1. Identification of Causes and Sources of Impairment

This section identifies the causes and sources of impairments. Sources of impairments are identified and described. Pollution loads are attributed to each source of impairment and quantified. Data sources are identified and verifiable and assumptions can be reasonably justified. Lastly, watershed-level estimates of necessary pollution control are provided, including overall load reduction.

1.1. Watershed concerns, issues, goals, and other problems

The Codorus Creek watershed is located in southeastern York County (Figure 1-1) and has a drainage area of approximately 278 square miles. The watershed is comprised of three primary drainages: East Branch Codorus, South Branch Codorus and West Branch Codorus. Contractor Aquatic Resource Restoration Company has completed fluvial geomorphic assessments of the East, South and West Branches of the Codorus for the York Chapter of the Izaak Walton League and Codorus Creek Watershed Association. The Codorus Creek watershed and all contributing drainages flow into the Susquehanna River near Saginaw.

1.1.1. East Branch Codorus Creek

The East Branch Codorus Creek (EBCC) has a drainage of 44 square miles and begins northeast of Stewartstown, Pennsylvania. The stream flows northeast and receives drainage from the southwest and northeast with the larger streams being Seaks Run, Barshinger Creek and Inners Creek. All of these tributaries are listed as impaired on the Pennsylvania 303(d) list. The East Branch drains to Lake Redman, which flows into Lake Williams. Both of these reservoirs serve as a public water supply maintained by York Water Company Inc. From Lake Williams, the East Branch flows a mile before its confluence with the South Branch Codorus at Reynolds Mill. Approximately 105 miles of stream were assessed in the East Branch Codorus Creek watershed.

Over 74% of the EBCC watershed is agriculture (cropland and pasture). The primary population centers are located along the northern watershed boundary near Dallastown and Red Lion. Interstate 83 is the approximate western watershed boundary and S.R. 74 serves as the approximate northern watershed boundary. Considerable residential development is also found along Susquehanna Trail between Jacobus and Loganville. A storm water management plan is currently being prepared for the watershed. The East Branch Codorus Creek flows through three County Parks, Spring Valley, William Kain, and Nixon County Parks. The Pennsylvania Fish and Boat Commission has verified wild trout reproduction in the headwaters of the East Branch and also in an unnamed tributary in the headwaters near Blymire Hollow. As shown on Table 1-3, the East Branch from the headwaters to the S.R. 214 Bridge is protected as a high quality cold water fishery (HQ-CWF). From the S.R. 214 Bridge to Lake Redman, the East Branch is protected as a coldwater fishery (CWF). The remainder of the East Branch (including both Lake

Redman and Lake Williams) to the confluence is protected as a warm water fishery (WWF).

1.1.2. South Branch Codorus Creek

South Branch Codorus Creek (SBCC) has a drainage area of 68 square miles and begins near the Maryland/Pennsylvania state line near New Freedom. The stream flows northwest through Glen Rock and picks up additional flow from several tributaries. The largest of these tributaries is Centerville Creek. From the confluence with Centerville Creek, the stream continues northwest towards Seven Valleys, Pennsylvania where additional drainage enters from both the southwest and northeast. Near Seven Valleys, the South Branch turns northeast to confluence with the East Branch Codorus Creek near Reynolds Mill. Approximately 148 miles of streams in the South Branch watershed were assessed. The South Branch Codorus from the confluence with the East Branch to the confluence with the mainstem (below Indian Rock Dam) was not assessed during earlier watershed assessments. This reach of stream and the New Salem Tributary are included in this watershed assessment as shown in Figure 2 and the Watershed Assessment Map.

Over 80% of the SBCC watershed is agriculture (cropland and pasture). Major population centers include New Freedom, Railroad, Glen Rock and Seven Valleys. The upper portion of the SBCC watershed is under increasing development pressure, especially along the Interstate 83 corridor. A storm water management plan (Act 167) has been developed for the South Branch and is currently being updated. The South Branch Codorus and tributaries: Centervillle Creek, Pierceville Run, Foust Creek, and Krebs Valley Run are listed as impaired on the Pennsylvania 303(d) list. Additionally, total maximum daily loads (TMDLs) have been established for the watershed. The Pennsylvania Fish and Boat Commission has verified wild trout reproduction in Centerville Creek near its confluence with Pierceville Run. The upper part of the watershed through Glen Rock is protected as a cold water fishery (CWF) as shown on Table 1-3. From Glen Rock the remainder of the basin is protected as a warm water fishery (WWF).

1.1.3. West Branch Codorus Creek

The headwaters of the Codorus Creek begins near the Maryland/Pennsylvania state line west of Glenville PA. The top of the drainage divide is approximately 1,040 feet above mean sea level (MSL). This section of the watershed is locally referred to as the East Branch Codorus. For the purpose of this assessment and to eliminate any confusion with the assessed East Branch near Dallastown, this section is referred to as the Upper Codorus Creek basin (See Figure 1-3). The upper Codorus Creek is predominantly agriculture (crops and pasture), and is very similar to the South Branch Codorus Creek watershed with respect to land use and drainage patterns. The stream flows southeast for about one half mile and turns northeast for approximately two miles through Glenville. At Glenville, the Codorus makes an abrupt turn to the northwest and flows approximately six miles to confluence with the West Branch. The entire length of the stream parallels a railroad grade. The Upper Codorus is protected as a trout stocked fishery (TSF).

The West Branch Codorus begins near Lineboro, Maryland and flows north into Lake Marburg. The West Branch Codorus watershed terminates at its confluence with the Upper Codorus Creek. Long Run flows north and drains directly to Lake Marburg from the south. Furnace Creek drains to the tailwaters of Lake Marburg southeast of Hanover. Several small unnamed tributaries drain to Lake Marburg from both the north and south.

When filled to capacity, the water level in Lake Marburg is around 620 feet mean sea level. The outlet from Lake Marburg provides a unique cold water fishery due to the bottom release from the reservoir. This discharge combines with the upper Codorus Creek subwatershed, and over the next several miles the influence of this cold water provides a productive brown trout fishery.

For the purpose of this plan, the West Branch Codorus (WBC) and Upper Codorus Creek (UCC) are considered the mainstem of the Codorus Creek (CC). The West Branch and Lake Marburg have a protected use of warm water fishery (WWF) as shown on Table 1-3. From this confluence, Codorus Creek flows north towards Menges Mill, and receives drainage from Porters Creek and Oil Creek. Along its course in this section, the stream crosses from the uplands section into the Lowlands Section near Ambau. Along this section, the Codorus has numerous tributaries coming from the northwest. The Codorus is protected as a high quality cold water fishery (HQ-CWF) from the confluence of the West Branch and upper Codorus Creek to the confluence with Oil Creek. The Pennsylvania Fish and Boat Commission has verified wild trout reproduction in this section of the Codorus.

