5.0 SOURCE ASSESSMENT

This section identifies the potential sources of fecal coliforms in the study area discharging into the Peconic Bay estuarine system. Sources of information include GIS data and literature provided by EPA Region 2, NYSDEC, and the PEP. The Brown Tide Comprehensive Assessment and Monitoring Program (BTCAMP) study conducted by the Suffolk County Department of Health (1992), and previously summarized by HydroQual (2003), also assisted in characterizing the relationship between point and nonpoint source loadings and in-stream responses at the monitoring stations located throughout the Peconic Bay study area.

Based on the historic water quality monitoring, the NYSDEC has indicated that the water quality standards were generally exceeded in a number of water bodies within Peconic Bay (see Section 4). The standards were often met in the open water except the areas in the vicinity of storm water outfalls, STP effluent outfalls and tributaries (e.g., Flanders Bay).

Point sources of pollution are those that discharge flows and pollutant loads to a water body from a fixed location or through a single point of entry such as a discrete pipe or ditch. The major point sources in the study area include: (1) STPs that receive and treat domestic/commercial/industrial wastewater; (2) commercial and industrial plants whose discharges are permitted such as duck farms; and (3) urban storm water from permanent drainage areas such as those with Phase 1 or Phase 2 storm water permits.

Non-point sources encompass those pollution sources that have no single identifiable point of entry for the contamination. One example is wildlife which is often a major source of bacterial contamination to the surface waters with large open spaces/forests and wildlife population. Other potential nonpoint sources include contributions from poorly designed, or failing, septic systems and cesspools; marinas; boating activities; and limited bacterial contamination from ground water. Storm water from municipalities not covered by Phase 1 or Phase 2 storm water permits is considered a nonpoint source for this study.

The following sections summarize the likely point and nonpoint sources of pollution in the study area.

5.1 Point Sources

There are five STPs with surface water discharges regulated by NYSDEC through State Pollution Discharge Elimination System (SPDES) that contribute directly to the Peconic estuary system. Located in Riverhead, the Calverton Enterprise Park (formerly Grumman Aerospace) outfall flows into McKay Lake which feeds Swan Pond which feeds the freshwater (non-tidal) Peconic River. The Town of Riverhead is currently in the design phase of a planned upgrade for the Calverton STP, which includes upgrading the STP to provide nitrogen removal and relocating the outfall to discharge to groundwater rather than surface water. The Brookhaven National Laboratory STP discharges to the freshwater (non-tidal) Peconic River and has recently been upgraded to employ ultraviolet disinfection. The Riverhead STP effluent is combined with the Riverhead/Southampton Scavenger Waste Facility. This facility has also been recently upgraded and the effluent is subjected to ultraviolet disinfection prior to being discharged to the tidal portion of the Peconic River. Discharge from the Sag Harbor STP outfall is located outside of the Sag Harbor study area has resulted in an administrative closure of an area immediately seaward of the harbor’s mouth. This facility has recently been upgraded and employs ultraviolet disinfection. Data on the potential for tidal transport of pollutants from this point source to inner Sag Harbor are currently not available. The Shelter Island Heights STP is a small sequencing batch reactor (SBR) that uses sodium hypochlorite disinfection and is capable of treating up to 72,000 gallons per day (gpd). In addition to the five STPs, Atlantis Marine World discharges approximately 2,000 gallons per day and pretreats its discharge using ozone or chlorine prior to discharge to the tidal Peconic River. There are no combined sewers[5] in the entire area. A majority of the Peconic Watershed is served by septic systems and a portion of the Towns of Brookhaven, Riverhead, and Southampton within the watershed are served by separate sanitary and storm sewers. The village of Greenport is also sewered, but the STP discharge is to Long Island Sound.

The towns of Riverhead and Southampton are both regulated under the EPA's Phase II Stormwater Program, as are the New York State Department of Transportation and the Suffolk County Department of Public Works, within these towns. As of March 2003, the municipal separate storm sewer systems (MS4s) that serve these two towns were required to have a NPDES permit and a management plan that prevents pollutant-laden stormwater from being discharged into nearby water bodies and impacting water quality. The outfalls from these MS4s are considered point sources to the Peconic Estuary.

