SECTION 3: IDENTIFY SOURCES

Sources of Key Pollutants or Conditions

It is evident through evaluations of the data that a variety of pollutants are threatening the designated uses in the Sugar Creek Watershed. Agricultural uses comprise approximately 80% of the 84,750 acre watershed. Through evaluations of several groups and agencies, pathogens (*E. coli*), sediment, nutrients and flooding have been indicated to be problematic in the Watershed. Although these pollutants and conditions may be a problem throughout the Watershed, they are not necessarily problematic in all portions of the 5 (12-digit) subwatersheds. Each subwatershed has different challenges to address sources associated with these pollutants and conditions in order to improve overall water quality. Probable causes and sources identified are listed on a watershed scale and have been assumed to be present based on a general knowledge of the environmental systems under this watershed study. Pathogens (*E. coli*), sediment, nutrients and flooding are the four most significant pollutants and conditions within the Sugar Creek Watershed.

Sediment

Excess sediment is an issue in the Sugar Creek Watershed. The Boyd Ditch subwatershed contributes the highest amount of sediment, as it had the most significant TSS load from this studies modeling effort. The second most significant TSS modeling load was generated by the Marsh & Trees Ditch subwatershed. Excess sediment causes unsightly turbid water, smothers and destroys aquatic habitats necessary for fish and macroinvertebrate growth and development, impedes navigation, changes stream geomorphology, decreases flood storage capacity, and acts as a delivery system for nutrients, pathogens and other contaminants.

Sediment can come from in-stream sources, river bank erosion, and erosion occurring throughout the Watershed. The presence of highly erodible soils and potentially highly erodible soils are discussed earlier in this report and are shown on Exhibit 9. These locations depicted on this exhibit showing where highly erodible soil locations overlap with surface water runoff depicts specific locations where river bank erosion would be most extreme. The total acreage of highly erodible soil accounts for 15% of the total watershed. These soil types, coupled with slopes of more than 3:1 ratio, and the presence of a stream or tributary drainageway would provide the most sediment load.

Sources of sediment transport are found in both urban and rural environments. Sources of sediment in the Sugar Creek Watershed include bank erosion and lack of a stable buffer between human activities and the stream itself. Very few row cropped agricultural lands within the watershed have a buffer of 50 to 100 feet between the surface water stream and the production crop land. Exhibit 3 shows the locations of where these sources are emanating. The acreages of land use are depicted on Table 3, demonstrating how much of the land is in production agriculture. Specific to our windshield survey effort, how much of the subwatersheds are identified as lacking a stable buffer found the Boyd Ditch subwatershed to be the portion of the watershed representing the largest source.

Other sources include uncontrolled sheet flow across the land surface and runoff from existing construction sites. In urban areas, this stormwater flow can include a large variety of pollutants and toxins that are a by-product of urban life. On agricultural croplands, a lack of proper erosion control methods (conservation tillage, cover crops, etc.) contribute to sedimentation and related nutrients in the runoff that flows overland to Sugar Creek and associated ditches and tributaries. Similarly on pasturelands, a lack of proper erosion control methods, such as exclusionary fencing, contributes to livestock degrading streambanks and adding sediment load to the watershed. Livestock having direct access to the stream was documented to include cattle, hogs and horses. The most significant subwatershed for contributing to the source of this problem is the Pee Dee Ditch subwatershed. Target areas for sediment identified by the steering committee based on the windshield survey data collected provided more than 30% of the survey stations as having severe conditions of erosion.

