4. Methods of Analysis

To begin work in the Plum Creek Watershed, the Partnership utilized a variety of approaches to interpret water quality patterns in the watershed, identify pollutant sources, and assist in making decisions regarding necessary management measures.

LAND USE CLASSIFICATION

The Plum Creek Watershed was delineated using elevation maps to determine the size and characteristics of lands contributing to the creek along its course (Figure 4.1). Using 2004-2005 National Agriculture Imagery Program (NAIP) aerial photography, land use in the watershed was classified by hand using ESRI ArcGIS 9 software (Figure 4.2). In addition, based on elevation and flows, the watershed was broken down into a total of 35 subwatersheds to enable closer examination of possible pollutant sources and to aid in targeting implementation efforts.

Figure 4.1. Pasture near Mustang Ridge during spring. Much of the Plum Creek Watershed is agricultural land.

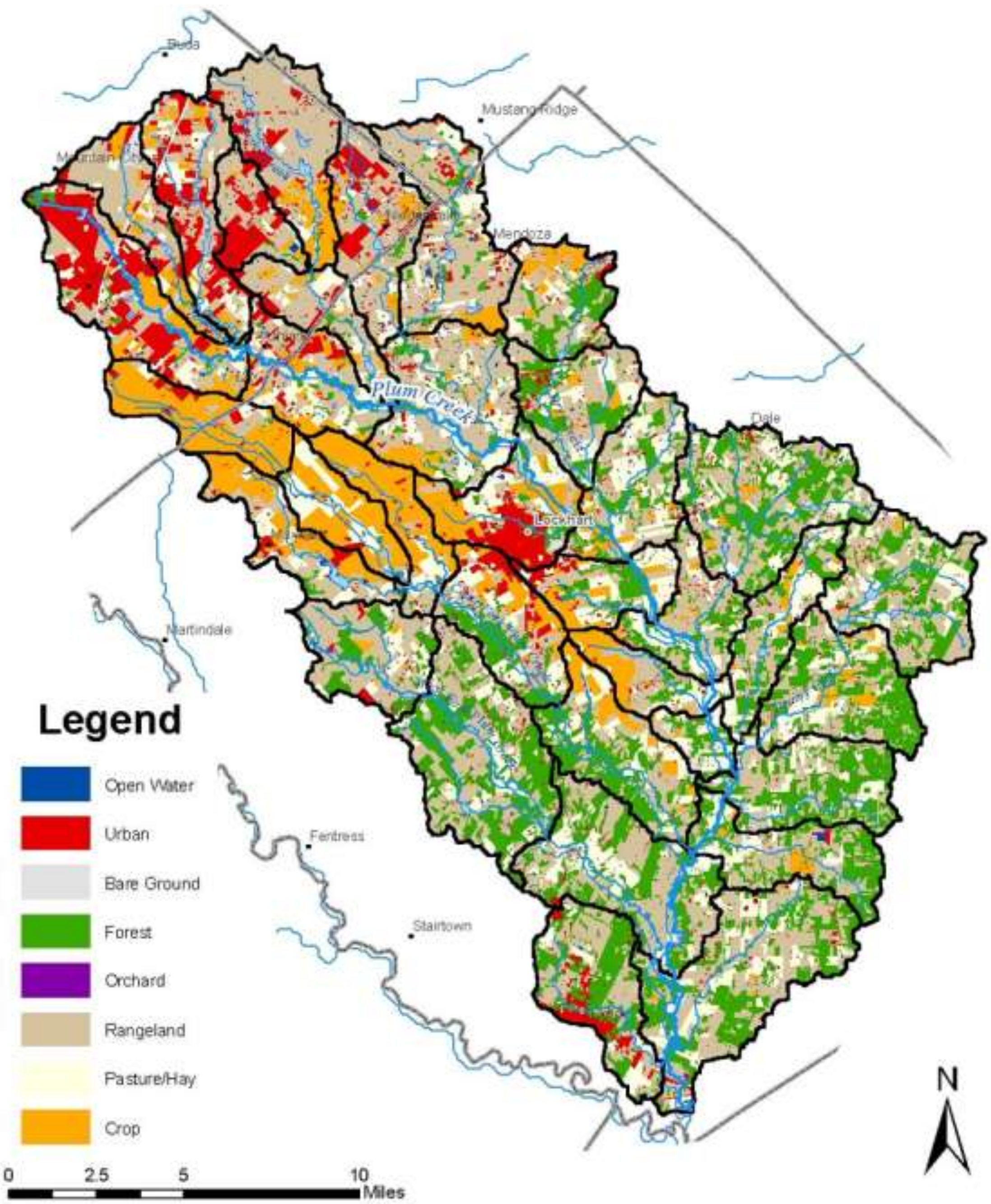

Figure 4.2. Land use classification map of the Plum Creek Watershed based on 2004-2005 NAIP aerial photography. Bold lines represent subwatershed boundaries.