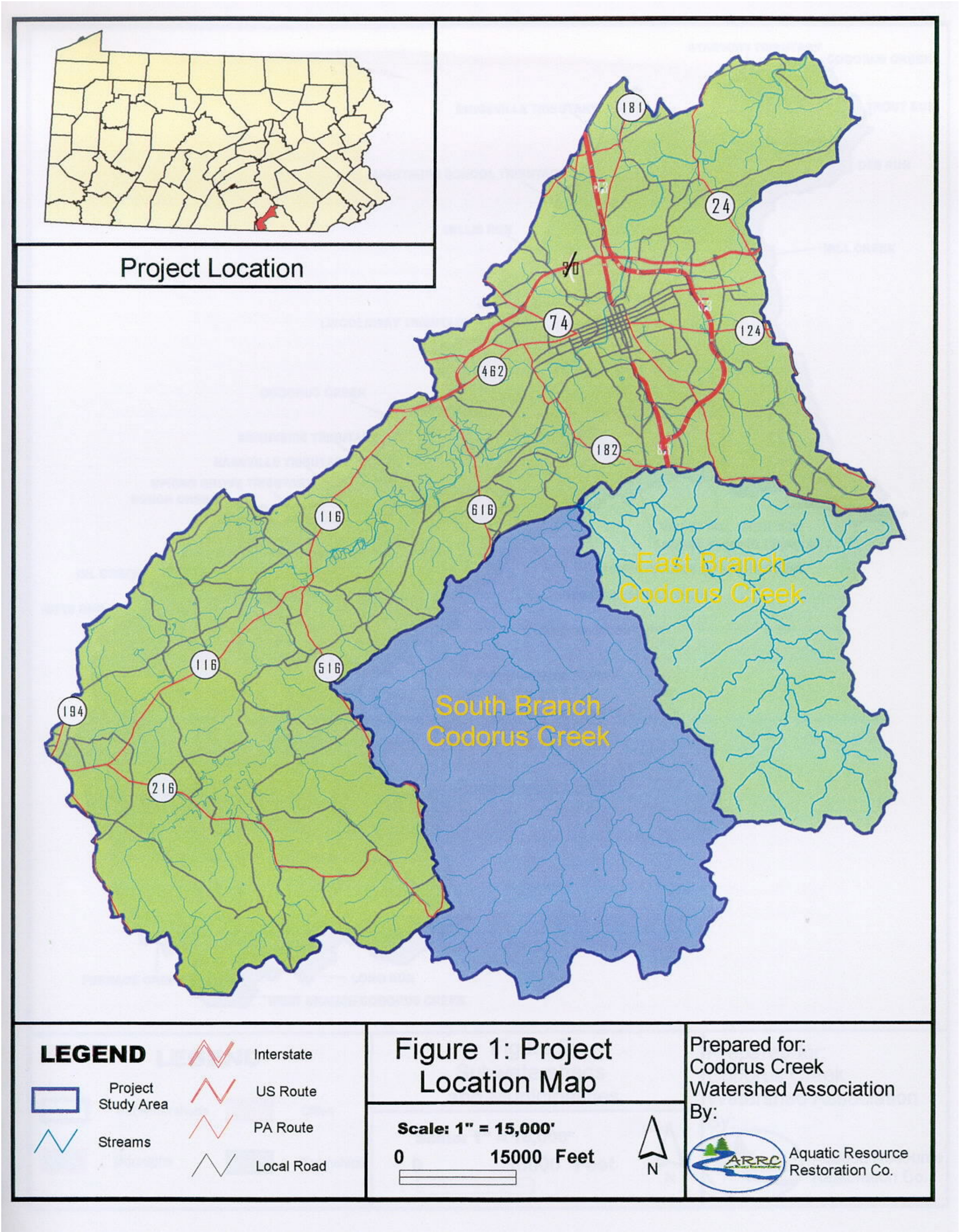

Figure 1-1. Codorus Creek Watershed

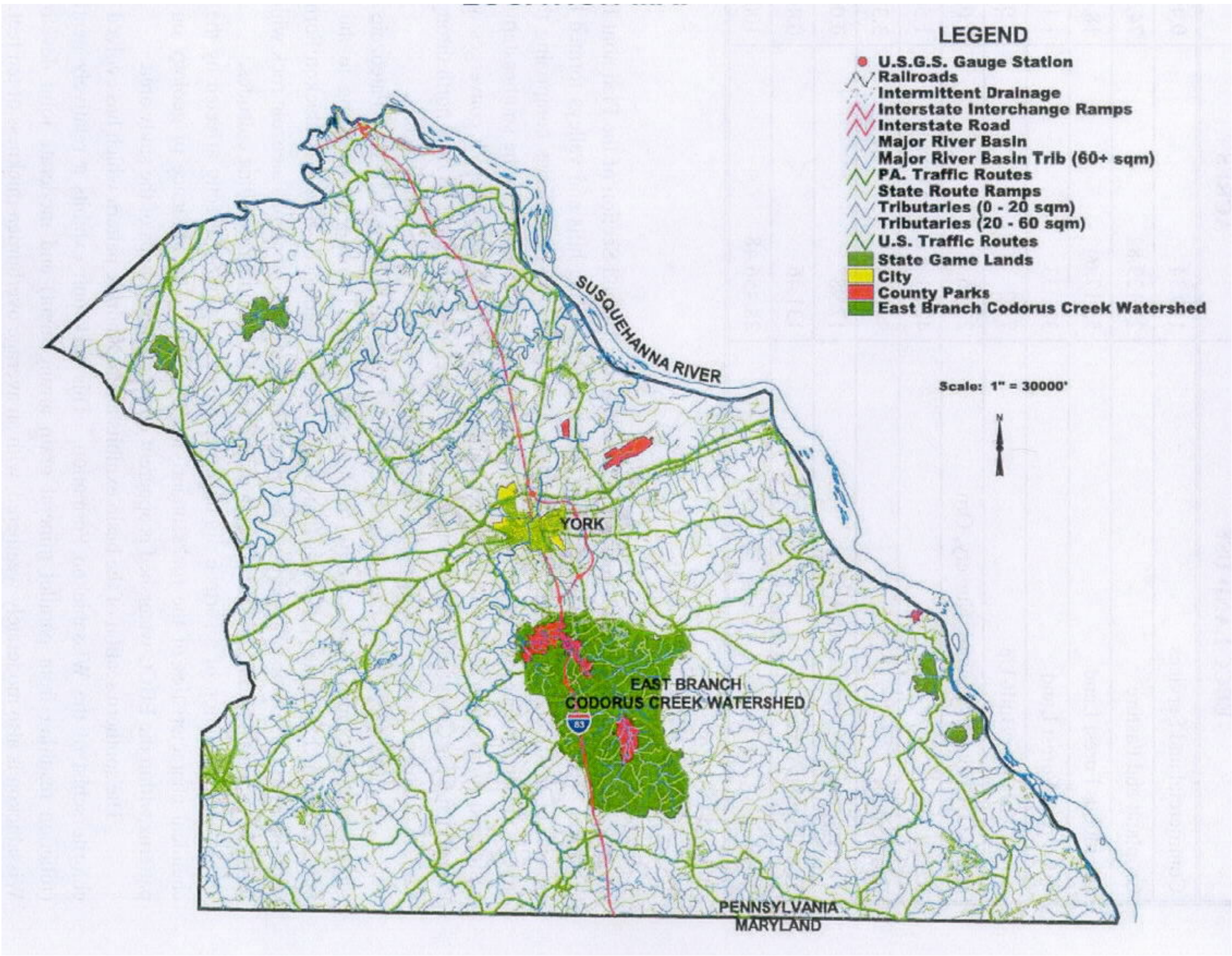

Figure 1-2. East Branch Codorus Creek

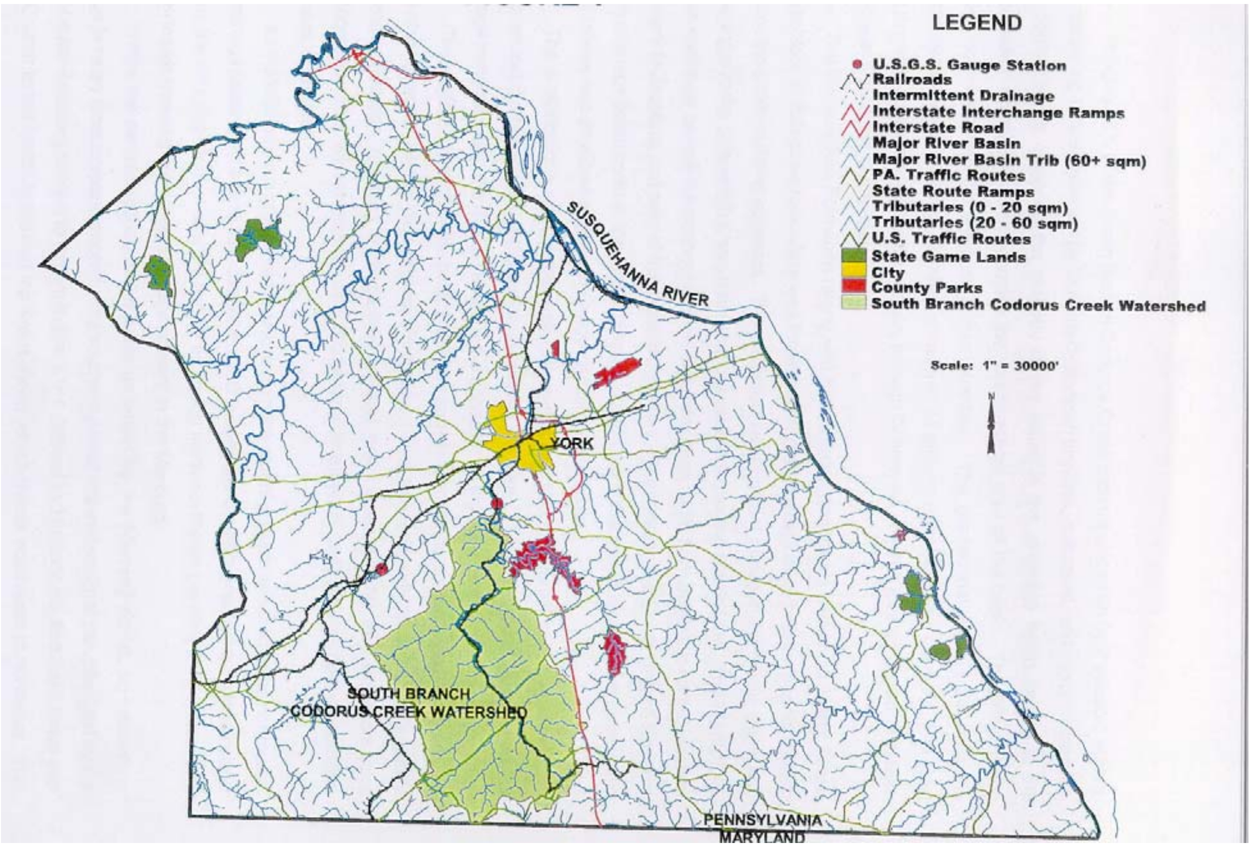

Figure 1-3. South Branch Codorus Creek

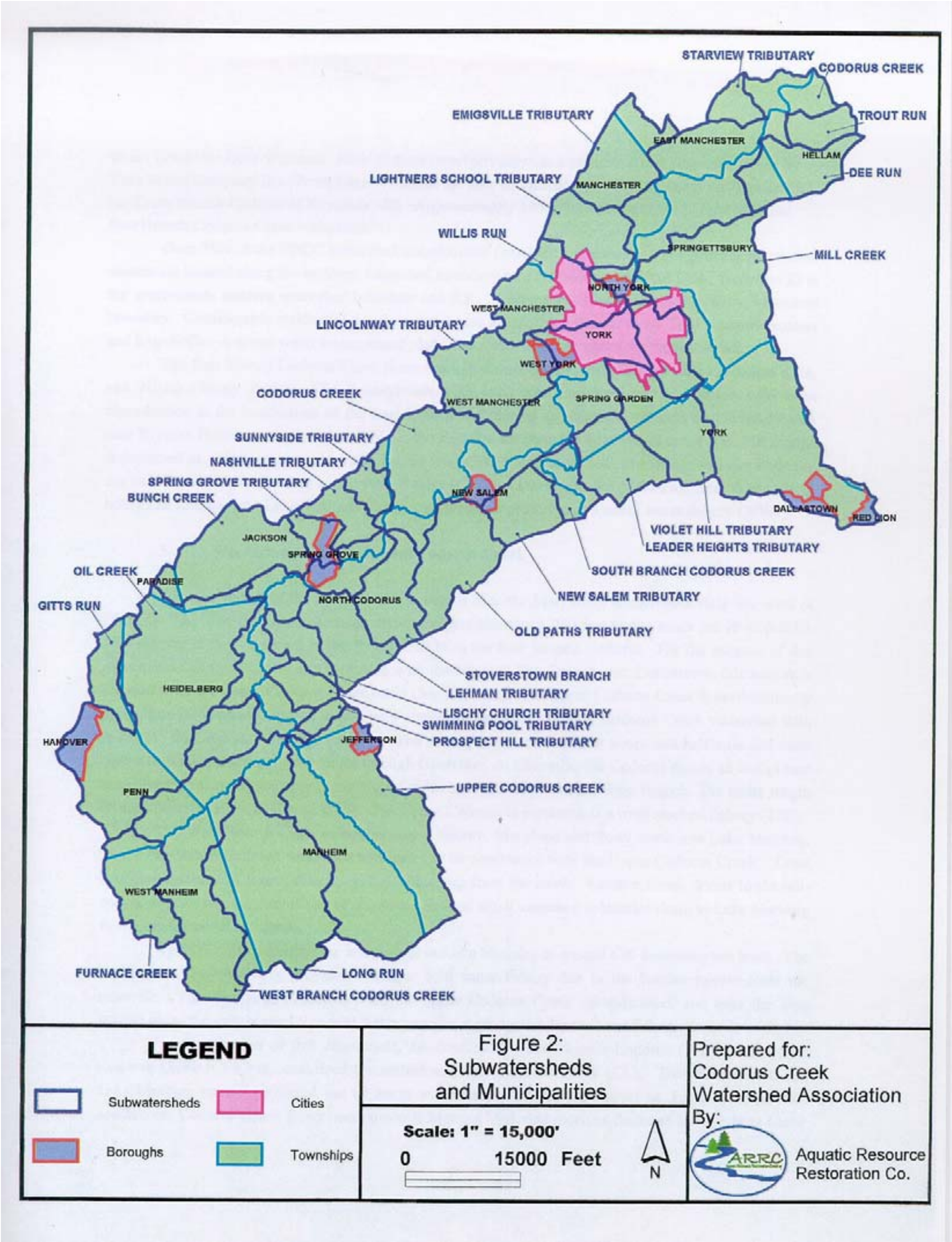

Figure 1-4. West Branch Codorus Creek

1.2. Land Use

The Codorus Creek Watershed has many different land uses, including residential, agricultural, industrial, commercial, parks and recreation, and forested. Agriculture comprises the largest land use category in the entire watershed, covering an average of 65%, or about 115,092 acres, of the total land area of 177,065 acres. As mentioned previously, the Codorus Creek and its three main branches begin in the southern portion of the watershed and flow north through York City to meet the Susquehanna near Saginaw. The watershed starts out approximately 20 miles wide from the eastern edge of Hanover Borough (West/Main Branch Codorus Watershed) to the eastern edge of Hopewell Township (East Branch Codorus Watershed). Generally, the southern portion of the watershed is more agricultural, and as the watershed narrows toward the City of York, the watershed becomes more residential, commercial, and industrial. After exiting the city, land use in the watershed becomes more rural again with suburban sprawl into the northern section of the watershed. The watershed surrounding the northern most section of the Codorus Creek becomes more forested and agricultural before joining the Susquehanna.

1.2.1. East Branch

This watershed area consists of four municipalities: Springfield Township, North Hopewell Township, Hopewell Township, and York Township and five boroughs: Dallastown, Red Lion, Winterstown, Loganville and Jacobus. The primary population centers are along the northern watershed boundary near Dallastown and Red Lion. Considerable residential development is also found along the Susquehanna Trail between Jacobus and Loganville.

There are five primary transportation corridors which pass through the watershed. Four of these corridors serve as the approximate boundaries of the East Branch watershed: State Route 74 to the north, State Route 24 to the east, State Route 2074 (Plank Road) to the south and the Susquehanna Trail to the west. Interstate 83 is the largest of the transportation corridors and passes north to south along the western portion of the watershed.

The majority of the watershed is rural with a predominant land use of agriculture as shown on Table 1-1. Agriculture in the watershed includes both crop and animal production. Agricultural cropland is present throughout the watershed and is found on a wide range of slopes. Pasture areas are more prevalent along the valley floors and include beef, sheep, swine, and goats. The upper portion of the watershed is primarily rural agriculture.

Table 1-1. Land Use East Branch Codorus Creek

Land Use	Percentage
Agriculture	75.0
Forest	19.0
Residential	3.0
Reservoirs	1.5
Other	1.0
Commercial	0.5
Total	100

1.2.2. South Branch

The South Branch Codorus subbasin consists of eight municipalities including Codorus, North Codorus, Springfield, and Shrewsbury Townships, and Glen Rock, New Freedom, Railroad, and Seven Valleys Boroughs, the major population centers and located adjacent to the South Branch Codorus Creek. The majority of the watershed is rural with a predominant land use of agriculture. Agriculture in the watershed includes, row crop, hay, pasture, and animal production. Agricultural cropland is present throughout the watershed and is found on a wide range of slopes. Pasture areas are more prevalent along the valley floors and include beef, sheep, swine and goats. The upper portion of the watershed, along the Mason-Dixon Line, is under development pressure, particularly in the vicinity of New Freedom and Shrewsbury. This development includes both residential and commercial uses.

1.2.3. West Branch

There are twenty seven municipalities included in the West Branch watershed area. Hanover is located in the upper watershed and primarily drains to Lake Marburg and Oil Creek. The remainder of the upper watershed is primarily agriculture and forest. Dallastown and Red Lion are located at the headwaters of Mill Creek and majority of this watershed is developed including residential, commercial and industrial land uses. The City of York lies in the lower third of the watershed is the largest urbanized area. Due to encroachment on Codorus Creek and development since the mid 1700's, a flood control project was constructed in the 1940's including the construction of Indian Rock Dam and five miles of flood control channel.

Table 1-2. Land Use West Branch Codorus Creek

Land Use	Percentage
Agriculture/Forest	51.0
Residential	26.0
Urban	9.0
Commercial	7.0
Other	6.0
Apartment	1.0
Total	100

1.3. Geology

The Codorus Creek watershed lies in the Piedmont Physiographic Province and includes the Uplands and Lowlands Section. The geology of the underlying watershed is shown in Figure 1-5. Stream channels and the surrounding geology are closely related. Factors that can control the development and evolution of a stream channel include: 1) durability of the rock, 2) how the rock was cleaved during crustal movement (jointing), and 3) how the rock has been bent or broken (folded and faulted).

1.3.1. East Branch

The East Branch subbasin is situated within the Piedmont Upland Section of the Piedmont Physiographic Province. This section is characterized by broad, gently rolling hills and valleys formed by the fluvial erosion of the underlying metamorphic rocks. The streams and tributaries comprising this watershed cover a linear distance of approximately 105 miles. The East Branch begins in the southeastern corner of the basin, and flows north to discharge to the main stem Codorus Creek where it converges with the South Branch Codorus Creek at Reynolds Mill. Codorus Creek then continues to flow north through the City of York to discharge into the Susquehanna River south of Saginaw, Pennsylvania.

The majority of the East Branch Codorus subasin is underlain by Paleozoic schists. The schists which comprise the majority of the rocks in the drainage basin belong to the Wissahickon Formation which occupies the southernmost area of the watershed. The Wissahickon Formation (along with the Marburg Member) is part of the Martic Block, a huge block of Paleozoic rock which was thrust from the southeast into its present position during tectonic mountain-building episodes.

The evolution of a surface drainage pattern in a region is directly affected by the physical and chemical characteristics of the rocks underlying the area. The influence of geology on the drainage patterns within the East Branch watershed is apparent on topographic maps of the study area.

The southern section of the basin exhibits a sub-dendritic pattern which has evolved on the albite-chlorite schist of the Wissahickon Formation. This rock unit exhibits a relatively gently schistosity (foliation resulting from parallel mineral grain arrangement) and moderate joint development. The Wissahickon is also moderately weathered, with an average overburden thickness of ten feet.

1.3.2. South Branch

The South Branch Codorus subbasin is situated within the Piedmont Upland Section of the Piedmont Physiographic Province. This section is characterized by broad, gently rolling hills and valleys formed by the fluvial erosion of the underlying metamorphic

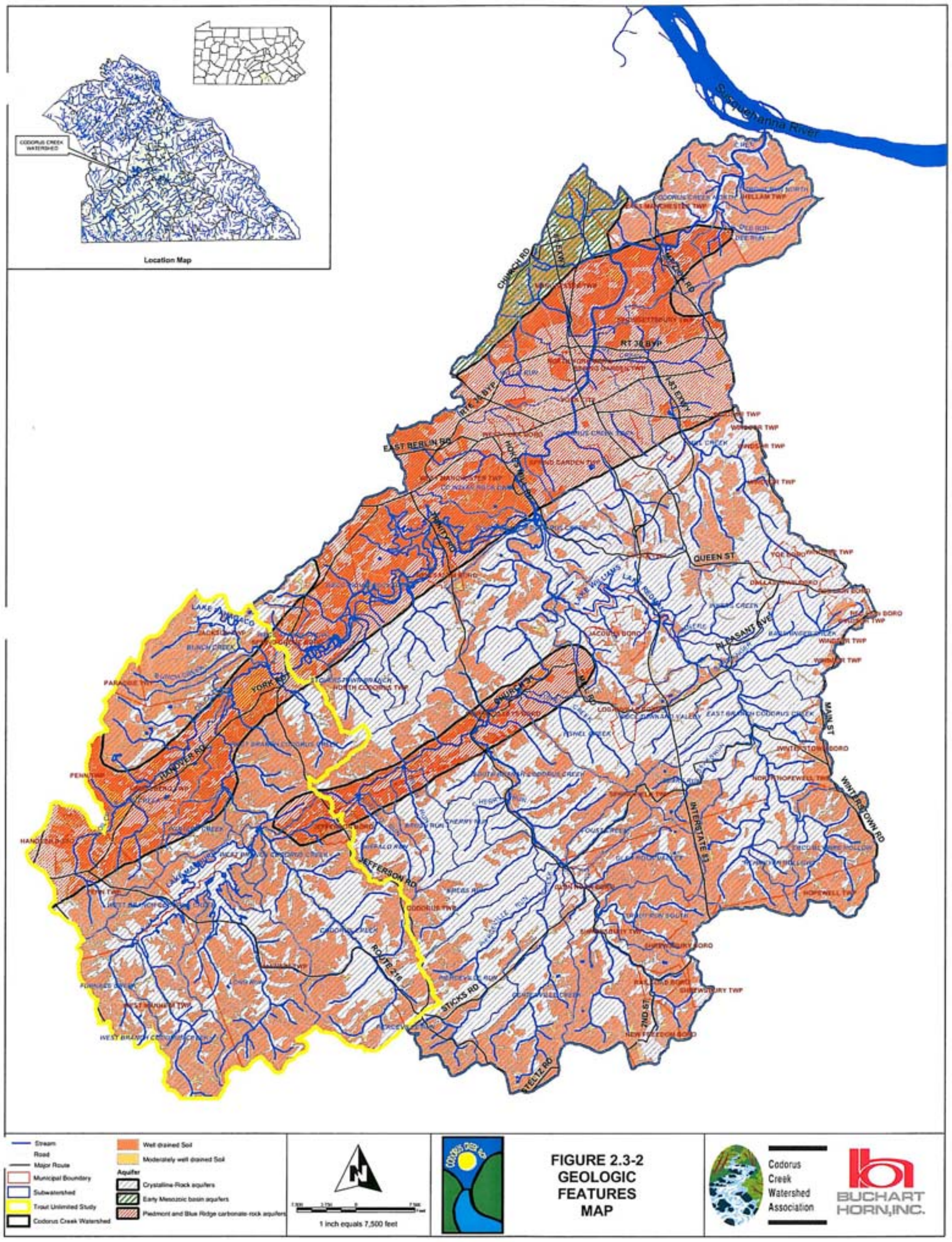

Figure 1-5. Geology of Codorus Creek Watershed

rocks. The streams and tributaries comprising this subwatershed cover a linear distance of approximately 148 miles. The South Branch begins in New Freedom Borough, in the southeast corner of the subbasin, and flows north where it converges with the East Branch at Reynolds Mill and then discharges to the West Branch at Indian Rock Dam. Roughly 85% of the South Branch Codorus subbasin is underlain by Paleozoic schist. The remaining 15% is underlain by Camrbo-Ordivician phyllites, quartzites, conglomerates, and minor limestones. The schist which comprises the majority of the rocks in the drainage basin belongs to the Wissahickon Formation which occupies the southernmost area of the basin. The Wissahickon grades northward into the Marburg Schist Member. The gradational contact between the Wissahickon and the Marburg Member is mapped striking northeast from Glenville, just west of the west-central boundary of the basin, through Centerville, which is located just north of Glen Rock near the center of the basin.