Duck farms have typically been the active permitted industrial discharges in the study area. By 1976, most of the duck farms that discharged into the Peconic system went out of business. Although the Corwin Duck Farm is the sole remaining duck farm in operation in the Peconic Watershed, it no longer directly discharges processing waste to surface water as of the late 1980s. This farm is located north of Hubbard Avenue in the upstream reach of Meetinghouse Creek, and has a renewed SPDES permit that prohibits discharge except in the case of a 10 year, 24-hour rainfall event. Limited monitoring conducted by NYSDEC and SCDHS has shown high levels of total coliform bacteria in the Meetinghouse Creek, particularly after the rain events. This is potentially due to surface runoff from Corwin duck farm during high rainfall events along with other sources such as urban storm water from the creek's drainage area.

The PEP has delineated groundwater subbasins that discharge to the Peconic Estuary. Heatherwood Golf Club at Calverton has a groundwater discharge in the vicinity of the western Peconic River. In addition, nine operating or closed landfills are identified as possible point sources of contamination. The industrial discharges or landfills have been shown in the BTCAMP studies to have adversely affected groundwater and surface water ecosystems. Although the groundwater discharges and landfills may contribute other pollutants such as nutrients, these are minor sources for pollutants such as pathogens.

The extent and intensity of storm water runoff was investigated by the Long Island 208 Wastewater Management Treatment Plan (LIRPB, 1978). The Long Island Segment of the Nationwide Urban Runoff Program (LI NURP) further explored the problem of storm water runoff as it relates to local groundwater and surface water quality (LIRPB, 1982). Both the 208 and LI NURP studies identified storm water runoff as the major source of bacterial loadings to surface waters in Suffolk County.

5.2 Non-Point Sources

The nonpoint sources that typically contribute pathogens into estuarine systems include failing on-site sewage disposal (septic) system; storm water runoff from developed areas not covered by Phase 1 or Phase 2 Stormwater permits; runoff from agricultural areas and open space/forest; direct waterfowl/wildlife inputs; and boats and marinas. Relative contributions from each type of source are significantly site-specific in nature, particularly in localized areas of study.

[5] Combined sewers are historic sewer systems designed to contain stormwater and sanitary sewage in the same pipe. Under normal weather conditions, combined sewers transport the wastewater directly to a treatment plant. However, during periods of heavy precipitation, these systems are designed to occasionally overflow and discharge the stormwater and raw sewage directly into nearby water bodies.

5.2.1 Agricultural Sources

Although county-wide data on estimated livestock abundance has been compiled, no site-specific data have been analyzed. Table 5-1 summarizes the Suffolk County agricultural data. Site-specific information on livestock populations (i.e., representative of individual contributing areas) is not available which makes estimating these sources difficult.

Table 5-1. Summary of Suffolk County Agricultural Data.

Type of Livestock	Suffolk County	
	1997 Number	2002 Number
Total Cattle and Calves	188	232
Total Hogs and Pigs	553	175
Poultry		
Layers 20 weeks or older	3,719	3,544
Broilers	not available	not available
Pullets	not available	1,146
Turkeys	not available	270
Horses and Ponies	not available	1,391
Sheep and Lambs	392	182
Total Number of Farms (crops and livestock)	721	651

SOURCE: USDA, 2002

5.2.2 Marine Vessels and Marinas

Increased development throughout the coastal zone in conjunction with increasing demand for recreational marina facilities has created the need to protect sensitive coastal environments while enhancing multiple uses of valuable coastal resources. In 1993, the Peconic Estuary Program Comprehensive Conservation and Management Plan (PEP, 2001) conservatively estimated that approximately 1,150 establishments within the Peconic watershed were estuarine dependent (e.g., commercial fishing, marinas, boat repair, hotels/motels, and other businesses aimed at tourists and/or recreationists). The estimated asset values (in 1995 dollars) of recreational fishing and boating were assessed to be $276 million and $210 million, respectively.

