High	High	Low	D
	PH	High	High	High	Low	D
On-lot Septic	MP	High	Medium	Medium	Medium	D
	NN	High	Medium	Medium	Medium	D
Sewage Treatment Facilities	MP	High	Medium	Medium	Medium-High	C
	NN	High	Medium	Medium	Medium-High	C
	VOC	High	Medium	Medium	Medium-High	C
	SOC	High	Medium	Medium	Medium-High	C
	M	High	Medium	Medium	Medium-High	C
	D	High	Medium	Medium	Medium-High	C
Residential / Golf courses	VOC	High	High	Medium	Medium-High	C
	SOC	High	High	Medium	Medium-High	C
	NN	High	High	Medium	Medium-High	C
	HM, M	High	High	Medium	Medium-High	C
	T	High	High	Medium	Medium-High	C
Transportation Corridors	NN	High	High	High	Medium	C

Source of Contaminants	Contaminant	Matrix A (TOT vs. Persistence)	Matrix B (Matrix A vs. Quantity)	Matrix C (Contamination Potential vs. Sensitivity)	Potential for Release	Matrix D (Susceptibility Rating)
	VOC	High	High	High	Medium	C
	SOC	High	High	High	Medium	C
	HM, M	High	High	High	Medium	C
	PH	High	High	High	Medium	C
	T	High	High	High	Medium	C
Landfills	VOC	High	Medium	Medium	Low	E
	SOC	High	Medium	Medium	Low	E
	HM, M	High	Medium	Medium	Low	E
	NN	High	Medium	Medium	Low	E
	MP	High	Medium	Medium	Low	E

APPENDIX C. Summary of Pennsylvania's 303(d) List of Streams and Rivers for the Conodoguinet Creek Watershed

Stream Name	Source of Impairment	Cause of Impairment
Alexanders Spring Creek	Agriculture Construction	Siltation
Back Creek	Agriculture	Organic Enrichment / Low D.O. Siltation
Big Spring Creek	Other	Organic Enrichment / Low D.O. Siltation
Bulls Head Branch	Agriculture Other	Pesticides Organic Enrichment / Low D.O. Siltation
Center Creek	Agriculture	Organic Enrichment / Low D.O. Siltation
Clippingers Run	Agriculture	Organic Enrichment / Low D.O. Nutrients
Conodoguinet Creek	Agriculture Construction Habitat Modification Other Source Unknown	Nutrients Siltation Suspended Solids Organic Enrichment / Low D.O. Pesticides Flow Alterations Cause Unknown
Green Spring Run	Agriculture Other	Pesticides Siltation Organic Enrichment / Low D.O.
Gum Run	Agriculture Habitat Modification	Siltation Other Habitat Alterations
Hogestown Run	Agriculture Urban Runoff	Organic Enrichment / Low D.O. Siltation Cause Unknown
Letort Spring Run	Urban Runoff / Storm Sewers	Priority Organics Metals Pesticides
Mains Run	Agriculture Habitat Modification	Siltation Other Habitat Alterations
Middle Spring Run	Agriculture Urban Runoff / Storm Sewers	Suspended Solids
Mount Rock Spring	Agriculture Construction	Nutrients Siltation
Newburg Run	Agriculture	Nutrients Siltation
Paxton Run	Agriculture	Siltation Suspended Solids
Rowe Run	Agriculture	Organic Enrichment / Low D.O. Siltation
Sears Run	Construction Land Disposal	Siltation Cause Unknown
Trindle Spring Run	Agriculture Construction Urban Runoff / Storm Sewers Land Disposal	Priority Organics Siltation Cause Unknown

Stream Name	Source of Impairment	Cause of Impairment
Wertz Run	Agriculture Construction	Siltation
Whiskey Run	Unknown	Unknown