The Wissahickon Formation (along with the Marburg Member) is part of the Martic Block, a huge block of Paleozoic rock which was thrust from the southeast into its present position during tectonic mountain-building episodes. The unconformable contact between the Martic Block and the younger rocks onto which it was thrust is referred to as the Martic Line. The Martic Line strikes northeast across the northern portion of the drainage basin from Jefferson on the western boundary of Jacobus, just east of the easternmost boundary. The rocks in the South Branch Codorus subbasin north of the Martic Line are comprised of Cambrian low grade metamorphic rocks (slates and phyllites) and minor Ordovician limestone units.

The evolution of the surface drainage pattern in the region is directly affected by the physical and chemical characteristics of the rocks underlying the area. The influence of geology on the drainage patterns within the South Branch is apparent on topographic maps and aerial photographs of the area.

The southern section of the subbasin exhibits a sub-dendritic pattern which has evolved on the albite-chlorite schist of the Wissahickon Formation. This rock unit exhibits a relatively gentle foliation resulting from parallel mineral grain arrangement and moderate joint development. The Wissahickon is also moderately weathered, with an average overburden thickness of ten feet.

As the Wissahickon grades into the Marburg mica-chlorite-quartzite schist to the northwest, the drainage pattern shifts from sub-dendritic to sub-rectangular or directional trellis. This transition reflects the structural control exerted largely by strong north-northwest trending joint system and the northeast trending schistose cleavage present in the Marburg.

Within the central section of the basin underlain by the Marburg schist, an interesting change in valley developmental is noted. The southern part of this section (that part bounded by the Wissahickon-Marburg contact to the south and a line defined by Huntrick Hill and Saint Peter’s and Paul’s Church to the north) is drained through Krebs Valley which trends southwest to northeast. The tributaries feeding the stream in Krebs Valley strike north-northeast. However, the reverse is true in the northern part of the Marburg schist section where the main valley's primary strike is north-northwest and the tributaries trend to the northeast. This variation may be caused by a cluster of quartzite interbeds north and south of Krebs Valley. The quartzite beds apparently form the ridgelines of Huntrick Hill to the north and Saubell Hill to the south. Differential erosion parallel to the strike of the resistant quartzite layers has resulted in the formation of the northeast trending Krebs Valley. The tributaries to Krebs Valley formed along the strike of the north-northwest trending joint system. The quartzite beds are not found north from the Huntrick Hill ridgeline. Therefore, the joint system becomes the predominant structural control for the formation of the main valley and the regional northeast trending schistose foliation that controls the formation of the tributaries.

The northern Cambro-Ordovician section of the South Branch drainage basin located north of the Martic Line and characterized by a sub-dendritic to directionally trellis drainage pattern. The controlling factor for tributary development appears to be the north-northwest trending joint system present in the underlying low grade metamorphic rocks. These joint controlled tributaries drain the highlands to a relatively broad valley which strikes northeast across the southern part of the section. This valley is underlain by a narrow band of limestone of the (Conestoga Formation. The soluble nature of this limestone unit has permitted the evolution of a relatively broad valley floor and floodplain across almost the entire width of the basin. Near Glatfelter, at the eastern edge of the basin, the stream channel makes an abrupt 90 degree turn to the northwest. This flexure is apparently due to the termination of the Conestoga limestone bed which formed the valley floor. Structural control of drainage subsequently reverts to the northwest trending joint system. The stream channel again changes direction southwest from Reynolds Mill to resume a northeasterly flow for a short distance. The cause for this change is apparently caused by a northeast striking fault zone which provides the stream a preferential path of flow. Joint control is reestablished at the confluence with the East Branch Codorus Creek.

1.3.3. West Branch

Rock exposures are rare along the West Branch within the Uplands Section due to the low resistivity to weathering of the schistose rocks. However, one exposure of the Marburg Member south of Lake Marburg exhibited foliation paralleling the drainage. A regional look at the drainage pattern in the Uplands Section does show a distinctive northwest-to-southeast pattern which may represent a major joint set.

Within the Lowlands Section, the absence of numerous tributaries to the north and west of the Codorus Creek is due to karst topography. As a result of inspections of available exposures within the limestone valley, both jointing and faulting has influenced Codorus Creek. Also, the presence of more durable rocks within the Uplands Section compared to the Lowlands Section assisted to develop a meandering system bordering between the two physiographic sections.

The last portion of Codorus Creek passes through the Hellam Hills Formation. Again, jointing appears to be a large contributor to the stream's development. Many of the rapids developed in the lower reaches of the stream are formed by the Chickies quartzite near the contact with softer rocks belonging to the Harpers Formation.

The West Branch of the Codorus Creek and Codorus Creek pass through two diabase dikes. Diabase is considered the most-resistant rock to weathering and erosion in southeastern Pennsylvania. One section of stream near New Salem encounters a dike, but shows no effect on the stream. The more notable diabase occurrence, the Stoneybrook Dike, does create rapids in the lower reaches of the Codorus Creek. A description of general geologic conditions is presented for various sections of the project watershed.

1.4. Soils

The Codorus Creek Watershed contains seven major soil associations, and many more different soil types (Figure 1-6). The nature and properties of each soil are influenced by the parent geologic material and land cover. Descriptions of each major soil group are given below. For more information, refer to the Soil Survey of York County, Pennsylvania (2000).

1.4.1. East Branch

According to the Soil Survey for York County, two primary soils associations are found in the watershed: Glenelg-Manor Association and the Chester-Eliok-Glenelg Association.

<u>Glenelg-Manor</u> – This soil association is found through the northern portion of the study area watershed. The topography is hilly and is characterized by long slopes and moderately broad ridges. The Glenelg soils are well drained, moderately deep, and usually gently or moderately sloping. The Manor soils are shallow, well drained to excessively drained, and mostly moderately sloped. The soils in this association are somewhat droughty but are good for agriculture. Grain, potatoes, orchard fruits, and hay are the main crops. Pastures for dairy and beef cattle are common.

<u>Chester-Eliok-Glenelg</u> – This association is found in the southern or upper portion of the EBCC watershed. The topography is characterized by broad gently rounded ridges. The Chester and Eliok soils are well drained and are nearly level to moderately sloping. The Chester soils have a yellowish-brown silty clay loam subsoil and the Eliok have a somewhat firmer, reddish silty clay loam subsoil. This is the most important agricultural area in York County with nearly all the acreage devoted to full-time agriculture.

<u>Chewacla and Congaree</u> – These silt loam soils are located along the immediate floodplain of the major drainages in the watershed. The Chewacla silt loam soils are somewhat removed from the streambank where the depth to the normal water level of the streams is 36 inches or more. These soils have a Capability unit IIw-1 with scouring

being the only erosion hazard. The Congaree silt loam soils are primarily found on narrow bottom land next to steep hills. These soils are not prone to erosion and make good pasture areas.

1.4.2. South Branch

Soils of the South Branch Watershed are identical to those major associations previously described.

1.4.3. West Branch

Mount Airy-Glenelg-Linganore – This soil association is shallow and moderately deep soils, mostly moderately sloping to moderately steep soils underlain by schist or phyllite. These soils are found in the West Branch, Long Run, upper Codorus Creek subwatersheds and are also found along the entire southern edge of the study area including the upper two thirds of Mill Creek watershed.

Chester-Glenelg-Manor – This soil association is deep and moderately deep soils, underlain by schist or phyllite. This association is only found in the upper watershed to Spring Grove and the lower watershed in the Starview Tributary and lower Dee Run watersheds.

Hagerstown-Duffield-Clarksburg – This soil association is deep, nearly level to moderately steep soils underlain by limestone. These soils are prime agriculture soils and occur in the Gitts Run and Oil Creek watersheds. These soils also extend from an area north of Indian Rock dam, through York and lower Mill Creek, and east through Emigsville and the upper Codorus gorge.

Neshaminy-Lehigh-Glenelg – This soil association is deep upland soils underlain by quartzite, aporhyolite, quartz, or metabasalt; and deep colluvial soils over limestone. These soils only occur in the upper Bunch Creek watershed along Pigeon Hill, and in the upper watersheds of Dee Run and Trout Run.

Ungers-Penn-Klinesville – This soil association is shallow to deep, mostly nearly level or gently sloping soils underlain by Triassic sandstone or shale. This soil is only found along the watershed divide between Emigsville and Starview.

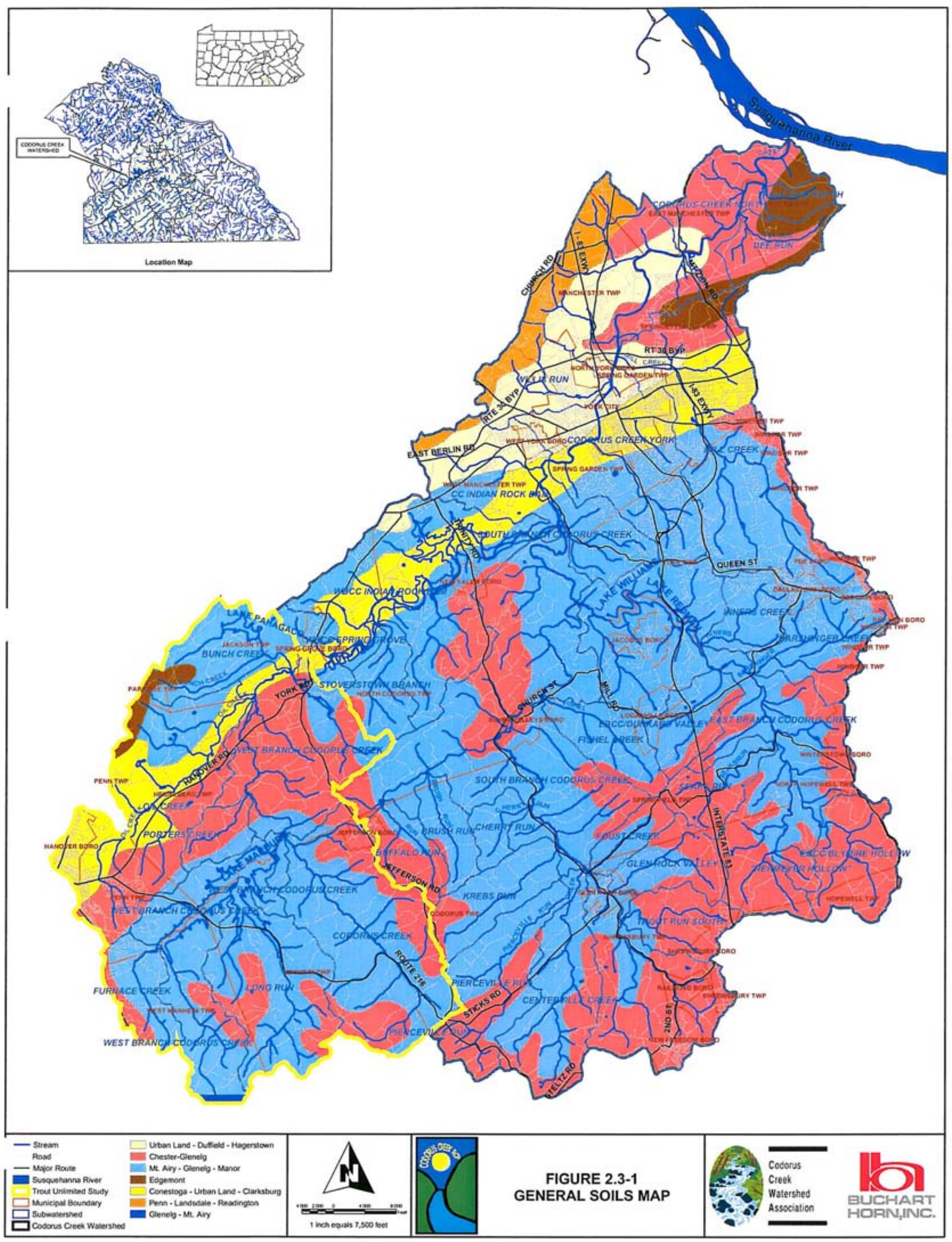

Figure 1-6. Soil Associations of Codorus Creek Watershed

1.5. Applicable Water Quality Standards

Pennsylvania's Water Quality Standards are encoded in Title 25. Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards, Chapter 96, Water Quality Standards Implementation, and Chapter 16, Water Quality Toxics Management Strategy (December 15, 2001). The scope of Chapter 93 sets forth water quality standards for surface waters of the Commonwealth, including wetlands. These standards are based upon water uses which are to be protected and considered by the Department in its regulation of discharges. When an interstate or federal agency under an interstate compact or agreement establishes water quality standards more stringent than those in this title, the more stringent standards apply. Protected water uses are based upon the development of water quality criteria set forth in Table 1 of Chapter 93, including aquatic life, water supply, recreation, fish consumption, special protection, and navigation. The criteria associated with the statewide water uses apply to all surface waters, unless a specific exception is indicated. Applicable water quality criteria in the Codorus Watershed are given in table 1-3 below.

Table 1-3. Applicable Water Quality Standards of Codorus Creek Watershed

No.	Streams	Zone	Water Use Protected	Exceptions to Criteria
EAST BRANCH				
1	East Branch	Basin, Source to PA Rt. 214	HQ-CWF	None
2	East Branch	Basin, PA Rt. 214 to mouth	CWF	None
SOUTH BRANCH				
3	South Branch	Main Stem	WWF	None
4	UNT to South Branch Codorus Creek	Basins, Source to UNT from Glen Rock Valley at RM 16.06	WWF	None
5	UNT to South Branch Codorus Creek through Glen Rock Valley	Basin	CWF	None
6	UNT to South Branch Codorus Creek	Basins, UNT from Glen Rock Valley to Mouth	WWF	None
7	Trout Run	Basin	WWF	None
8	Foust Creek	Basin	WWF	None
9	Centerville Creek	Basin	WWF	None
10	Cherry Run	Basin	WWF	None
11	Fishel Creek	Basin	WWF	None
WEST BRANCH				
12	Codorus Creek	Basin, Source to West Branch	TSF	None
13	West Branch Codorus Creek	Basin	WWF	None
14	Codorus Creek	Main Stem, West Branch to Oil Creek	HQ-CWF	None
15	UNT to Codorus Creek	Basins, West Branch to Oil Creek	WWF	None
16	Porters Creek	Basin	WWF	None
17	Oil Creek	Basin	WWF	None
18	Codorus Creek	Main Stem, Oil Creek to Mouth	WWF	None
19	UNT to Codorus Creek	Basins, Oil Creek to Mouth	WWF	None
20	Bunch Creek	Basin	WWF	None
21	Stoverstown Branch	Basin	WWF	None
22	Willis Run	Basin	WWF	None
23	Mill Creek	Basin	WWF	None
24	Dee Run	Basin	WWF	None
25	Trout Run	Basin source to river mile 0.3	HQ-CWF	None

1.5.1. Aquatic Life Protection

The Bureau of Watershed Conservation has listed several classifications for the streams in Pennsylvania. These classifications are listed by watershed in Title 25 of the Pennsylvania Code, Chapter 93 – Water Quality Standards, and represent the characteristics of the streams which are to be protected. Some of the standards found within the sub-watersheds include the following, as defined in Title 25 of the Pennsylvania Code, Chapter 93:

Cold Water Fishes (CWF) – Maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.

Warm Water Fishes (WWF) – Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

Migratory Fishes (MF) – Passage, maintenance and propogation of anadromous and catadromous fishes and other fishes which ascend to flowing waters to complete their life cycle.

Trout Stocking (TSF) – Maintenance of stocked trout from February 15 to July 31 and maintenance and propogation of fish species and additional flora and fauna which are indigenous to warm water habitat.

1.5.2. Special Protection

Exceptional Value Waters (EV) – Exceptional Value Waters shall be maintained and protected.