Urban land, open water, bare ground, forest, rangeland, and cultivated land were considered major land use classes (see Appendix D for descriptions). Parcels were assigned classes based on natural and human-impacted attributes including vegetation, hydrology, and level of development (Table 4.1). If land use was distinct, classification was performed on areas to the level of less than one acre in size. Tracts with land use characteristics similar to neighboring areas were combined to form larger areas of a common class. Following digital classification, land use was verified through on-the-ground field sampling within the watershed (Figure 4.3).

Table 4.1. Land use classes in the Plum Creek Watershed.

Land Use Class	Total Acres	Proportion of Watershed (%)
Developed Open Space	1,607	< 1
Developed Low Intensity	12,033	4
Developed Medium Intensity	8,043	3
Developed High Intensity	2,446	< 1
Open Water	3,548	1
Barren Land/Bare Ground	1,362	< 1
Forested Land	27,996	10
Riparian Forested Land	16,371	6
Mixed Forest	22,522	8
Orchard	122	< 1
Rangeland	110,158	38
Pasture / Hay	49,290	17
Cultivated Crop	32,740	11
Total	288,240	100

Figure 4.3. Riparian forest near Luling. Such areas are common in lowland areas, particularly in downstream portions of the watershed.

DETERMINING SOURCES OF POLLUTION

Load Duration Curve

A widely accepted approach for predicting whether pollutants are coming from point and/or nonpoint sources is the use of a Load Duration Curve (LDC). An LDC is developed by first constructing a flow duration curve using historical streamflow data (Figure 4.4). Flow data are then multiplied by a threshold concentration (such as a desired target or an official water quality criterion) of a pollutant, including *E. coli* bacteria or a specific nutrient.

For the purposes of this plan, a 10% margin of safety was applied to the threshold concentrations for both bacteria and nutrient pollutants. Thus, threshold concentrations used in the LDC analysis were 114 cfu/100mL for bacteria and 1.76 mg/L, 0.33 mg/L, and 0.62 mg/L for nitrate, orthophosphorus, and total phosphorus, respectively.

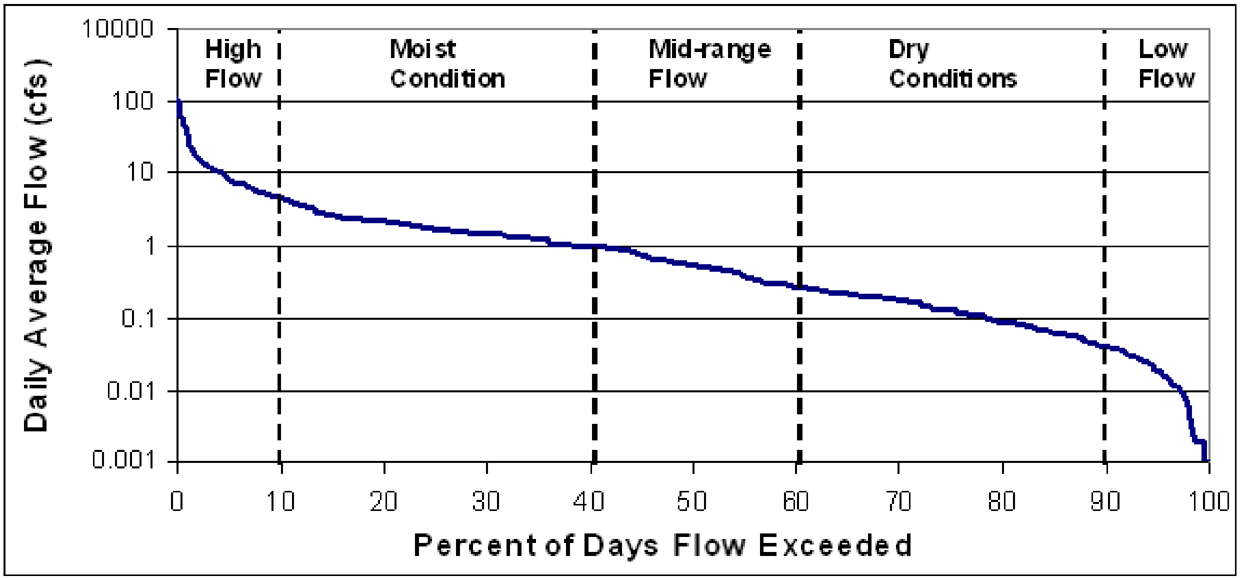

Figure 4.4. Example flow duration curve. Historical streamflow data are used to determine how frequently stream conditions exceed different flows.

When flow and the critical concentration are multiplied together, they produce the estimated pollutant load (Figure 4.5). The resulting load duration curve can then be used to show the maximum load a stream can carry without exceeding regulatory criteria or screening criteria across the range of flow conditions (low flow to high flow). In addition, stream monitoring data for a pollutant can be plotted on the curve to show when and by how much criteria are exceeded. For example, in Figure 4.5, the solid line indicates the maximum acceptable stream load for *E. coli* bacteria and the pink boxes represent monitored loads from water quality sample data. Where the pink boxes are above the solid line, the actual stream load has exceeded the regulatory limit, and a violation of the criterion has occurred.

