Introduction and Background

The Annual Water Quality Study has been administered by the Monroe County Planning Commission with collaboration with the Monroe County Conservation District for the past 25 years, commencing from its inception in 1985. These hydrological surveys consisted of two basic types: (1) groundwater (wells) and (2) surface water (streams). The groundwater consisted only of chemical analysis and was discontinued in 1989. The surface water included analyses of benthic macroinvertebrates and physical parameters (habitat evaluations and chemical parameters) (MCPC 2008).

During 1993, the United States Environmental Protection Agency (EPA) evaluated the current statistical analyses for the water quality study, and the County began utilization of EPA's Rapid Bioassessment Protocols (RBPs). These RBPs examine water quality as it relates to the macroinvertebrate community and the associated habitat. It was decided to implement an EPA modified subecoregion format, which included four ecological zone types for Monroe County: North Central Appalachians of Pocono High Plateau and the Low Pocono; Ridge and Valley of the Northern Shale Valleys and the Northern Sandstone Ridges. These subecoregions were chosen due to the glaciation that formed the substrata and were grouped according to soil type.

The intent of an assigned ecoregion is to provide a spatial framework for the assessment, inventory, monitoring and management of an ecosystem. These ecoregions have no political boundaries, and contain areas that harbor predictable patterns that are critical for configuration and implementation of ecosystem management approaches (EPA 2007).

From these initial steps toward the refinement of data, the County chose to implement a family level Index of Biological Integrity (IBI) that utilized regional reference streams to develop an assemblage of metrics; a group of statistical equations that embody the IBI for Monroe County. Biological monitoring is the first step toward the protection of life in running waters and through measurement and evaluation surveys, the ecological health of these systems can be tracked (Karr et al. 1999). The next modification to the Study took place in 2003 when the County changed from a subjective evaluation of the stream bottom to an objective format (pebble counts). The pebble count measures particle sizes and is indicative of which type of organism has the ability to colonize that area. The addition of pebble counts allowed for the analysis of transition of the particles in transport. Figure 1 in Volume II details how transition occurs, i.e. the bed load of a stream, such as particles of sand, gravel, or soil carried by the natural flow of a stream on or immediately above its bed.

The subsequent studies incorporated sites in support of several Watershed Management Plans, such as the Framework for Sustainable Watershed Management for Pocono Creek (2009) and the Paradise Creek Watershed Management Plan (2005).

These studies utilized the water quality study data as a tool to determine trends, current conditions of the watershed as well as to indicate success of the management plans after completion. The County water quality study has proven to be an invaluable resource of existing data for these plans and is intended to be the tool used to monitor success. Also, to provide scientific data to watershed groups to assist them in compiling redesignation petitions.

The County employs two types of biological sampling procedures presently utilized by the DEP within Monroe County for the assessment of streams. The first protocol is for the riffle-run stream type and the second is the multihabitat approach for low gradient streams that naturally lack riffles. These modified RBPs depict the sampling approach, which is either the single most productive habitat (riffle-run) or the multihabitat (low gradient) approach. Both protocols require the D-frame aquatic dip net method for collections. These are innovative assessment protocols which provide more intensive field surveys and water quality approaches than previously used. Prior to 2008, Monroe County's sampling protocols required utilizing a kick seine for the collection of macroinvertebrates. Volstad, et al. argue that D-Net sampling protocols offer a higher level of reliability for benthic IBIs, attributable to a superior representation of a particular stream segment versus the previous kick seine protocol.

During the 2009 water quality study, the County was awarded another grant from the Pennsylvania Department of Environmental Protection (DEP) - Section 205(j)(1)/604(b) for surface water assessments, financed from American Recovery and Reinvestment Act (ARRA) funds. During the spring of 2009, DEP revised the riffle-run metrics for their IBI. DEP recognized the importance of attainment during different seasons throughout the year for thresholds and has subsequently incorporated sampling season as a factor for determining impairment. The new seasonal sampling periods are October - May and June - September. All anti-degradation (redesignation) surveys must occur between October and May - all other sampling can occur year-round.

During the June – September timeframe, the IBI scoring benchmark for streams to attain is $\geq$ 50, but < 40 indicates impairment. However, scores between 40 and 50 require additional evaluations: (1) if the sample has a Beck's Index Score < 20 or % Sensitive Individuals < 20% in the subsample; (2) if subsample is dominated by tolerant taxa or individuals or; (3) if EPT are absent from subsample; the sample shows impairment. These newly refined metrics were employed and the data will be used to compare Monroe County stream results to the state ALU assessment process for determining impairment status, however, the County assumes no accountability in the state government decision process.

Macroinvertebrates are identified to the genus level of taxonomy, and then statistical equations are completed and incorporated into the IBI, which is utilized to evaluate the health of the aquatic ecological unit. The study requires the collection of a 200 count for macroinvertebrates (previously 100 specimens), which provides a more precise level of in-depth analysis for evaluations of the benthic macroinvertebrates. During the 2009 study, the County completed winter sampling on 6 low gradient streams utilizing the multihabitat protocol. These results will be evaluated for comparison to the summer sampling assessments of the same stream segment.

The additional data collected throughout Monroe County's aquatic ecosystems can be utilized to address chronic problem areas, produce recommendations for remediation and to support watershed association requests. Data field sheets are available upon request, and the comprehensive database being generated will allow for long term trending of the water quality.