High Quality Waters (HQ) – High quality commands special protection as noted in Section 93.4c – Antidegradation, of the Pennsylvania Code, Title 25.

1.5.3. Antidegradation

Antidegradation requirements apply to surface waters of the Commonwealth. Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. The water of High Quality and Exceptional Value Waters needs to be maintained and protected for specific chemical and physical properties listed in section 93.4.b. Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life. In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances which produce color, tastes, odors, turbidity or settle to form deposits.

1.5.4. Other Specific Criteria

Other specific water quality criteria apply to surface waters in drainage basins and streams listed in sections 93.9a-93.9z. All applicable criteria apply to surface waters as specified in this chapter, Chapter 96, and other applicable State and Federal laws and regulations.

1.6. Water Quality Quantified and Mapped by Category

Pennsylvania's Department of Environmental Protection (DEP) uses an integrated format for Clean Water Act Section 305(b) reporting and Section 303(d) listing. The "2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report" satisfies the requirements of both Sections 305(b) and 303(d). The narrative that follows contains summaries of various water quality management programs including water quality standards, point source control and nonpoint source control. It also includes descriptions of programs to protect lakes, wetlands and groundwater quality. A summary of the use support status of streams and lakes is also presented in the narrative report.

In addition to this 305(b) narrative, the water quality status of Pennsylvania's waters is presented using a five-part characterization of use attainment status. The listing categories are:

<u>Category 1</u>: Waters attaining all designated uses.

<u>Category 2</u>: Waters where some, but not all, designated uses are met. Attainment status of the remaining designated uses is unknown because data are insufficient to categorize the water.

<u>Category 3</u>: Waters for which there are insufficient or no data and information to determine if designated uses are met.

<u>Category 4</u>: Waters impaired for one or more designated use but not needing a TMDL. These waters are placed in one of the following three subcategories:

- Category 4A: TMDL has been completed.
- Category 4B: Expected to meet all designated uses within a reasonable timeframe.
- Category 4C: Not impaired by a pollutant.
- Category 5: Waters impaired for one or more designated uses by any pollutant.

The 303(d) impaired streams listings for the Codorus Creek Watershed are given below (table 1-4).

Table 1-4. 303(d) Impaired Streams Listings of Codorus Creek Watershed

No.	Stream	Drainage Area1 (sq.mi.)	Stream Length (ft.)	303d List Status	Impaired Length (ft.)	Cause/Effect[1]
EAST BRANCH						
1	East Branch (Lakes)	0	0		0	
2	East Branch (B,I & S)	11.81	46,000	Impaired	16,000	Agriculture Sediment
3	East Branch	44.5	36,000		0	
SOUTH BRANCH						
4	South Branch	117	72,000	Impaired	54,000	Agriculture/Urban Sediment & Nutrients
5	UNT to South Br RM 16	0	18,000	Impaired	10,000	Municipal Nutrient
6	Glen Rock Valley	0	12,000		0	
7	UNT to South Branch	0	7,000	Impaired	6,000	Urban Sediment
8	Trout Run	3.43	14,000	Impaired	6,500	Agriculture Sediment & Nutrients
9	Foust Creek	1.76	12,000	Impaired	6,000	Agriculture Sediment & Nutrients
10	Centerville Creek	21.65	48,000	Impaired	24,000	Agriculture Sediment & Nutrients
11	Cherry Run	1.65	9,000		0	
12	Fishel Creek	3.83	19,000		0	
CODORUS CREEK						
13	Willis Run	4.78	18,000	Impaired	18,000	Urban Sediment
14	Mill Creek	18.5	30,000	Impaired	24,000	Urban Sediment
15	Dee Run	3.12	10,000		0	
16	Trout Run	1.31	6,000		0	
WEST BRANCH						
17	Upper West Br Codorus Cr	0	36,000	Impaired	36,000	Agriculture Sediment
18	West Branch	23.8	42,000		0	
19	Codorus Creek	0	18,000		0	
20	UNT to Codorus Creek	0	0		0	
21	Porters Creek	1.96	10,500		0	
22	Oil Creek	18.7	36,000	Impaired	36,000	Urban Sediment
23	Codorus Creek	0	96,000		0	
24	UNT to Codorus Creek	0	0		0	
25	Bunch Creek	5.31	21,000		0	
26	Stoverstown Branch	3.06	15,000	Impaired	8,000	Agriculture Sediment

The most significant issue or concern facing the Codorus Creek Watershed is related to water quality and quantity. Much of the watershed contains streams and waterways that are impaired by one or more variables. There are approximately 296 miles of Priority 1 & 2 impaired streams within the watershed, approximately 259 of which are located in the planning area. These impairments are mostly related to stream bank erosion and fluvial geomorphological impairments such as abandoned floodplains, and loss of channel stability.

In addition to the Priority 1 & 2 streams, the Pennsylvania Department of Environmental Protection Section has established a Total Maximum Daily Load (TMDL) for the South Branch Codorus Creek and Oil Creek. Although agriculture is listed as the primary cause, current data shows that stream bank and channel erosion is the most significant nonpoint sources of sediment and nutrient pollution in the watershed (table 1-5 and figure 1-7).

Table 1-5. Sources of Stream Bank Erosion of Codorus Creek Watershed

No.	Municipality	Watershed	Stream Name	Reach_ID	Site (LF)
1	York City	Codorus Creek	Codorus Creek	CC22	500
2	York City	Codorus Creek	Codorus Creek	CC24	850
3	Springettsbury	Codorus Creek	Codorus Creek	CC2504	620
4	Hellam	Codorus Creek	Codorus Creek	CC26/CC25	2500
5	Springettsbury	Codorus Creek	UNT Codorus Creek	CC2602	850
6	E Manchester	Codorus Creek	UNT Codorus Creek	CC2701	1500
7	E Manchester	Codorus Creek	UNT Codorus Creek	CC2705	1090
8	Springettsbury	Codorus Creek	Codorus Creek	CC2805	1280
9	Hellam	Codorus Creek	Dee Run	DRT101	460
10	Springettsbury	Codorus Creek	Dee Run	DRT201	640
11	Springettsbury	Codorus Creek	Dee Run	DRT301	1175
12	E Manchester	Codorus Creek	Emigsville Tributary	ET101	500
13	Manchester	Codorus Creek	Emigsville Tributary	ET502/503/501	1240
14	Manchester	Codorus Creek	Emigsville Tributary	ET607	780
15	Manchester	Codorus Creek	Emigsville Tributary	ET608	735
16	Manchester	Codorus Creek	Emigsville Tributary	ET701	1030
17	York	Codorus Creek	Leaders Heights Trib	LH01	900
18	York	Codorus Creek	Leaders Heights Trib	LH03/LH101	2650
19	York	Codorus Creek	Leaders Heights Trib	LH07/LH401	4480
20	Manchester	Codorus Creek	Lightners School Trib	LST03	1900
21	Manchester	Codorus Creek	Lightners School Trib	LST04	1225
22	Manchester	Codorus Creek	Lightners School Trib	LST05/LST04	4250
23	Manchester	Codorus Creek	Lightners School Trib	LST105	800
24	Manchester	Codorus Creek	Lightners School Trib	LST201	1267
25	W Manchester	Codorus Creek	Lincolnway Trib	LWT301/LWT04/LWT05	2280
26	York	Codorus Creek	Mill Creek	MC02/MC03/MC04	1960
27	York	Codorus Creek	Mill Creek	MC09	2600
28	York	Codorus Creek	Mill Creek	MC10	1165
29	York	Codorus Creek	Mill Creek	MC1002	1100
30	York	Codorus Creek	Mill Creek	MC1003	1500
31	York	Codorus Creek	Mill Creek	MC1006	3700
32	York	Codorus Creek	Mill Creek	MC1101	1180
33	York	Codorus Creek	Mill Creek	MC1201	1500
34	York/Springettsbury	Codorus Creek	Mill Creek	MC13/MC12	1470
35	York	Codorus Creek	Mill Creek	MC1512	500
36	York	Codorus Creek	Mill Creek	MC1601	420
37	Springettsbury	Codorus Creek	Mill Creek	MC19	1660
38	York	Codorus Creek	Mill Creek	MC1901	1733
39	Springettsbury	Codorus Creek	Mill Creek	MC21	0
40	Springettsbury	Codorus Creek	Mill Creek	MC22	2600
41	Springettsbury	Codorus Creek	Mill Creek	MC23	1000
42	Springettsbury	Codorus Creek	Mill Creek	MC2606	1255
43	Springettsbury	Codorus Creek	Mill Creek	MC2611	1260
44	Springettsbury	Codorus Creek	Mill Creek	MC2805	1445
45	Springettsbury	Codorus Creek	Mill Creek	MC2805	0

46	York	Codorus Creek	Mill Creek	MC304	1030
47	Springettsbury	Codorus Creek	Mill Creek	MC3601	460
48	York City	Codorus Creek	Mill Creek	MC3901	0
49	York	Codorus Creek	Mill Creek	MC402	1000
50	York	Codorus Creek	Mill Creek	MC502/MC501	2025
51	E Manchester	Codorus Creek	Starview Trib	SVT01	700
52	York	Codorus Creek	Tyler Run	VH04/VH03	675
53	York	Codorus Creek	Tyler Run	VH08	1400
54	Spring Garden	Codorus Creek	Tyler Run	VH14	1730
55	York	Codorus Creek	Tyler Run	VH401	500
56	York	Codorus Creek	Tyler Run	VH501	2210
57	W Manheim	Codorus Creek	Tyler Run	VH802	780
58	W Manchester	Codorus Creek	Willis Run	WR01	1500
59	York City	Codorus Creek	Willis Run	WR05	1500
60	York City	Codorus Creek	Willis Run	WR07	2420
61	Manchester	Codorus Creek	Willis Run	WR301	2020
62	York	East Branch	Barshinger Creek	BC06/BC05/BC04	1575
63	York	East Branch	Barshinger Creek	BC08	1260
64	York	East Branch	Barshinger Creek	BC11	2450
65	York	East Branch	Barshinger Creek	BC12/BC13/BC14	3300
66	N Hopwell	East Branch	Barshinger Creek	BC15/BC16/BC17	3400
67	N Hopwell/York	East Branch	Barshinger Creek	BC18/BC19/BC20/BC21	2820
68	N Hopwell	East Branch	Blymire Hollow Trib	BHT07	1400
69	N Hopwell	East Branch	Blymire Hollow Trib	BHT503-FILL	200
70	N Hopwell	East Branch	Blymire Hollow Trib	BHT504	820
71	York	East Branch	Barshinger Creek	DBT09/10/11/12/13	3000
72	Springfield	East Branch	East Branch Codorus Creek	EB25	2075
73	Shrewsbury	East Branch	Hametown Trib	HT05/HT04	1900
74	York	East Branch	Inners Creek	IC10	1100
75	York	East Branch	Inners Creek	IC1101	1185
76	York	East Branch	Inners Creek	IC13/IC12	1180
77	York	East Branch	Inners Creek	IC17	3650
78	York	East Branch	Inners Creek	IC203/IC05/IC06	1025
79	York	East Branch	Inners Creek	IC601	450
80	Springfield	East Branch	Nixon Park Trib	NPT1103/1102	1090
81	Springfield	East Branch	Nixon Park Trib	NPT15/NPT14	1900
82	Springfield	East Branch	Nixon Park Trib	NPT18/NPT17/EB	3670
83	Springfield	East Branch	Ridgeview Road Trib	RRT03/RRT04/RRT05	3350
84	Codorus	South Branch	Brush Valley Trib	BRVT09	2560
85	Codorus	South Branch	Buffalo Valley Trib	BUVT02	380
86	Codorus	South Branch	Buffalo Valley Trib	BUVT03/04	1850
87	Codorus	South Branch	Buffalo Valley Trib	BUVT04	1070
88	Codorus	South Branch	Buffalo Valley Trib	BUVT04	955
89	Codorus	South Branch	Buffalo Valley Trib	BUVT04	445
90	N Codorus	South Branch	Centerville Creek	CC12	760
91	Codorus/N Codorus	South Branch	Centerville Creek	CC12/CC11	1078
92	N Codorus	South Branch	Centerville Creek	CC16/CC17	5250
93	Codorus/N Codorus	South Branch	Centerville Creek	CC18/CC17/CC16	680
94	Codorus	South Branch	Centerville Creek	CC605/CC606/CC607	2000
95	N Codorus	South Branch	Centerville Creek	CC701	1000
97	Springfield	South Branch	Fischel Creek	FIC05	1565
98	Seven Valleys	South Branch	Fischel Creek	FIC01	2090
99	Springfield	South Branch	Fischel Creek	FIC02	1360
100	Springfield	South Branch	Fischel Creek	FIC08	1260
101	Springfield	South Branch	Fischel Creek	FIC1003	400

102	Springfield	South Branch	Fischel Creek	FIC1101	1930
103	Springfield	South Branch	Fischel Creek	FIC1201/FIC13	1150
104	Springfield	South Branch	Foust Creek	FOC02/FOC01	1010
105	Springfield	South Branch	Foust Creek	FOC04	780
106	Springfield	South Branch	Foust Creek	FOC07/FOC06	1732
107	Springfield	South Branch	Foust Creek	FOC09/FOC08	2415
108	Shrewsbury	South Branch	Foust Creek	FOC10	1440
109	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT03	1660
110	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT03	1720
111	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT06	1050
112	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT206	1300
113	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT209/208/GRVT03	1070
114	Shrewsbury	South Branch	Glen Rock Valley Tribs	GRVT501	1270
115	Codorus	South Branch	Hanover Junction Trib	HJT03/HJT04	990
116	Codorus	South Branch	Hanover Junction Trib	HJT05	1575
117	Shrewsbury	South Branch	Hunderford Trib	HuT05	1500
118	Codorus	South Branch	Krebs Valley Trib	KVT0[7]	1850
119	Codorus	South Branch	Krebs Valley Trib	KVT0[9]	2160
120	Codorus	South Branch	Krebs Valley Trib	KVT01	3150
121	Codorus	South Branch	Krebs Valley Trib	KVT04	1480
122	Codorus	South Branch	Krebs Valley Trib	KVT04	2730
123	Codorus	South Branch	Krebs Valley Trib	KVT401	0
124	Codorus	South Branch	Krebs Valley Trib	KVT601/KVT602	3870
125	Shrewsbury	South Branch	New Freedom Church Trib	NFCT04	1000
126	Shrewsbury	South Branch	New Freedom Church Trib	NFCT05	1040
127	N Codorus	South Branch	New Salem Trib	NST101/NST02	1885
128	N Codorus	South Branch	New Salem Trib	NST301	1000
129	N Codorus	South Branch	New Salem Trib	NST502/NST601	780
130	N Codorus	South Branch	New Salem Trib	NST703	1070
131	Codorus	South Branch	Pierceville Run	PR02	500
132	Codorus	South Branch	Pierceville Run	PR05/PR06	2000
133	Codorus	South Branch	Pierceville Run	PR12	3280
134	Codorus	South Branch	Pierceville Run	PR3E	850
135	Codorus	South Branch	Pierceville Run	PR502	1000
136	Codorus	South Branch	Pierceville Run	PR601	515
137	Springfield	South Branch	South Branch Codorus Creek	SB1601	1100
138	Shrewsbury	South Branch	South Branch Codorus Creek	SB17	400
139	N Codorus/Seven Valleys	South Branch	South Branch Codorus Creek	SB27	2650
140	Springfield	South Branch	South Branch Codorus Creek	SB28/SB29	8625
141	N Codorus	South Branch	South Branch Codorus Creek	SB31	1150
142	N Codorus/Springfield	South Branch	South Branch Codorus Creek	SB36/SB34	1745
143	N Codorus	South Branch	South Branch Codorus Creek	SBCC41	1460
144	York	South Branch	South Branch Codorus Creek	SBCC42	3440
145	N Codorus	South Branch	Seven Valleys North Trib	SVNT06/SVNT05	1478
146	N Codorus	South Branch	Seven Valleys North Trib	SVNT102/SVNT101	500
147	Springfield	South Branch	Seven Valleys South Trib	SVST08/SVST07	1650
148	Springfield/Seven Valleys	South Branch	Seven Valleys South Trib	SVST11/SVST12	950
149	Shrewsbury	South Branch	Trout Run (South)	TR05	1350
150	Shrewsbury	South Branch	Trout Run (South)	TR06	1640
151	Shrewsbury	South Branch	Trout Run (South)	TR07	1700
152	Shrewsbury	South Branch	Trout Run (South)	TR08	910
153	Shrewsbury	South Branch	Trout Run (South)	TR201/TR202	1500
154	Shrewsbury	South Branch	Trout Run (South)	TR301	775
155	Springfield	South Branch	Travis Trib	TT103	3200
156	Springfield	South Branch	Travis Trib	TT106/TT105/TT104	2320