In June 2002, the Peconic Estuary was officially approved as a designated Vessel Waste No Discharge Zone (NDZ) by the EPA (67 FR 39720). While a vessel is inside a NDZ, the discharge valve of a Type I or Type II marine sanitation device (MSD) (Type I and II MSDs treat the sewage before discharging it) must be visibly closed, preventing wastes from being discharged into surrounding waters. A padlock or a non-releasable wire tie can be used to secure the valve, or the valve handle can be completely removed. A Type III MSD has a holding tank and is permitted in a NDZ as long as pumpout facilities are used to empty the tank. An ongoing public education plan was designed to inform boaters that discharging raw or treated sewage within the NDZ is illegal and that all sewage from a Type III MSD must be held onboard the vessel until a pumpout facility or specialized boat can empty the holding tank. For violations of the NDZ law, section 33-e of New York State's Navigation Law provides for fines of up to $500 for a first discharge offense and $1,000 for further violations. According to the 2000 Peconic Estuary "Petition for Determination Regarding Adequacy of the Number of Vessel Waste Pumpout Facilities in a Water Body to Support a No Discharge Zone" , there are enough pumpout facilities in the greater Peconic Estuary area to service between 10,800 and 21,600 vessels with Type III MSDs. Vessel counts conducted for the same petition estimated that, in 2000, there were between 7,200 and 11,247 boats in the Estuary on a given summer weekend (Table 2 in Attachment 2), and not every one of these vessels has a Type III MSD onboard. It should be noted that there is transient boating (people who take day trips from Connecticut, New York City and other ports around Long Island) which is difficult to quantify due to lack of data. Based on the available information, the EPA concluded that more than enough pumpouts exist within the Peconic Estuary to support a NDZ designation. Given the 2002 NDZ designation and the sufficient pumpout facilities available, it is unlikely that vessel-derived human waste is a major source of coliform bacteria in Peconic Estuary waters. Even though sewage originating from vessels is thought to be a minor contributing source, it is believed that marine vessel waste disposal systems are efficient and illicit discharges are likely diminishing over time. The difficulty in estimating loading from this source makes modeling it futile, however, the NDZ and the increasing effectiveness of pumpout facilities likely renders value estimates for discharges from this source unnecessary.

Data on land-based and mobile pumpout facilities serving the Peconic Estuary were compiled for the 2000 Peconic Estuary "Petition for Determination Regarding Adequacy of the Number of Vessel Waste Pumpout Facilities in a Water Body to Support a No Discharge Zone". The facilities, as well as their location and their pumpout capacity, are presented in Table 1 in Attachment 2. To estimate the number of vessels using the Peconic Estuary on a regular or transient basis, this NDZ petition also compiled information on the number of slips, moorings, and private docks within several water bodies. These data are shown in Table 2 in Attachment 2. Finally, Table 3 in Attachment 2 presents the number of gallons of vessel waste pumped out by the several pumpout boats operating within the Estuary between 1995 and 2002.

5.2.3 Urban/Residential Sources

Urban and residential sources of fecal and total coliform bacteria are dependent upon a few primary factors. These include residential density and the associated impervious surface area within a contributing zone, domestic pet populations, wildlife populations, and the effectiveness of onsite wastewater disposal systems. The modeling approach (Watershed Treatment Model (WTM)) applied in this study assumes default values of "urban" or "residential" source and runoff coefficients to yield a bulk annual fecal coliform load to each receiving water in the study. These default values are based on extensive literature review and comparative studies within the U.S. (Caraco, 2001). See Section 6.0 for further information on the WTM and its default values.

Several thousand dogs and other pets are also estimated to be present (personal communication: NYSDEC, 2003). According to the Long Island Power Authority's 2004 Population Census, the five towns surrounding the Peconic Estuary had approximately 52,881 year-round households (LIPA, 2004). In its 2004-2005 Statistical Abstract, the United States Census Bureau made a national estimate that about 36% of households have dogs, and each household has an average of 1.6 dogs (U.S. Census Bureau, 2004). From these approximations, it can be assumed there are about 30,500 dogs in the five towns surrounding the Peconic Estuary.