Pathogens (E. coli)

Pathogens, or disease causing organisms in the water, include bacteria, viruses, and protozoa. Since *E. coli* bacteria are found in the intestines of humans and other warm blooded mammals, it is the indicator species used in the state to denote the possibility of other pathogens that may be present in the aquatic system. CFOs contribute to the E. coli load within the watershed from these agricultural livestock feeding operations. The Pee Dee Ditch subwatershed and the Boyd Ditch subwatershed possess the most CFOs in the watershed. E. coli concentrations that exceeded the state standard during the TMDL evaluation had the most exceedances within the Boyd Ditch Subwatershed (39% of the sampling stations) and the second most significant contributing subwatershed was the Marsh & Tree Ditch, with 33% of the sampling stations. The data from V3, IDEM, NPDES permits, and volunteer efforts corresponded with the TMDL data in finding Boyd Ditch subwatershed as having the highest amount of *E. coli* concentrations. This study identifies the Boyd Ditch subwatershed as the most significant source location for *E. coli*. There is only one CAFO within the Sugar Creek Watershed, it is located in Hancock County along the border of Henry County within the Pee Dee Ditch subwatershed. As there is only one location, which was installed during our watershed management planning process, the overall magnitude from the contribution of *E. coli* from CAFOs is yet to be determined.

As is apparent from the information mentioned previously, this organism has been found to be present in numbers that exceed the state's water quality standards, and thus indicate a potential health risk. *E. coli* has been indicated as a problem in the 2007 IDEM TMDL report for Sugar Creek. Sources of *E. coli* include both human and animal origins and can emanate from both point and non-point sources of pollution. Sources in the Sugar Creek Watershed include: failing septic systems, package plants, discharge of inadequately treated wastewater, wild and domestic animal waste, livestock in the stream, runoff from pasture lands without proper erosion control measures. The Pee Dee Ditch subwatershed was identified as the location within the watershed as having the most significant contribution. Approximately 30% of the windshield survey stations within this subwatershed identified livestock access gates to the stream for cattle, hogs and horses, which provides a direct source of *E. coli* from animal waste.

E. coli growth occurring in sediment, and E. coli from Combined Sewer Overflows (CSOs) are also problematic sources within the Sugar Creek Watershed. New Palestine is the main source of CSO in the Sugar Creek Watershed. The contribution of E. coli within the watershed as a whole from CSOs is slight. Soil types have the ability to provide septic tanks with suitable locations. There are no locations in the Sugar Creek Watershed where ideal soils for septic tanks can be found. Exhibit 8 shows the Septic Tank Suitability, with 95% of the watershed being mapped as "very limited" and 5% being "not rated". Any septic tank location has the potential to be a contributing source of *E. coli* to the watershed. This is identified as a significant problem within the watershed.

Target areas for *E. coli* identified by the steering committee based on the windshield survey data collected and the available water quality data include: Pee Dee Ditch and urban areas surrounding Warrington, urban areas surrounding Nashville, urban areas surrounding Eden, urban areas surrounding Mohawk, Mohawk Campground, Conservation Club, and Leary Weber Ditch, Heartland Resort, S&H Campground, Philadelphia, Wildwood Subdivision, Spring Lake, and Arrowhead Mobile Park, and The Overlook Subdivision.

Nutrients

Nutrients are naturally occurring in the environment, but in excess can cause major problems in aquatic ecosystems. Our modeling effort identified the Boyd Ditch subwatershed as being the most significant source of nitrogen and phosphorus loads. The V3 collected water quality data provided the Barrett Ditch subwatershed as the most significant source of nitrate and the Boyd Ditch subwatershed as the most significant source of phosphorus to the surface water issues within the Sugar Creek Watershed. Data analysis of nitrate-nitrite exceedances of the 10 mg/L value from IDEM, TMDL, NPDES permits, and volunteer monitoring all indicate the Boyd Ditch subwatershed as having the most significant source of nutrients to the watershed.