157	N Codorus	South Branch	Wangs Trib	WT01	2560
158	N Codorus	South Branch	Wangs Trib	WT02	2110
159	Jackson	West Branch	Bunch Creek	BC05	1250
160	Jackson	West Branch	Bunch Creek	BC301	750
161	Heidelberg	West Branch	Codorus Creek	CC05	540
162	Codorus/N Codorus	West Branch	Codorus Creek	CC101	1620
163	New Salem	West Branch	UNT Codorus Creek	CC1302	800
164	W Manchester	West Branch	Hawksbill Pond Trib	CC1502	4000
165	W Manchester	West Branch	Hawksbill Pond Trib	CC1503	0
166	W Manchester	West Branch	Hawksbill Pond Trib	CC1503/1504	3135
167	W Manchester	West Branch	Hawksbill Pond Trib	CC1601	1875
168	W Manchester	West Branch	Hawksbill Pond Trib	CC1604/1603/1602	2565
169	W Manchester	West Branch	Hawksbill Pond Trib	CC1606/1605	4270
170	Heidelberg	West Branch	Codorus Creek	CC201	1000
171	Heidelberg	West Branch	Codorus Creek	CC401	800
172	W Manheim	West Branch	Furnace Creek	FC02	550
173	W Manheim	West Branch	Furnace Creek	FC03	314
174	W Manheim	West Branch	Furnace Creek	FC04	735
175	W Manheim	West Branch	Furnace Creek	FC07/FC06(D/S)	2700
176	W Manheim	West Branch	Furnace Creek	FC08/FC801	2525
177	W Manheim	West Branch	Furnace Creek	FC10	888
178	W Manheim	West Branch	Furnace Creek	FC1002/FC09	590
179	W Manheim	West Branch	Furnace Creek	FC1101(D/S)	380
180	Hanover	West Branch	Furnace Creek	FC1202	530
181	W Manheim	West Branch	Furnace Creek	FC701	1690
182	W Manheim	West Branch	Furnace Creek	FC703	540
183	N Codorus	West Branch	Lischy Church Trib	LCT02	2460
184	N Codorus	West Branch	Lischy Church Trib	LCT04/LCT03	950
185	N Codorus	West Branch	Lischy Church Trib	LCT05	500
186	N Codorus	West Branch	Lischy Church Trib	LCT201	625
187	W Manheim	West Branch	Long Run	LR01	0
188	Manheim	West Branch	Long Run	LR03	280
189	Manheim	West Branch	Long Run	LR04/LR102	2080
190	Manheim	West Branch	Long Run	LR06	500
191	Manheim	West Branch	Long Run	LR07	500
192	Manheim	West Branch	Long Run	LR09	700
193	Manheim	West Branch	Long Run	LR10	1550
194	Manheim	West Branch	Long Run	LR11	805
195	Manheim	West Branch	Long Run	LR2301 (D/S)	600
196	Manheim	West Branch	Long Run	LR2303	800
197	Manheim	West Branch	Long Run	LR2501 (D/S)	1400
198	Manheim	West Branch	Long Run	LR2701	1260
199	Manheim	West Branch	Long Run	LR2801	630
200	Manheim/W Manheim	West Branch	Long Run	LR2901/LR2902	1360
201	W Manheim	West Branch	Long Run	LR3201 (U/S)	750
202	Manheim	West Branch	Long Run	LR3202	1350
203	W Manheim	West Branch	Long Run	LR3302	560
204	Manheim	West Branch	Long Run	LR3601	270
205	Manheim	West Branch	Long Run	LR401	1500
206	Manheim	West Branch	Long Run	LR502	900
207	Manheim	West Branch	Long Run	LR503	2050
208	Manheim	West Branch	Long Run	LR902/LR1001	1670
209	N Codorus	West Branch	Lehman Trib	LT01	1570
210	N Codorus	West Branch	Lehman Trib	LT06/LT05/LT04	1700
211	N Codorus	West Branch	Lehman Trib	LT201	500

212	Jackson	West Branch	Nashville Trib	NA02	500
213	Jackson	West Branch	Nashville Trib	NA03	3025
214	Jackson	West Branch	Nashville Trib	NA04	1280
215	Jackson	West Branch	Nashville Trib	NA05	3180
216	Heidelberg	West Branch	Oil Creek	OC19	2650
217	N Codorus	West Branch	Old Paths Trib	OPT04	600
218	N Codorus	West Branch	Old Paths Trib	OPT1001	2000
219	Heidelberg	West Branch	Porters Sidling Trib	PC01	975
220	Heidelberg	West Branch	Porters Sidling Trib	PC03/PC101	2180
221	Heidelberg	West Branch	Porters Sidling Trib	PC04/PC201	1650
222	Heidelberg	West Branch	Porters Sidling Trib	PC05	750
223	Heidelberg	West Branch	Porters Sidling Trib	PC06	2000
224	Heidelberg	West Branch	Porters Sidling Trib	PC08	780
225	Heidelberg	West Branch	Porters Sidling Trib	PC09	500
226	Heidelberg	West Branch	Porters Sidling Trib	PC10	650
227	Heidelberg	West Branch	Porters Sidling Trib	PC401	1700
228	N Codorus	West Branch	Prospect Hill Trib	PHT01	1480
229	N Codorus	West Branch	Prospect Hill Trib	PHT03	500
230	N Codorus	West Branch	Prospect Hill Trib	PHT05	750
231	Spring Garden	West Branch	Spring Grove Trib	SG03	2280
232	Jackson	West Branch	Spring Grove Trib	SGR01	380
233	Spring Grove	West Branch	Spring Grove Trib	SGR03	1155
234	N Codorus	West Branch	Swimming Pool Trib	SPT07/SPT08	1725
235	N Codorus	West Branch	Swimming Pool Trib	SPT201	790
236	N Codorus	West Branch	Swimming Pool Trib	SPT501	1200
237	Jackson	West Branch	Sunnyside Trib	SS02	350
238	Jackson	West Branch	Sunnyside Trib	SS02	1200
239	N Codorus	West Branch	Stoverstown Branch	ST01	1840
240	N Codorus	West Branch	Stoverstown Branch	ST02/ST03/ST04	2685
241	N Codorus	West Branch	Stoverstown Branch	ST03ST103	2280
242	N Codorus	West Branch	Stoverstown Branch	ST04	1390
243	N Codorus	West Branch	Stoverstown Branch	ST05(GOLF)	1950
244	N Codorus	West Branch	Stoverstown Branch	ST09	640
245	N Codorus	West Branch	Stoverstown Branch	ST10	875
246	N Codorus	West Branch	Stoverstown Branch	ST11	1650
247	N Codorus	West Branch	Stoverstown Branch	ST204/ST205/ST203	1350
248	N Codorus	West Branch	Stoverstown Branch	ST501	0
249	N Codorus	West Branch	Stoverstown Branch	ST702/ST703	1160
250	Manheim	West Branch	Upper Codorus Creek	UCC03	500
251	Manheim	West Branch	Upper Codorus Creek	UCC04	390
252	Manheim	West Branch	Upper Codorus Creek	UCC06	500
253	Manheim	West Branch	Upper Codorus Creek	UCC08	1150
254	Manheim	West Branch	Upper Codorus Creek	UCC10	750
255	Manheim	West Branch	Upper Codorus Creek	UCC1003/UCC1002	800
256	Manheim	West Branch	Upper Codorus Creek	UCC1004	1785
257	Manheim	West Branch	Upper Codorus Creek	UCC11	3600
258	Manheim	West Branch	Upper Codorus Creek	UCC1201	780
259	Manheim	West Branch	Upper Codorus Creek	UCC14/UCC13/UCC12	1900
260	Codorus	West Branch	Upper Codorus Creek	UCC1402	1600
261	Codorus	West Branch	Upper Codorus Creek	UCC1403	1470
262	Codorus	West Branch	Upper Codorus Creek	UCC15	1550
263	Codorus	West Branch	Upper Codorus Creek	UCC1602	990
264	Manheim	West Branch	Upper Codorus Creek	UCC17/UCC16/UCC18	2850
265	Manheim	West Branch	Upper Codorus Creek	UCC1701/1702	950
266	Manheim	West Branch	Upper Codorus Creek	UCC1801	225

267	Manheim	West Branch	Upper Codorus Creek	UCC1801	735
268	Manheim	West Branch	Upper Codorus Creek	UCC1801(U/S)	950
269	Manheim	West Branch	Upper Codorus Creek	UCC1802	650
270	Manheim	West Branch	Upper Codorus Creek	UCC1803	1105
271	Manheim	West Branch	Upper Codorus Creek	UCC1804	1130
272	Manheim	West Branch	Upper Codorus Creek	UCC1805	1700
273	Manheim	West Branch	Upper Codorus Creek	UCC19/UCC18	1750
274	Codorus	West Branch	Upper Codorus Creek	UCC20	575
275	Manheim	West Branch	Upper Codorus Creek	UCC201	600
276	Manheim	West Branch	Upper Codorus Creek	UCC21	0
277	Manheim	West Branch	Upper Codorus Creek	UCC21/UCC3402	1450
278	Manheim/Codorus	West Branch	Upper Codorus Creek	UCC22//UCC23	1320
279	Manheim	West Branch	Upper Codorus Creek	UCC2301	1350
280	Codorus	West Branch	Upper Codorus Creek	UCC2901	350
281	Codorus	West Branch	Upper Codorus Creek	UCC3002	750
282	Codorus	West Branch	Upper Codorus Creek	UCC3003	1350
283	Manheim	West Branch	Upper Codorus Creek	UCC302/UCC301	1540
284	Codorus	West Branch	Upper Codorus Creek	UCC3301	600
285	Codorus	West Branch	Upper Codorus Creek	UCC3301	775
286	Codorus	West Branch	Upper Codorus Creek	UCC3301	475
287	Manheim	West Branch	Upper Codorus Creek	UCC3401	600
288	Jefferson	West Branch	Upper Codorus Creek	UCC3703	700
289	Codorus	West Branch	Upper Codorus Creek	UCC3704	1300
290	Codorus	West Branch	Upper Codorus Creek	UCC3705	1700
291	Codorus	West Branch	Upper Codorus Creek	UCC3706	720
292	Codorus	West Branch	Upper Codorus Creek	UCC3902	1100
293	Manheim	West Branch	Upper Codorus Creek	UCC401	825
294	Manheim	West Branch	Upper Codorus Creek	UCC601	800
295	Codorus	West Branch	Upper Codorus Creek	UCC701	1120
296	Codorus	West Branch	Upper Codorus Creek	UCC801	2400
297	Codorus	West Branch	Upper Codorus Creek	UCC902	500
298	W Manheim	West Branch	West Branch Codorus Creek	WBCC02	700
299	W Manheim	West Branch	West Branch Codorus Creek	WBCC03	2140
300	W Manheim	West Branch	West Branch Codorus Creek	WBCC04	1380
301	W Manheim	West Branch	West Branch Codorus Creek	WBCC07	1250
302	W Manheim	West Branch	West Branch Codorus Creek	WBCC08	860
303	W Manheim	West Branch	West Branch Codorus Creek	WBCC09	2500
304	W Manheim	West Branch	West Branch Codorus Creek	WBCC1001	400
305	W Manheim	West Branch	West Branch Codorus Creek	WBCC1201	677
306	W Manheim	West Branch	West Branch Codorus Creek	WBCC1302	790
307	Hanover	West Branch	West Branch Codorus Creek	WBCC1501	830
308	W Manheim	West Branch	West Branch Codorus Creek	WBCC1902	0
309	W Manheim	West Branch	West Branch Codorus Creek	WBCC201	1700
310	W Manheim	West Branch	West Branch Codorus Creek	WBCC202	1670
311	W Manheim	West Branch	West Branch Codorus Creek	WBCC203	500
312	Manheim	West Branch	West Branch Codorus Creek	WBCC2501	500
313	Heidelberg	West Branch	West Branch Codorus Creek	WBCC2701	500
314	Heidelberg	West Branch	West Branch Codorus Creek	WBCC2901	950
315	W Manheim	West Branch	West Branch Codorus Creek	WBCC301	2775
316	W Manheim	West Branch	West Branch Codorus Creek	WBCC801	560
				TOTAL LINEAR FEET	436277

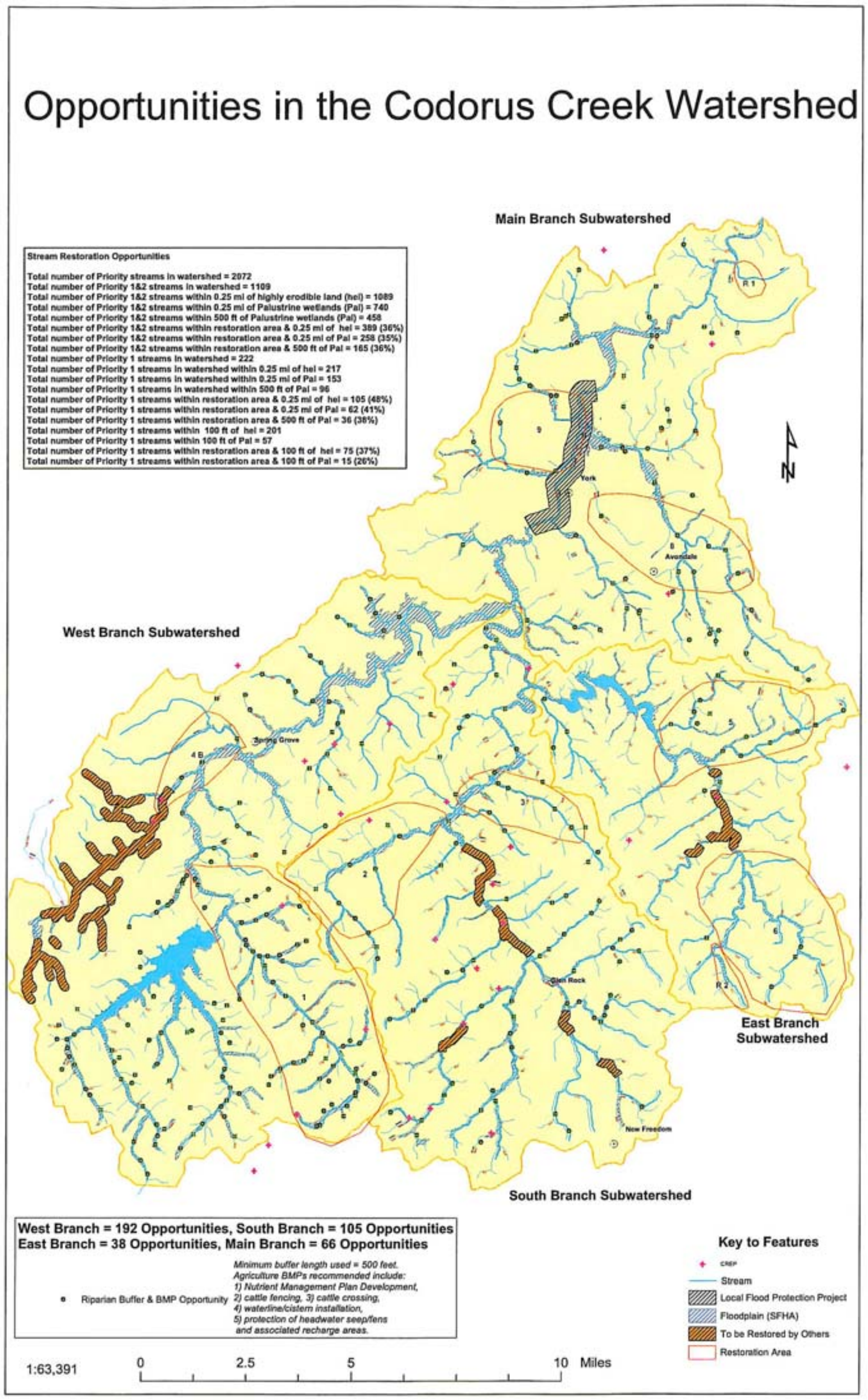

Figure 1-7. Opportunities for Stream Restoration of Codorus Creek Watershed

1.7 Total Maximum Daily Loads (TMDL) and Previous Studies

Under Section 303(d) of the Federal Clean Water Act, Pennsylvania is required to maintain a list of "impaired waters" that do not meet water quality standards required to protect aquatic life, human health/fish consumption, and/or recreational uses. In order for a waterbody to be included on the list, it must be determined that required technology-based treatment measures for pollution sources (point and non-point) will not be adequate to attain/maintain water quality standards. Once the waterbody is listed on the impaired waters, or 303(d) list, the Pennsylvania Department of Environmental Protection must determine conditions that would return the quality of the impaired waters to acceptable standards.