5.2.4 Waterfowl

Large waterfowl populations are present during the migration and winter seasons. Smaller, but significant, numbers of waterfowl are present throughout the year. Several sources including NYSDEC, Suffolk County Department of Health Services (SCDHS), and the local Audubon Society were contacted to get an estimate of the number of birds, but this data was not readily available.

Horsely and Witten (2003) provided a series of site-specific analyses of fecal coliform loads and transport within the Peconic Bay area. In these studies, they rely on information reported by Weiskel *et al.* (1996) in their estimation of waterfowl contributions to coastal waters. Based on their analysis, they assume that one can account for about 0.3 waterfowl per acre of surface water. They then multiply the area by this "occupancy rate" and again by the estimated fecal coliform load associated with waterfowl waste generation (applied an average of 10^8 FC/day/bird). Because no additional site-specific rates of waterfowl presence in the Peconic Bay area are available, this loading algorithm is applied consistently across the 25 water bodies in this study. This annually integrated rate does not represent event-driven abundances in fecal coliform detection in these water bodies, especially in local conditions (i.e., particular feeding or breeding areas). Based on personal communication with local scientists and managers, the paucity of waterfowl and other wildlife data suggest that further research in this area is necessary to reduce uncertainties in relative magnitudes of these load sources (Dr. Robert Nuzzi, personal communication).

Additional information on waterfowl contributions to some of the water bodies within the study area is described in Section 5.3.1.

5.2.5 Beach Wrack

Beach wrack is the mat of organic material that often lines recent high tide lines along the coastal zone. These mats largely consist of resident aquatic vegetation that has either died or been pruned by tidal, storm, or animal disturbance. Wrack mats can harbor bacterial populations and can also provide environments for growth and redistribution of bacteria. Weiskel *et al*. (1996) estimated that wrack yielded approximately 1.25 x 10^6 FC/kg. However, no site-specific data on the abundance, or variability, of wrack biomass is currently available and literature values are extremely variable. For example, Dugan et al. (2003) reported observations of 1,200 to 2,179 kg/m/year of kelp wrack in South Africa and 473 kg (wet) of macrophyte wrack per meter per year in a California coastal zone. These values are clearly not applicable to Peconic Bay, but demonstrate the large ranges in wrack production and deposition. In a recent analysis of several embayments in Peconic Bay Horsely and Witten (2003) reported a general lack of information on wrack deposition rates; however, they surmised that this could be an important source of bacteria to Peconic Bay water bodies. Therefore, more analysis is required to establish the spatial and temporal contributions of beach wrack as a source of bacteria in the Peconic Bay embayments.

5.2.6 Marine Sediment Resuspension

The resuspension of bacteria present in coastal sediments can potentially be a significant source to shallow, localized areas. However, the resuspension is highly variable (Weiskel et al., 1996) and can be quite difficult to predict due to a variety of confounding factors. Rates reported by Valiela et al. (1991) and further discussed by Horsely and Witten (2003) range from 7 to 18 FC/100 mL seawater.

5.3 Summary of Pollution Sources

Based on the review of past studies conducted by NYSDEC and SCDHS, the bays within the Peconic Estuary are primarily affected by urban storm water runoff (which carries waterfowl, wildlife, and domestic pet waste into the Estuary) and direct waterfowl and wildlife inputs, followed by STPs, failing septic systems, and boater waste. In the absence of quantifiable and accurate data on many of these sources, limited data reported in literature from previous studies and experience gained from similar nation-wide studies were used to develop reasonable estimates of pollutant loads. These assumptions are discussed throughout the following section on modeling approach.

5.3.1 Bacterial Source Tracking

The Cornell Cooperative Extension of Suffolk County has developed an *E. coli* bacteria library of potential sources in the Peconic Estuary area. This library is being used to estimate predominant sources of *E. coli* bacteria in surface waters, through DNA analyses, and help in the development of a more accurate characterization of bacterial sources in specific areas under various environmental conditions.