In the Sugar Creek Watershed, phosphorus is a possible limiting nutrient. If Phosphorus is present in large amounts, it can cause excessive aquatic plant growth which leads to large fluctuations in the amount of oxygen in the water, referred to as dissolved oxygen (DO). This can alter the aquatic community and favor more of the tolerant, low quality organisms and decrease biodiversity. The problem is amplified in downstream lakes and impoundments where the water slows and nutrients drop out with the sediments. The sediment then becomes a major source of nutrient flow throughout the aquatic ecosystem. Many nutrient sources are the same as those that contribute to *E. coli* contamination and include: CFOs, failing septic systems, package plants, discharge of inadequately treated wastewater, overflow from manure storage facilities, and fertilizer applications. According to the USGS the primary concern with Nitrate levels is causing algal blooms in the Sugar Creek Watershed and contributes to hypoxia in the Gulf of Mexico. Target areas for problematic nutrient loading includes: areas where livestock have stream access, Pee Dee Ditch and urban areas surrounding Warrington, urban areas surrounding Nashville, urban areas surrounding Eden, urban areas surrounding Mohawk, Mohawk Campground, Conservation Club, Leary Weber Ditch, and Heartland Resort.

Flooding

Flooding is a natural component of the floodplain, but flooding can cause major problems in aquatic ecosystems in addition to causing damage to property. Floodplain areas within the watershed are demonstrated in Exhibit 12. The subwatershed location with the most damage from flooding is the Boyd Ditch subwatershed. The source of flooding originating in the headwaters identifies the Pee Dee Ditch subwatershed as the most significant source. How much of a problem flooding causes is shown on Table 13b where the Marsh & Tree Ditch subwatershed has the most identified flooding problems (up to 33% of the survey stations).

Land use changes with increased development results in less open space and more impervious cover in a watershed. Undeveloped open land is able to infiltrate rainfall into the ground, and ponded runoff is stored in numerous natural depressions in the landscape. Vegetation also reduces the amount of surface runoff by intercepting rainfall and through evapotranspiration. Development reduces the capacity of the land to hold water by compacting soils when grading for construction, removing natural vegetation and adding impervious cover such as rooftops, driveways, streets and parking lots. Impervious cover directly influences streams by dramatically increasing surface runoff. According to the Importance of Imperviousness, T. Schueler, *Watershed Protection Techniques,* 1995, the result has been that traditional development significantly increases the volume and accelerates the rate of rainfall runoff.

Log jams can impede the conveyance of water through the watershed and disruption to this flow path results in additional flooding problems to the surrounding land uses. Three of the four subwatersheds surveyed during the windshield survey identified Pee Dee Ditch, Marsh & Tree Ditch, and Boyd Ditch as having stations (from 21% to 50%) with log and debris blockages making sources for flooding issues.

Land use has a direct effect on flood damage in the Watershed. The most obvious way land development results in flood damage, is the location of homes, buildings, development and infrastructure in the floodplain. Less obvious, but of equal significance, is the impact an increased volume of runoff generated from upland development has on expanding the floodplain and causing localized flooding problems. Peak flows in Sugar Creek will increase and overbank and localized flooding will worsen without adequate stormwater infiltration, runoff detention, appropriate best management practices (BMPs), and/or wetlands.

Understanding flooding involves both hydrology and hydraulics. Hydrology refers to the way that water behaves from its beginning as precipitation, through its movement on or beneath the land surface, to its entry into drain tiles, storm sewers, streams, lakes, oceans and its return to the atmosphere. Hydraulics addresses how water flows over the land surface, within storm sewers and stream channels, over and under bridges and dams and through culverts, wetlands, lakes and impoundments (detention basins and reservoirs).

The types of flooding within the Sugar Creek Watershed include the following:

Depressional flooding - flooding that results from stormwater collecting in a depressional area of the landscape that either has no outlet for the water to drain, or an insufficiently sized outlet to efficiently drain the amount of collected run-off. Common form of flooding that causes crop loss.

Local drainage problems - drainage problems that result from nearby development creating more stormwater run-off in a localized area, from poorly located or designed developments that eliminate or alter the natural water storage or drainage system, or from inadequate drainage system infrastructure.

Overbank flooding - flooding caused by water elevations that exceed the banks of a lake, river, stream or other channel and overflows onto adjacent lands, typically within the flood plain. Common form of flooding that causes property damage and crop loss.

Septic system failure - when a septic field becomes saturated or flooded to the extent that it cannot adequately accept or process the wastewater it receives.