1.7.1 South Branch Codorus Creek Watershed Targeted TMDLs

Targeted TMDL values for the South Branch Codorus Creek subbasins were established based on current loading rates for phosphorus and sediment in the North Branch Muddy Creek reference subwatershed. Biological assessments have determined that the North Branch Muddy Creek subwatershed is currently attaining its designated uses. Reducing the loading rate of phosphorus and sediment in the South Branch Codorus subbasins (Figure 1-8) to levels equivalent to those in the reference portion of the North Branch Muddy Creek subwatershed will provide conditions favorable for the reversal of current use impairments.

There are two separate considerations of background pollutants within the context of these TMDLs. First, there is the inherent assumption of the reference watershed approach that because of the similarities between the reference and impaired watershed, the background pollutant contributions will be similar. Therefore, the background pollutant contributions will be considered when determining the loads for the impaired watershed that are consistent with the loads from the reference watershed. Second, the Arc View Generalized Watershed Loading Function (AVGWLF) model implicitly considers background pollutant contributions through the soil and the groundwater component of the model process.

The targeted TMDL values for phosphorus and sediment were determined by multiplying the total area of subbasins 1 and 2 (25,180.00 acres and 20,759.40 acres respectively) by the appropriate unit area loading rate for the North Branch Muddy Creek reference subwatershed. The existing mean annual loading of phosphorus and sediment to subbasin 1 (33,852.94 lbs/yr and 29,141,794.00 lbs/yr respectively) will need to be reduced by 52 percent and 53 percent to meet the targeted TMDL of 16,367.00 lbs/yr of phosphorus and 13,773,460.00 lbs/yr of sediment respectively. The existing mean annual loading of phosphorus and sediment to subbasin 2 (24,269.89 lbs/yr and 17,753,092.40 lbs/yr respectively) will need to be reduced by 44 percent and 36 percent to meet the targeted TMDL of 13,493.61 lbs/yr of phosphorus and 11,355,391.80 lbs/yr of sediment respectively.

Targeted TMDL values were then used as the basis for load allocations and reductions in the South Branch Codorus Creek subbasins, using the following two equations:

1. TMDL = WLA + LA + MOS
2. LA = ALA + LNR

where:

TMDL = Total Maximum Daily Load
WLA = Waste Load Allocation (point sources)
LA = Load Allocation (nonpoint sources)
ALA = Adjusted Load Allocation
LNR = Loads not Reduced

South Branch Codorus Creek Wasteload Allocation

There are two point sources in the watershed that discharge nutrients into the South Branch Codorus Creek. Both discharges are wastewater treatment plants associated with the towns of Glen Rock and New Freedom. Glen Rock has an average annual loading for phosphorus of 1,754.00 lbs/yr, with a permit limit of 3,650.00 lbs/yr. New Freedom has an average annual loading for phosphorus of 5,031.80 lbs/yr, with a permit limit of 4,562.50 lbs/yr to be implemented in September 2005. An interim permit limit for phosphorus of 6,752.50 lbs/yr currently exists at the New Freedom facility. This TMDL utilizes the final permit limits for both facilities in determining the loading limits.

South Branch Codorus Creek Margin of Safety

The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10 percent of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of the South Branch Codorus Creek subbasins. The MOS used for the phosphorus and sediment loads for subbasin 1 were 1,636.7 lbs/yr and 1,377,346.00 lbs/yr respectively. The MOS used for the phosphorus and sediment loads for subbasin 2 were 1,349.36 lbs/yr and 1,135,539.18 lbs/yr respectively.

Subbasin 1

Phosphorus - MOS = 16,367.00 lbs/yr (TMDL) x 0.1 = 1,636.70 lbs/yr
Sediment - MOS = 13,773,460.00 lbs/yr (TMDL) x 0.1 = 1,377,346.00 lbs/yr

Subbasin 2

Phosphorus - MOS = 13,493.61 lbs/yr (TMDL) x 0.1 = 1,349.36 lbs/yr
Sediment - MOS = 11,355,391.80 lbs/yr (TMDL) x 0.1 = 1,135,539.18 lbs/yr

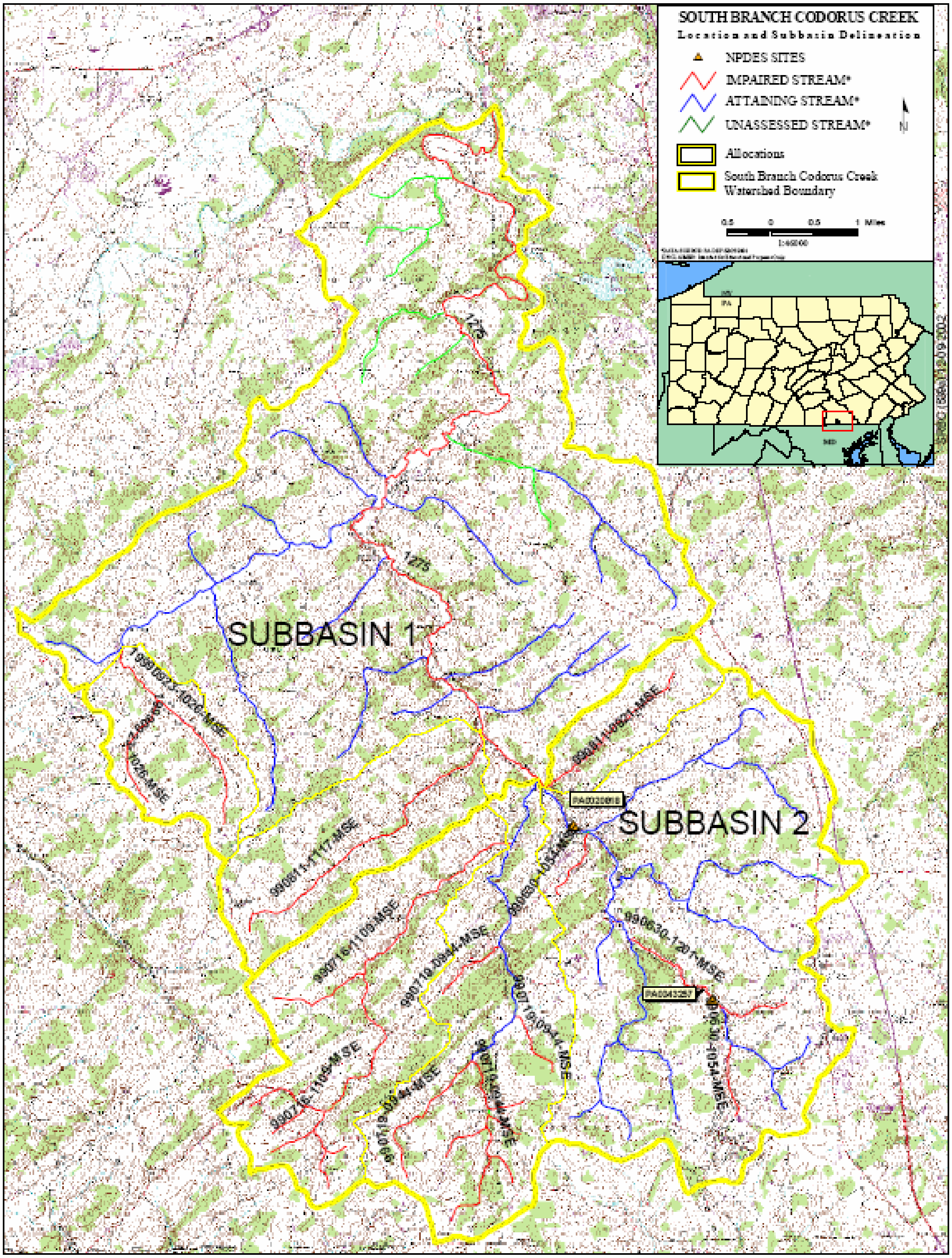

Figure 1-8. South Branch Codorus Creek Watershed TMDL Areas

South Branch Codorus Creek Load Allocation

The LA is that portion of the TMDL that is assigned to nonpoint sources. The LA was computed by subtracting the WLA and MOS values from the targeted TMDL value. The LAs for subbasin 1 for phosphorus and sediment were 11,080.30 lbs/yr and 12,396,114.00 lbs/yr respectively. The LAs for subbasin 2 for phosphorus and sediment were 7,581.75 lbs/yr and 10,219,852.62 respectively.

Subbasin 1

Phosphorus - LA = 16,367.00 lbs/yr (TMDL) – 3,650.00 lbs/yr (WLA) – 1,636.7 lbs/yr (MOS) = 11,080.30 lbs/yr
Sediment - LA = 13,773,460.00 lbs/yr (TMDL) – 0.0 lbs/yr (WLA) – 1,377,346.00 lbs/yr (MOS) = 12,396,114.00 lbs/yr

Subbasin 2

Phosphorus - LA = 13,493.61 lbs/yr (TMDL) – 4,562.50 lbs/yr (WLA) – 1,349.36 lbs/yr (MOS) = 7,581.75 lbs/yr
Sediment - LA = 11,355,391.80 lbs/yr (TMDL) – 0.0 lbs/yr (WLA) – 1,135,539.18 lbs/yr (MOS) = 10,219,852.62 lbs/yr

South Branch Codorus Creek Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Phosphorus and sediment reductions were made to the hay/ pasture, cropland, developed areas, and streambanks. Those land uses/sources for which existing loads were not reduced (CONIF_FOR, MIXED_FOR, DECID_FOR, GROUNDWATER) were carried through at their existing loading values. The ALAs for phosphorus and sediment for subbasin 1 were 6,276.10 lbs/yr and 12,308,514.00 lbs/yr respectively. The ALAs for phosphorus and sediment for subbasin 2 were 4,301.95 lbs/yr and 10,151,852.62 lbs/yr respectively.

South Branch Codorus Creek TMDLs

The phosphorus and sediment TMDLs established for the South Branch Codorus Creek subbbasins consists of a WLA, a LA and a MOS. No TMDL was established for nitrogen because the stream is phosphorus limited.

South Branch Codorus Creek Calculation of Sediment Load Reductions

The ALAs established in the previous section represent the annual phosphorus and sediment loads that are available for allocation between contributing sources in the South Branch Codorus Creek subbasins. The ALAs for phosphorus and sediment were allocated between agricultural and developed land uses, and stream banks. Data needed for load reduction analyses, including land use distribution, were obtained by GIS analysis. The

Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute the ALA between the appropriate contributing land uses.

The load allocation and EMPR procedures were performed using MS Excel. Table 1-6 and 1-7 contain the results of the EMPR for total phosphorus and sediment for the appropriate contributing land uses in the South Branch Codorus Creek subbasins 1 and 2, respectively. The load allocation for each land use is shown, along with the percent reduction of current loads necessary to reach the targeted LA. Each allocation unit corresponds with a TMDL segment shown in figure 1-8.

Table 1-6. TMDL Load Allocations of South Branch Codorus Creek Subbasin 1

Allocation 1 – South Branch Codorus –Glen Rock to Seven Valleys (Segment ID 1275)						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	4,580.28	0.14	0.1	641.24	549.63	14
Cropland	10,132.81	2.13	0.4	21,582.89	4,357.11	80
Developed	145.17	1.02	0.9	148.07	126.30	15
Streambanks	0	0	0	110.92	94.10	15
Subtotals	14,858.26	3.29	1.4	22,483.12	5,127.14	31
Sediment						
Hay/Pasture	4,580.28	145.50	132.71	666,430.74	607,848.96	9
Cropland	10,132.81	2,268.25	913.76	22,983,746.28	9,258,956.47	60
Developed	145.17	281.25	256.53	40,829.06	37,240.46	9
Streambanks	0	0	0	240,565.14	219,419.30	9
Subtotals	14,858.26	2,695	1303	23,931,571.22	10,123,465.19	22
Allocation 2 – South Branch Codorus –Buffalo Valley Hollow Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	507.25	0.14	0.1	71.02	60.87	14
Cropland	1,040.24	2.13	0.4	2,215.71	447.30	80
Developed	9.44	1.02	0.9	9.63	8.21	15
Streambanks	0	0	0	9.79	8.17	17
Subtotals	1,556.93	3.29	1.4	2,306.15	524.55	32
Sediment						
Hay/Pasture	507.25	145.50	132.17	73,804.88	67,317.15	9
Cropland	1,040.24	2,268.25	913.76	2,359,524.38	950,529.70	60
Developed	9.44	281.25	256.53	2,655.00	2,421.64	9
Streambanks	0	0	0	23,759.52	21,671.04	9
Subtotals	1,556.93	2,695	1302.46	2,459,743.78	1,041,939.53	22
Allocation 3 – South Branch Codorus, Krebs Valley Run Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	792.95	0.14	0.1	111.01	95.15	14
Cropland	1,183.88	2.13	0.4	2,521.66	509.07	80
Developed	10.09	1.02	0.9	10.29	8.78	15
Streambanks	0	0	0	12.48	10.46	16
Subtotals	1,986.92	3.29	1.4	2,655.44	623.46	31
Sediment						
Hay/Pasture	792.95	145.50	132.71	115,374.23	105,232.39	9
Cropland	1,183.88	2,268.25	913.76	2,685,335.81	1,081,782.19	60
Developed	10.09	281.25	256.53	2,837.81	2,588.39	9
Streambanks	0	0	0	3,2669.34	29,797.68	9
Subtotals	1,986.92	2,695	1303	2,836,217.19	1,219,400.65	22