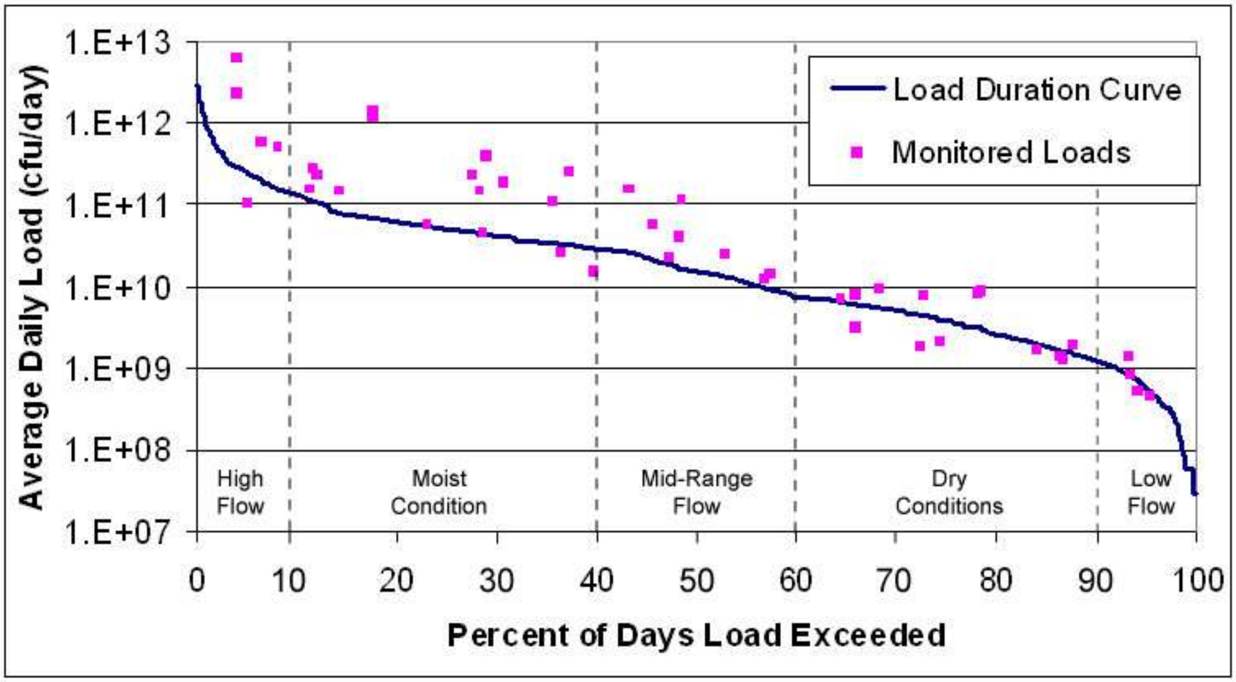

Figure 4.5. Example load duration curve. Multiplying streamflows by pollutant concentration produces an estimate of pollutant load. Regulatory criteria can be compared to monitored data and used to help determine if contributions are dominated by point or nonpoint sources.

By considering the processes at work during high, mid-range, and low flows, it is possible to link pollutant concentrations with potential point or nonpoint sources of pollution. Next, by using a regression analysis of monitored data, estimates of the percent reduction needed to achieve acceptable pollutant loads can be determined. For the Plum Creek Watershed, the highest of predicted load reductions considering all flow conditions at a given monitoring station was used to establish the target reduction for that portion of the watershed. A more complete explanation of the Load Duration Curve approach can be found in Appendix E.

Spatially Explicit Load Enrichment Calculation Tool (SELECT)

To more specifically identify potential pollutant sources and their contributions within a watershed, the SELECT approach was developed by the Spatial Sciences Laboratory and the Biological and Agricultural Engineering Department at Texas A&M University. Using the best available data, a potential pollutant load is estimated for each source based on known pollutant production rates. SELECT utilizes numbers and estimated distributions of developed urban land coverage, pets, septic systems, permitted wastewater facilities, livestock, and wildlife. These sources can then be compared across different subwatersheds and to each other. As a result, areas with the greatest potential for impacting water quality can be identified, and major contributors in those areas can be selected for the implementation process. A more complete explanation of the SELECT approach can be found in Appendix F.

DATA LIMITATIONS

When determining the relationships between in-stream conditions and driving factors in the surrounding landscape, it is important to consider all potential sources of pollution and rely on the most dependable data available. In addition to receiving input from local stakeholders, information used in the analysis of the Plum Creek Watershed was gathered from a number of sources, including local and regional groups, river authorities, and state and federal agencies.

It is important to remember that information collected in the Plum Creek Watershed represents a snapshot in time of the processes at work. Whether associated with human activities (Figure 4.6), weather patterns, animal distributions, or other factors, Plum Creek and other watersheds are very dynamic in nature, and conditions change dramatically between years and even within a given season. Because of this, the actual input of pollutants from different sources in the Plum Creek Watershed varies considerably over time.

Figure 4.6. A boy fishes using a handline in Lockhart's Town Branch.