APPENDIX D. Permitted Facilities Found in the Assessment Area

PWSID	MAP ID	PERMIT NUMBER	MAJOR GROUP NAME	MAJOR GROUP #	CITY	DATA SOURCE	SUSC. RATING
7210002-001	01	PA0014567	ELECTRIC, GAS, AND SANITARY SERVICES	49	JERSEY SHORE	NPDES	C
7210002-001	02	PAD987377892	SPECIAL TRADE CONTRACTORS	17	NEWVILLE	Rcris.shp	A
7210002-001	03	PAD987394996	INDUSTRIAL MACHINERY AND EQUIPMENT	35	NEWVILLE	Rcris.shp	A
7210002-001	04	PAD987400249	SPECIAL TRADE CONTRACTORS	17	CARLISLE	Rcris.shp	C
7210002-001	05	PA0000615963	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	CARLISLE	Rcris.shp	D
7210002-001	06	PA0000704668	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	CARLISLE	Rcris.shp	D
7210002-001	07	PAD013934088	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55		Rcris.shp	D
7210002-001	08	PAD069782233	LEATHER AND LEATHERS PRODUCTS	31		Rcris.shp	A
7210002-001	09	PAD072827959	ELECTRONIC AND OTHER ELECTRIC EQUIPMENT	36		Rcris.shp	A
7210002-001	10	PAD098739485	TRUCKING AND WAREHOUSING	42		Rcris.shp	A
7210002-001	11	PAD982367088	ADMINISTRATION OF ECONOMIC PROGRAMS	96	CARLISLE	Rcris.shp	D
7210002-001	12	PAD982676520	-	0	CARLISLE	Rcris.shp	A
7210002-001	13	PAD987280823	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	CARLISLE	Rcris.shp	A
7210002-001	14	PAD987353174	INDUSTRIAL MACHINERY AND EQUIPMENT	35	CARLISLE	Rcris.shp	A
7210002-001	15	PA0084085	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWVILLE	NPDES	C
7210002-001	16	PA0083178	ELECTRIC, GAS, AND SANITARY SERVICES	49	BALTIMORE	NPDES	C
7210002-001	17	PA0080837	REAL ESTATE	65	NEWVILLE	NPDES	B

PWSID	MAP ID	PERMIT NUMBER	MAJOR GROUP NAME	MAJOR GROUP #	CITY	DATA SOURCE	SUSC. RATING
7210002-001	18	PAD987359130	AUTO REPAIR, SERVICES, AND PARKING	75	CARLISLE	Rcris.shp	D
7210002-001	19	PAD043880095	ELECTRONIC AND OTHER ELECTRIC EQUIPMENT	36		Rcris.shp	D
7210002-001	20	PAD061105979	AUTO REPAIR, SERVICES, AND PARKING	75		Rcris.shp	D
7210002-001	21	PA0001005479	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	CARLISLE	Rcris.shp	D
7210002-001	22	PA0001808146	AUTO REPAIR, SERVICES, AND PARKING	75		Rcris.shp	D
7210002-001	23	PA8007300983	NATIONAL SECURITY AND INTERNATIONAL AFFAIRS	97	CARLISLE BARRACKS	Rcris.shp	B
7210002-001	24	PAD000774521	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55		Rcris.shp	D
7210002-001	25	PA0041793	CHEMICALS AND ALLIED PRODUCTS	28		Ifd.shp	A
7210002-001	26	PAD053281143	STONE, CLAY, AND GLASS PRODUCTS	32	CARLISLE	Tri.shp	B
7210002-001	27	PAD069784049	RUBBER AND MISC. PLASTICS PRODUCTS	30	CARLISLE	Tri.shp	B
7210002-001	28	PAD095362455	LEATHER AND LEATHERS PRODUCTS	31	CARLISLE	Tri.shp	B
7210002-001	29	PA0084751	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWVILLE	NPDES	C
7210002-001	30	PA0046221	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWVILLE	NPDES	D
7210002-001	31	PA0086240	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWVILLE	NPDES	D
7210002-001	32	PA0028339	EDUCATIONAL SERVICES	82	NEWVILLE	NPDES	D
7210002-001	33	PA0086665	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWVILLE	NPDES	D
7210002-001	34	PA0083194	ELECTRIC, GAS, AND SANITARY SERVICES	49	BALTIMORE	NPDES	C