Table 1-7. TMDL Load Allocations of South Branch Codorus Creek Subbasin 2

Allocation 4 – Upper South Branch Codorus - New Freedom to Glen Rock (Segment ID 19990630-1054-MSE & 19990630-1201-MSE)						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	2,272.25	0.10	0.09	227.23	204.50	10
Cropland	4,886.30	1.65	0.40	8,062.40	1,954.52	76
Developed	502.72	0.15	0.13	75.41	65.35	13
Streambanks	0	0	0	45.25	39.14	13
Subtotals	7,661.27	1.9	0.62	8,410.29	2,263.51	28
Sediment						
Hay/Pasture	2,272.25	113.04	105.28	256,855.14	239,222.48	7
Cropland	4,886.30	1,821.93	1,017.09	8,902,496.56	4,969,806.87	44
Developed	502.72	34.53	32.16	17,358.92	16,167.48	7
Streambanks	0	0	0	11,765.54	10,957.84	7
Subtotals	7,661.27	1,969.5	1,154.53	9,188,476.16	5,236,154.67	16
Allocation 5 – South Branch Codorus – Foust Creek Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	254.50	0.10	0.09	26.25	22.76	13
Cropland	631.37	1.65	0.40	1,039.13	253.39	76
Developed	12.02	0.15	0.13	1.82	1.58	13
Streambanks	0	0	0	5.30	4.59	13
Subtotals	897.89	1.9	0.62	1,072.5	282.32	29
Sediment						
Hay/Pasture	254.50	113.04	105.28	28,768.68	26,793.76	7
Cropland	631.37	1,821.93	1,017.09	1,150,311.94	642,160.11	44
Developed	12.02	34.53	32.16	415.05	386.56	7
Streambanks	0	0	0	11,765.54	10,957.84	7
Subtotals	897.89	1,969.5	1,154.53	1,191,261.21	680,298.27	16
Allocation 6 – South Branch Codorus -Centerville Creek Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	997.26	0.10	0.09	99.73	89.75	10
Cropland	1,884.38	1.65	0.40	3,109.23	753.75	76
Developed	21.13	0.15	0.13	3.17	2.75	13
Streambanks	0	0	0	17.14	14.83	13
Subtotals	2,902.77	1.9	0.62	3,229.27	861.08	28
Sediment						
Hay/Pasture	997.26	113.04	105.28	112,730.27	104,991.53	7
Cropland	1,884.38	1,821.93	1,017.09	3,433,208.45	1,916,584.05	44
Developed	21.13	34.53	32.16	729.62	697.54	7
Streambanks	0	0	0	39,218.48	36,526.14	7
Subtotals	2,902.77	1,969.5	1,154.53	3,585,886.82	2,058,799.26	16
Allocation 7 – South Branch Codorus – Pierceville Run Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Phosphorus						
Hay/Pasture	1,182.48	0.10	0.09	118.25	106.42	10
Cropland	1,898.42	1.65	0.40	3,132.39	759.37	76
Developed	19.04	0.15	0.13	2.86	2.48	13
Streambanks	0	0	0	18.31	15.84	13
Subtotals	3,099.94	1.9	0.62	3,271.81	884.11	28
Sediment						
Hay/Pasture	1,182.48	113.04	105.28	133,667.54	124,491.49	7
Cropland	1,898.42	1,821.93	1,017.09	3,458,788.35	1,930,864.00	44
Developed	19.04	34.53	32.16	657.45	612.33	7
Streambanks	0	0	0	41,179.40	38,352.45	7
Subtotals	3,099.94	1,969.5	1,154.53	3,634,292.74	2,094,320.27	16

1.7.2 Oil Creek Targeted TMDL

Targeted TMDL values for the Oil Creek subwatershed were established based on current loading rates for sediment in the Kreutz Creek reference subwatershed. Biological assessments have determined that the Kreutz Creek subwatershed is currently attaining its designated uses. Reducing the loading rate of sediment in the Oil Creek subwatershed (Figure 1-9) to levels equivalent to those in the reference portion of the Kreutz Creek subwatershed will provide conditions favorable for the reversal of current use impairments.

The targeted TMDL value for sediment was determined by multiplying the total area of the Oil Creek subwatershed (2,482.32 acres) by the appropriate unit area loading rate for the Kreutz Creek subwatershed. The existing mean annual loading of sediment to the Oil Creek subwatershed (1,549,618.60 lbs/yr) will need to be reduced by 33% to meet the targeted TMDL of 1,039,943.14 lbs/yr.

Targeted TMDL values were than used as the basis for load allocations and reductions in the Oil Creek subwatershed, using the following two equations:

1. TMDL = WLA + LA + MOS
2. LA = ALA + LNR

where:

TMDL = Total Maximum Daily Load
WLA = Waste Load Allocation (point sources)
LA = Load Allocation (nonpoint sources)
ALA = Adjusted Load Allocation
LNR = Loads not Reduced

Oil Creek Wasteload Allocation

There are no known wasteload allocations for sediment in the Oil Creek subwatershed.

Oil Creek Margin of Safety

The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for sediment was reserved as the MOS. Using 10% of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of the Oil Creek subwatershed. The MOS used for the sediment TMDL was 103,994.31 lbs/yr. MOS = 1,039,943.14 lbs/yr (TMDL) x 0.1 = 103,994.31 lbs/yr

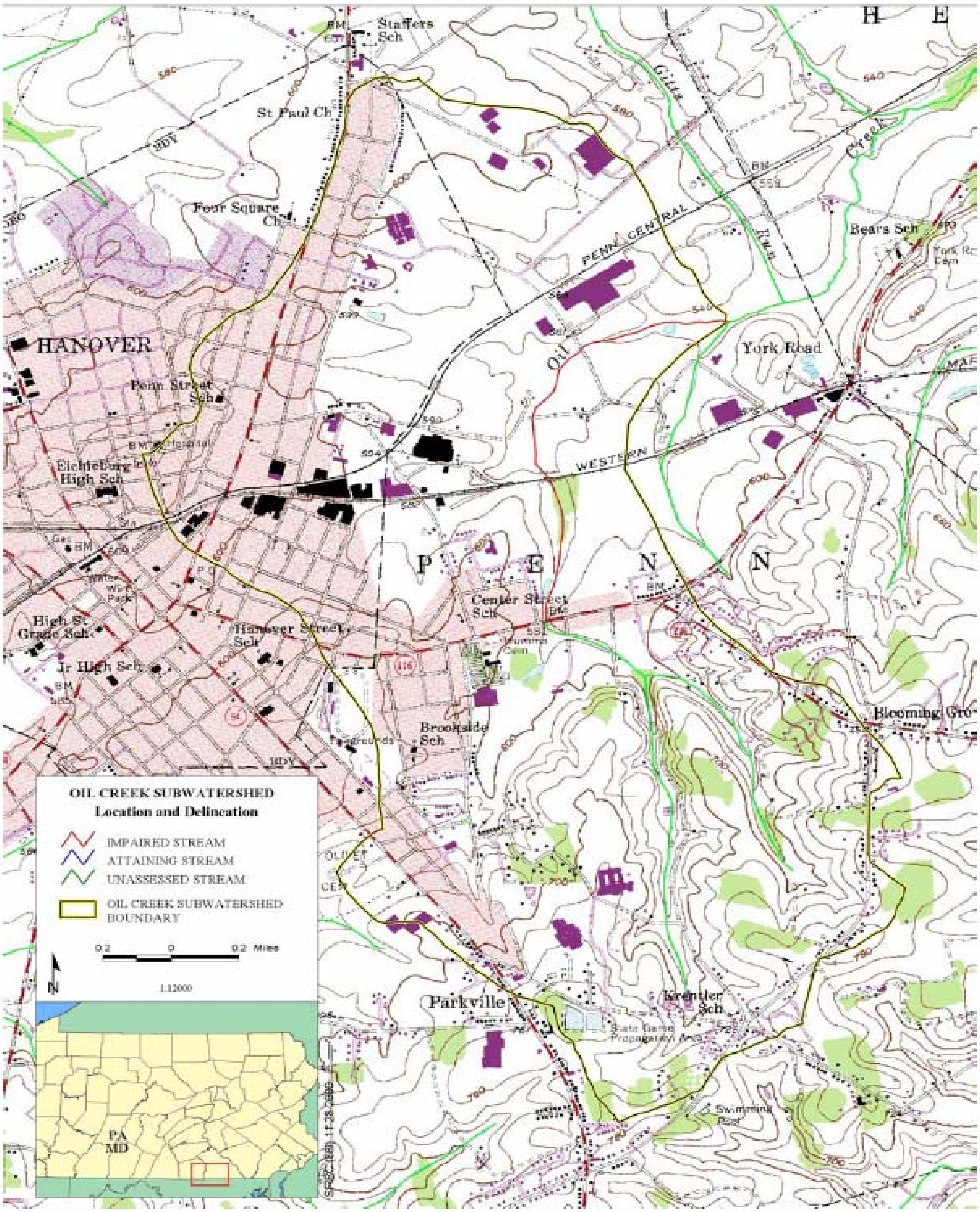

Figure 1-9. Oil Creek TMDL Subbasin

Oil Creek Load Allocation

The LA is that portion of the TMDL that is assigned to nonpoint sources. The LA was computed by subtracting the WLA and MOS values from the targeted TMDL value. LA for the Oil Creek subwatershed is 935,948.83 lbs/yr. LA = 1,039,943.14 lbs/yr (TMDL) – 0.0 lbs/yr (WLA) – 103,994.31 lbs/yr (MOS) = 935,948.83 lbs/yr

Oil Creek Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Sediment reductions were made to the hay/pasture, cropland, developed areas, and streambanks. Those land uses/sources for which existing loads were not reduced (CONIF_FOR, MIXED_FOR, DECID_FOR) were carried through at their existing loading values (Table 5). The ALA for the Oil Creek subwatershed was 935,548.83 lbs/yr.

Oil Creek TMDL

The sediment TMDL established for the Oil Creek subwatershed consists of a LA and a MOS.

Oil Creek Calculation of Sediment Load Reductions

The ALA is established in the previous section represent the annual sediment load that is available for allocation between contributing sources in the Oil Creek subwatershed. The ALA for sediment was allocated between agricultural and developed land uses. LA and reduction procedures were applied to the entire Oil Creek subwatershed using the Equal Marginal Percent Reduction (EMPR) allocation method. The LA and EMPR procedures were performed using MS Excel.

In order to meet the sediment TMDL for the Oil Creek subbasin (1,039,943.14 lbs/yr), the load currently emanating from agricultural sources (1,322,600 lbs/yr) must be reduced to 783,890.96 lbs/yr (Table 1-8). This can be achieved through a 33% and 42% reduction in current sediment loading from hay/pasture and cropland respectively. The load currently emanating from developed sources (30,000 lbs/yr) must be reduced by 33% to reach 20,076.62 lbs/yr. The load currently emanating from stream banks (196,618.60 lbs/yr) must be reduced by 33% to reach 131,581.25 lbs/yr.

Table 1-8. TMDL Load Allocations & Reductions of Oil Creek

Allocation 1 – Oil Creek Segment						
Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Reduction (%)
		Current	Allowable	Current	Allowable	
Sediment						
Hay/Pasture	492.59	478.69	320.35	235,800.00	157,802.26	33
Cropland	989.42	1,098.42	632.78	1,086,800.00	626,088.70	42
Developed	855.09	35.08	23.48	30,000.00	20,076.62	33
Streambanks	0	0	0	196,618.60	131,581.25	33
Subtotals	2337.1	1,612.19	976.61	1,549,218.6	935,548.83	39

1.7.3 Previous Studies

Riparian Zone

Riparian zones are transitional areas between land and water environments. Riparian areas have unique plant and soil characteristics often much different than the land and water environments they connect.

Undisturbed riparian zones teem with wildlife and dense vegetation such as grasses, shrubs, and larger tree species such as willows, oaks, maples, hemlocks, and sycamores. Riparian areas protect and stabilize the adjacent waterbody and perform many vital functions including, but not limited to: stream bank/shoreline stabilization, moderation of temperature, attenuation of flood waters, improve water quality, and enhance wildlife habitat.

According to the Watershed Assessments, the Codorus Creek lacks riparian zones and what riparian areas are in tact, are not in good condition. Many of the riparian zones are too narrow to offer any benefits and most are not forested and contain vegetation that cannot stabilize the bank nor offer temperature moderation.

Riparian areas, sometimes referred to as buffers, are one of the most important features of a landscape for the protection of water quality and quantity. Understanding the functions and benefits of riparian areas is critical to watershed planning. Many of the improvements to water quality and quantity needed in a watershed, can be achieved through the restoration of these areas.

Soil Erosion/Loss

Due to poor land management and uses, the watershed is experiencing significant soil erosion and loss. While it is tough to estimate the amount of soil lost each year, some estimates of soil loss through streambank erosion amount to more than 60,000 tons/year. These estimates only account for streambank erosion and do not consider soil loss through streambeds, agricultural lands, barren land, and construction sites with malfunctioning erosion control measures.

Soil and sediment deposition is one of, if not the most, significant causes of the decline in productivity of the Chesapeake Bay Estuary, of which the Codorus Creek is a major tributary through the Susquehanna River. Sedimentation of the bay causes complete communities of clams, oysters, kelp beds, and the famous Maryland Blue Crab to disappear. Suspended sediments in the bay block valuable light from reaching the organisms on the bay floor. These same sediments often have nutrients bonded to them from agricultural, commercial and recreational (golf courses) sources. Because of the increase in nutrient load, algal blooms form which also block sunlight from reaching the bay floor. Some of these algal blooms can be toxic to fish and humans. This process is known as *eutrophication.* Natural eutrophication is the process by which lakes gradually age and become more productive. It normally takes thousands of years to progress. However, humans, through their various cultural activities, have greatly accelerated this process in thousands of lakes around the globe. Cultural or anthropogenic "*eutrophication*" is water pollution caused by excessive plant nutrients.

Humans add excessive amounts of plant nutrients (primarily phosphorus, nitrogen, and carbon) to streams and lakes in various ways. Runoff from agricultural fields, field lots, urban lawns, and golf courses is one source of these nutrients. Untreated, or partially-treated, domestic sewage is another major source. Sewage was a particular source of phosphorus to lakes when detergents contained large amounts of phosphates. The phosphates acted as water softeners to improve the cleaning action, but they also proved to be powerful stimulants to algal growth when they were washed or flushed into lakes.

The excessive growth, or "blooms", of algae promoted by these phosphates changed water quality in Lake Erie and many other lakes. These algal blooms led to oxygen depletion and resultant fish kills. Many native fish species disappeared, to be replaced by species more resistant to the new conditions. Beaches and shorelines were fouled by masses of rotting, stinking algae. A means to control this problem became a paramount need.

Using small, natural lakes as experimental systems, scientists at the Experimental Lakes Area (ELA) were able to add various combinations of nutrients and determine which of the major plant nutrients (carbon, nitrogen, phosphorus) was the key to controlling cultural eutrophication in lakes. Over a number of years, seven different ELA lakes were experimentally fertilized in various ways. Two of these lakes were particularly important in demonstrating that phosphorus was the key nutrient for the control of eutrophication.

Although eutrophication is not a significant problem within the watershed, sound watershed planning principles must take into account the effects to downstream receiving waters and communities. As discussed earlier, the Codorus Creek is a major tributary to the Susquehanna River which is in turn a major tributary to the Chesapeake Bay estuary. As a result, understanding eutrophication including the causes of it, is important in a watershed management plan.

It is understood that within the Codorus Creek watershed there is excessive amounts of sediment being lost from riparian areas, agricultural fields, and the streams themselves.

What is not known, is the amount of phosphorus that is being transported with this sediment. As a result, reducing soil loss and erosion should be a major priority of watershed stakeholders.

Stormwater Management

Stormwater management is the detention, retention, control, and release of stormwater runoff often associated with impervious surfaces. Stormwater management is a relatively new (past 40 years) technique that is part of almost every sub-division/land development ordinance. Often, developers and land owners are required to match the post-development runoff to that of the pre-development conditions. On a small scale, and on a project-by-project basis, this works. However, stormwater from impervious surfaces is a major cause of stream degradation, soil loss, and streambank instability.

Every stream has a natural sediment load balance for a given watershed. If there is too much sediment in the water, such as from agricultural runoff, that sediment can settle out onto the bed of the stream and cause islands and significant point bars. If there is not enough sediment in the water, the stream will pull sediment from it's banks and bed, cause down cutting of the stream channel which then causes bank instability and collapse. This sediment is then transported downstream.

To be effective in our stormwater management we must begin to look at regional stormwater management on a watershed scale. When doing so, we are connecting different regions so our releases are timed to minimize damage.

The York County Planning Commission is currently completing an Act 167 Stormwater Management Plan for the Codorus Creek Watershed. The plan addresses stormwater management on a watershed level as opposed to a municipal level.