PWSID	MAP ID	PERMIT NUMBER	MAJOR GROUP NAME	MAJOR GROUP #	CITY	DATA SOURCE	SUSC. RATING
7210002-001	35	PA0009865	FISHING, HUNTING, AND TRAPPING	09	NEWVILLE	NPDES	C
7210002-001	36	PA0083941	ELECTRIC, GAS, AND SANITARY SERVICES	49	MERCERSBURG	NPDES	D
7210002-001	37	PA0080799	ELECTRIC, GAS, AND SANITARY SERVICES	49	NEWBURG	NPDES	D
7210002-001	38	PA0082511	MEMBERSHIP ORGANIZATIONS	86	ROXBURY	NPDES	D
7210002-001	39	PA0082201	ELECTRIC, GAS, AND SANITARY SERVICES	49	ORRSTOWN	NPDES	D
7210002-001	40	PA0082406	ELECTRIC, GAS, AND SANITARY SERVICES	49	ROXBURY	NPDES	D
7210002-001	41	PA0085227	ELECTRIC, GAS, AND SANITARY SERVICES	49	PLUMSTEADVILLE	NPDES	D
7210002-001	42	PA0030643	ELECTRIC, GAS, AND SANITARY SERVICES	49	SHIPPENSBURG	NPDES	D
7210002-001	43	PA0010502	EXECUTIVE, LEGISLATIVE, AND GENERAL	91	CHAMBERSBURG	NPDES	D
7210002-001	44	PAD987362647	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	NEWVILLE	Rcris.shp	E
7210002-001	45	PAD987371325	FOOD AND KINDRED PRODUCTS	20	SHIPPENSBURG	Rcris.shp	E
7210002-001	46	PAD987376480	PRIMARY METAL INDUSTRIES	33	SHIPPENSBURG	Rcris.shp	E
7210002-001	47	PAD987399433	AUTO REPAIR, SERVICES, AND PARKING	75	SHIPPENSBURG	Rcris.shp	E
7210002-001	48	PAD987399490	AUTO REPAIR, SERVICES, AND PARKING	75	NEWVILLE	Rcris.shp	E
7210002-001	49	PAD987400439	AUTO REPAIR, SERVICES, AND PARKING	75	SHIPPENSBURG	Rcris.shp	E
7210002-001	50	PA0000020438	AUTO REPAIR, SERVICES, AND PARKING	75	ORRSTOWN	Rcris.shp	E
7210002-001	51	PA0000074708	LUMBER AND WOOD PRODUCTS	24	SHIPPENSBURG	Rcris.shp	E
7210002-001	52	PA0000340877	AUTO REPAIR, SERVICES, AND PARKING	75	ORRSTOWN	Rcris.shp	E

PWSID	MAP ID	PERMIT NUMBER	MAJOR GROUP NAME	MAJOR GROUP #	CITY	DATA SOURCE	SUSC. RATING
7210002-001	53	PAD003007267	MISCELLANEOUS MANUFACTURING INDUSTRIES	39		Rcris.shp	E
7210002-001	54	PAD009489287	ELECTRIC, GAS, AND SANITARY SERVICES	49		Rcris.shp	E
7210002-001	55	PAD014577720	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55		Rcris.shp	E
7210002-001	56	PAD014578058	PERSONAL SERVICES	72		Rcris.shp	E
7210002-001	57	PAD980712640	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55		Rcris.shp	E
7210002-001	58	PAD981731748	PERSONAL SERVICES	72	SHIPPENSBURG	Rcris.shp	E
7210002-001	59	PAD982569923	AUTO REPAIR, SERVICES, AND PARKING	75	SHIPPENSBURG	Rcris.shp	E
7210002-001	60	PAD982579104	TRUCKING AND WAREHOUSING	42	SHIPPENSBURG	Rcris.shp	E
7210002-001	61	PAD987336872	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55	SHIPPENSBURG	Rcris.shp	E
7210002-001	62	PAR000006205	AUTO REPAIR, SERVICES, AND PARKING	75	NEWVILLE	Rcris.shp	E
7210002-001	63	PAD021450333	AUTO REPAIR, SERVICES, AND PARKING	75		Rcris.shp	E
7210002-001	64	PA0000888370	TRUCKING AND WAREHOUSING	42	SHIPPENSBURG	Rcris.shp	E
7210002-001	65	PA0001211762	AUTO REPAIR, SERVICES, AND PARKING	75	SHIPPENSBURG	Rcris.shp	E
7210002-001	66	PA0001211770	-	0	SHIPPENSBURG	Rcris.shp	E
7210002-001	67	PA0001384734	AUTO REPAIR, SERVICES, AND PARKING	75	NEWVILLE	Rcris.shp	E
7210002-001	68	PAD000795039	AUTOMOTIVE DEALERS AND SERVICE STATIONS	55		Rcris.shp	E
7210002-001	69	PA0041521	ELECTRIC, GAS, AND SANITARY SERVICES	49		Ifd.shp	D
7210002-001	70	PA0008079	FOOD AND KINDRED PRODUCTS	20		Ifd.shp	D

PWSID	MAP ID	PERMIT NUMBER	MAJOR GROUP NAME	MAJOR GROUP #	CITY	DATA SOURCE	SUSC. RATING
7210002-001	71	PAD981744170	PRINTING AND PUBLISHING	27	CHAMBERSBURG	Rcris.shp	C
7210002-001	72	PAD003026606	INDUSTRIAL MACHINERY AND EQUIPMENT	35	SHIPPENSBURG	Tri.shp	D
7210002-001	73	PAD069778942	INDUSTRIAL MACHINERY AND EQUIPMENT	35	SHIPPENSBURG	Tri.shp	D