Biological Resources

Invasive species are of great concern in the watershed. Invasive species are very aggressive and adaptable to environmental change and result in decreased biological diversity and can create economic hardships. Of special concern is mile-a-minute weed (Polygonum perfoliatum), purple loosestrife (Lythrum salicaria), Japanese knotweed (Polygonum cuspidatum), garlic mustard (Alliaria petiolata), autumn olive (Elaeagnus umbellate), multiflora rose (Rosa multiflora), and Japanese honeysuckle (Lonicera japonica). Invasive species often take over native communities and usually offer little habitat to other native species of birds and mammals. This is compounded by the continued growth and construction in the watershed. The subsequent loss of wetlands, floodplains, riparian areas, and forested habitats reduces habitat for threatened and endangered species.

Because of the aggressive and adaptable nature of invasive species, exposed and/or disturbed ground is particularly vulnerable to growth and establishment of these species. Once established, eradication can be difficult hence the need to stabilize exposed areas with native vegetation. Invasive species often out compete native species for available resources. Of high priority in the watershed is mile-a-minute weed which acts as a vegetative blanket over native low-growing vegetation.

Fluvial Geomorphological Assessments

There were three separate geomorphic assessment reports for the entire Codorus Creek Watershed. These assessments were completed between 1999 and 2003. The goals of the assessments were to determine the stability of the watersheds streams and streambanks and develop a list of prioritized reaches for restoration. These assessments should be used as a tool for the eventual restoration of the Priority 1 and 2 stream reaches within the watershed. The reports of each for the assessments contain valuable information about the locations for restoration and the techniques and have been incorporated into the following sections for developing this implementation plan.

Water Resources Development Act Feasibility Study Sec. 206

The Interim Environmental Restoration Report is a combination of two previously initiated feasibility studies being conducted under the Continuing Authorities Program (CAP). Both feasibility studies were initiated in January 2003 but were subsequently halted in Fiscal Year 2004 due to limited CAP funding. In November 2004, Congress reinstated the funding to the Army Corps of Engineers for the continuation of this effort. The two feasibility studies were the Section 206 of the Water Resources Development Act of 1996 for the aquatic resources restoration within the watershed and the Section 1135 of the Water Resources Development Act of 1986 which provides the ACOE the authority to make modifications to existing structures for the improvement of the environment. Section 1135 relates to the Flood Control Project on the Codorus Creek through the City of York. Officials from the City of York and the York County Commissioners requested the USACOE, Baltimore District, conduct two studies to investigate the potential for environmental improvements and restoration. These studies used a watershed based ecosystem approach to identify problems and restoration opportunities in the watershed, focusing on restoration of aquatic life and stream habitat.

Other Efforts

Fortunately for the watershed, the re are numerous school groups, universities, non-profit organizations, municipalities, and government resource agencies which are conducting studies and completing projects that analyze and protect the watershed. These projects range from stream restoration using natural channel design principles and detailed water quality surveys to community involvement programs such as stream clean-ups. By partnering with other agencies and organizations, groups can form alliances that make an effort more feasible and stronger. Table 1-9 is a list of past and present projects within the Codorus Creek Watershed. Please note that this is not an exhaustive list and may not contain some projects.

Table 1- 9. Stream Restoration Best Management Practices Implemented (1995-2005) and Planned (2006-2010) in Codorus Creek Watershed

Year	Best Management Practices	Linear Feet	Stream	Status	Pounds Sediment Reduced	Documentation
1994	Habitat improvement	1,000	EBCC	Implemented	NA	319 Program
1999	Stream stabilization & riparian forest buffer planting	2,600	SBCC	Implemented	2,080,000	Growing Greener
2000	Stream stabilization & riparian forest buffer planting	400	EBCC	Implemented	320,000	Growing Greener
2000	Stream stabilization & riparian forest buffer planting	2,100	SBCC	Implemented	1,680,000	Growing Greener
2001	Stream stabilization & riparian forest buffer planting	650	EBCC	Implemented	520,000	Growing Greener
2001	Stream stabilization & riparian forest buffer planting	11,000	Seaks Run EBCC	Implemented	8,800,000	319 Program
2001	Stream stabilization & riparian forest buffer planting	4,500	SBCC	Implemented	3,600,000	319 Program
2003	Stream stabilization & riparian forest buffer planting	4,300	EBCC	Implemented	3,440,000	319 Program
2003	Stream stabilization & riparian forest buffer planting	14,000	SBCC	Planned	11,200,000	319 Program
2003	Stream stabilization & riparian forest buffer planting	3,400	Oil Creek	Planned	2,720,000	319 Program
2004	Stream stabilization & riparian forest buffer planting	4,000	SBCC	Planned	3,200,000	319 Program
2004	Stream stabilization & riparian forest buffer planting	4,000	EBCC	Planned	3,200,000	319 Program
2005	Stream stabilization & riparian forest buffer planting	2,300	Pierceville Run SBCC	Implemented	1,840,000	319 Program
2005	Stream stabilization & riparian forest buffer planting	3,300	EBCC	Planned	2,640,000	319 Program
2005	Streambank rehabilitation and protection	150	Mill Creek CC	Implemented	120,000	HELP-Streams
2006	Stream stabilization & riparian forest buffer planting	2,200	EBCC	Planned	1,760,000	319 Program
2006	Stream stabilization & riparian forest buffer planting	3,350	EBCC	Planned	2,680,000	319 Program
2006	Stream stabilization & riparian forest buffer planting	2,270	Pierceville Run SBCC	Planned	1,816,000	319 Program
2006	Streambank rehabilitation and protection	300	Mill Creek CC	Implemented	240,000	HELP-Streams
2007	Stream stabilization & riparian forest buffer planting	2,000	UNT EBCC	Planned	1,600,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	1,500	Mill Creek CC	Planned	1,200,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	3,500	Poorhouse Run CC	Planned	2,800,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	6,000	EBCC	Planned	4,800,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	3,250	EBCC	Planned	2,600,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	8,400	DVT EBCC	Planned	6,720,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	2,400	SBCC	Planned	1,920,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	1,900	SBCC	Planned	1,520,000	319 Program
2007	Stream stabilization	500	Mill Creek CC	Planned	400,000	Growing Greener II
2007	Stream stabilization	1,500	Mill Creek CC	Planned	1,200,000	Growing Greener II
2007	Stream stabilization & riparian forest buffer planting	5,000	Pieceville Run SBCC	Planned	4,000,000	319 Program
2007	Stream stabilization & riparian forest buffer planting	2,000	Hollow Trib EBCC	Planned	1,600,000	319 Program
2008	Stream stabilization & riparian forest buffer planting	3,400	SBCC	Planned	2,720,000	319 Program
2008	Stream stabilization	1,600	SBCC	Planned	1,280,000	Private
	TOTAL	108,770			86,216,000	

1.8 Watershed Priorities

The most significant issue or concern facing the Codorus Creek Watershed is related to water quality and quantity. As we have seen previously, much of the watershed contains streams and waterways that are impaired by one or more variables. There are approximately 296 miles of Priority 1 & 2 impaired streams within the watershed. These impairments are mostly related to stream bank erosion and fluvial geomorphological impairments such as abandoned floodplains, and loss of channel stability.

In addition to the Priority 1 & 2 streams, there are eight subwatersheds that are on the Pennsylvania Department of Environmental Protection Section 303(d) list of impaired waters. These streams must maintain a Total Maximum Daily Load (TMDL) established for the source/cause of impairment. The historical and current data on macroinvertebrate and fish communities indicate very poor to good water quality throughout the watershed. According to the US ACOE Interim Report, abundance of sensitive EPT taxa (macro- invertebrates) could increase provided in stream habitat and general water quality (pollution) were improved.

These impairments to water quality can be attributed to a variety of causes. The increasing population in our suburban and rural areas, particularly in the south, has substantial impacts to water quality and quantity. Development of traditional rural/ agricultural areas to accommodate the emigration from the urban areas threatens the aesthetics, quality of life, and quality of the environment which made these areas so appealing in the first place. Poor land use planning and dysfunctional zoning in and around the watershed and particularly the drainage corridor will destroy the values of the watershed.

Not only is the growth and development of the rural areas an issue, but traditional farming practices are also a major source of declining water quality. Too often livestock are allowed free access to streams which greatly deteriorates the stream banks and water quality. In addition poor farming techniques, such as non-contour farming, and farming directly adjacent to streams and waterways, causes massive erosion problems and results in the loss of the watersheds valuable soils that are either prime farmland soils or soils suitable for infiltration.

Figure 1-10 shows the locations of very poor, poor, and fair water quality locations in relation to the locations of known point and nonpoint sources of pollution in the Codorus Creek Watershed. Figure 1-11 shows the locations of Priority 1 & 2 streams in relation to land use.

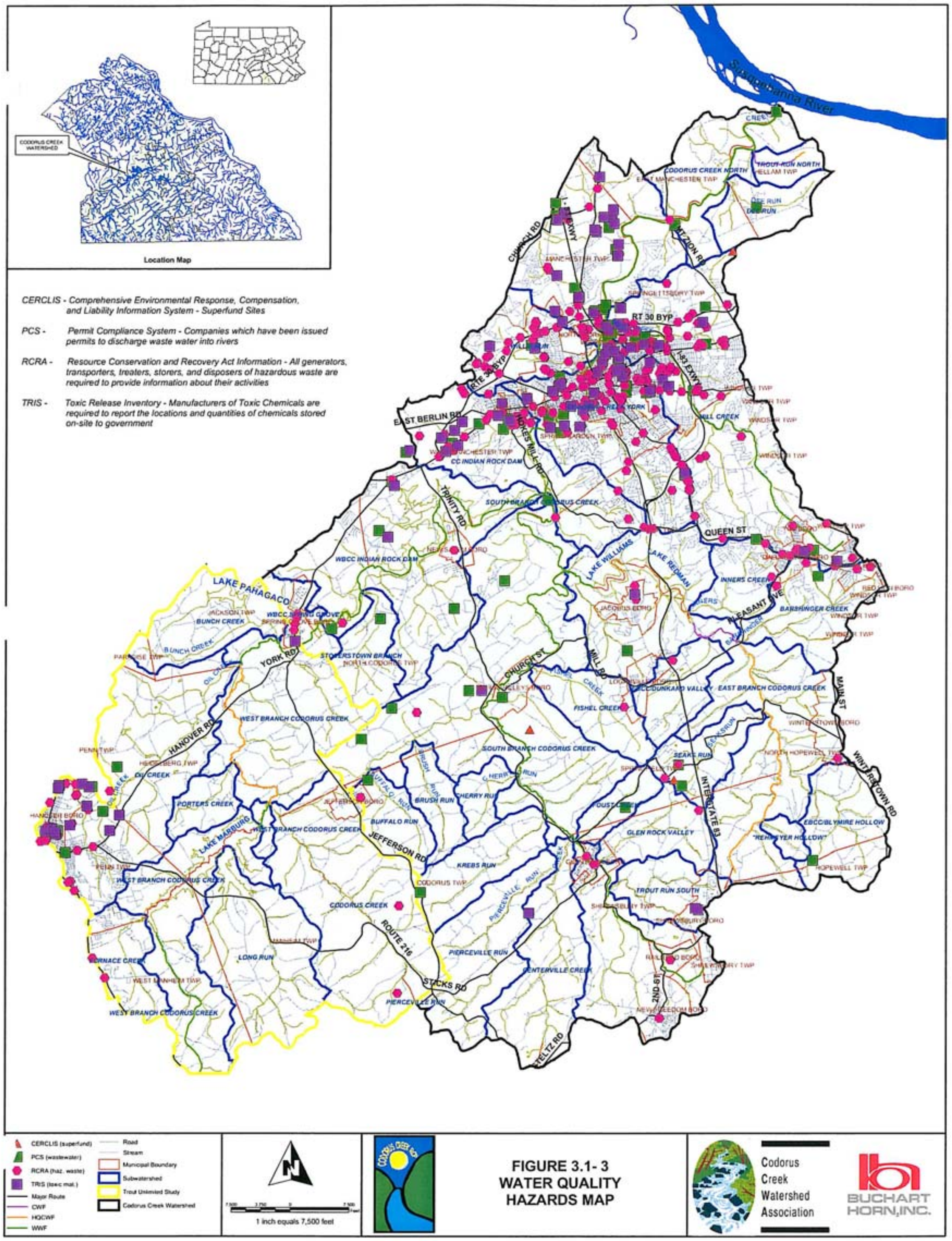

Figure 1-10. Water Quality Hazards Analysis.

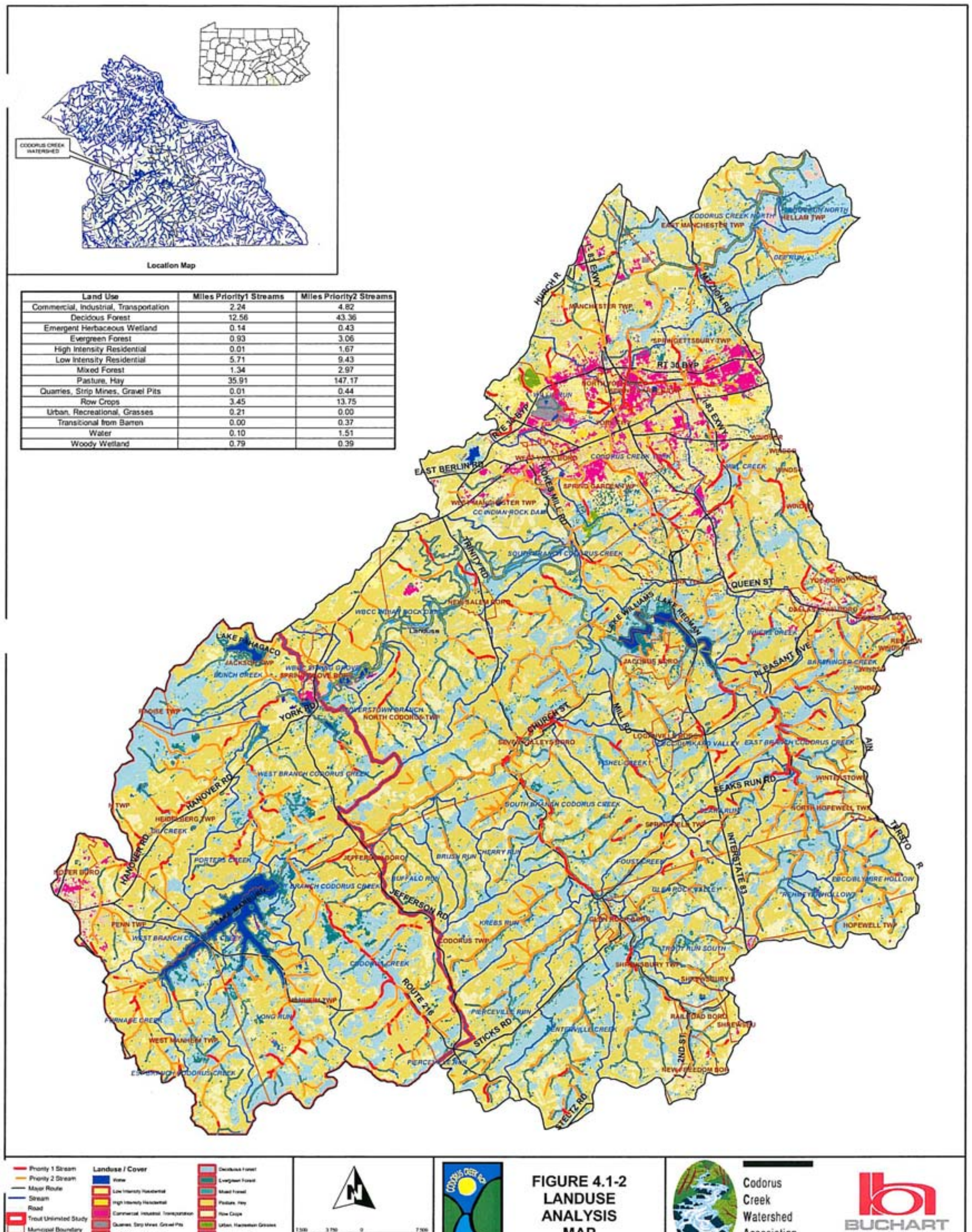

Figure 1-11. Land Use Analysis.