The sampling and analysis effort associated with this study spanned from 1999 to 2002 and results have been reported in Hasbrouck (2004), *Identification of* E. coli *Sources for the Peconic Estuary Watershed for Effective Mitigation of Nonpoint Source Pollution*. This effort included 4 of the 25 water bodies identified in this TMDL study:

(1) Sag Harbor

(2) Hashamomuck Pond

(3) Northwest Creek

(4) Reeves Bay

The results suggest that while there are a variety of predominant sources of *E. coli* in the Peconic Bay estuarine systems, the majority of samples indicate that waterfowl and other coastal inhabitants (e.g., muskrat and fox) typically rank among the highest in both wet events (i.e., rain events) and dry periods. Table 5-2 summarizes the stations that occur within the 4 water bodies listed above.

Table 5-2. Summary of *E. coli* detection in 4 of the 25 study area water bodies as reported by Hasbrouck (2003). Values represent percentages of total observations that are associated with each defined source category during wet and dry conditions.

Water Body	Station	Date	Wet/Dry	Human %	Waterfowl %	Dog %	Other Wildlife %	Unknown %
Sag Harbor	9	Aug 1999	Dry	0	100	0	0	0
Sag Harbor	9	Oct 1999	Wet	0	0	4.5	95.5	0
Sag Harbor	9	Oct 1999	Dry	0	55.5	0	22.2	22.2
Sag Harbor	9	Nov 1999	Wet	0	0	0	0	100
Reeves Bay (Goose Creek)	18C	Nov 2001	Dry	0	33.3	11.1	33.3	22.2
Reeves Bay (Goose Creek)	18C	Nov 2001	Wet	8.3	91.6	0	0	0
Hashamomuck Pond	1.1	Sep 1999	Wet	5.2	0	21.1	21.1	52.6
Hashamomuck Pond	1.1	Oct 1999	Dry	0	77.7	0	0	22.2
Hashamomuck Pond	1.1	Nov 1999	Wet	0	0	0	25	75
Hashamomuck Pond	2.1	Dec 2001	Wet	0	0	100	0	0
Hashamomuck Pond	2	Dec 2001	Dry	0	66.6	0	0	33.3
Hashamomuck Pond	2	Dec 2001	Wet	0	100	0	0	0
Hashamomuck Pond	2	Jan 2002	Dry	0	0	0	100	0
Northwest Creek	3	Nov 2001	Wet	66.6	8.3	0	8.3	16.6
Northwest Creek	3	July 2000	Dry	0	100	0	0	0
Northwest Creek	3	Aug 2000	Wet	0	0	0	0	100
Northwest Creek	3	Nov 2001	Wet	0	100	0	0	0

6.0 MODELING APPROACH

The most critical component of TMDL development is the establishment of the relationship between source loadings and the impacts on the receiving water body. This relationship will assist in the screening and selection of appropriate watershed management options that will eventually achieve the desired water quality goals.

Some of the core principles in selecting modeling approaches for the Peconic Bay water bodies include: (1) the TMDL must be based on scientific analysis and reasonable and acceptable assumptions. All major assumptions must have been based on available data and experience gained from similar watersheds; (2) the TMDL must use the best available data. All available data in the appropriate watersheds were reviewed and used in the assessment wherever possible; and (3) methods should be clear and as simple as possible to facilitate explanation to stakeholders. All methods and major assumptions used here are described in detail and presented in a format accessible to a wide range of audiences.

To achieve these objectives, a Watershed Treatment Model (WTM; Caraco, 2001) has been utilized for characterizing the 25 Peconic Bay water bodies. Some of these water bodies either did not exhibit exceedances of coliform standards or they lacked data essential to determine impairment (see Section 4, Table 4-3). However, all 25 water bodies were included in the WTM source assessment. Most of the water bodies in question have one certification status (uncertified, conditionally certified, or seasonally certified) for the entire water body. However, several water bodies contained more than one type of certification status and therefore have been divided into local zones to simplify the TMDL analysis. Each of these zones within these water bodies are addressed through separate TMDLs.

6.1 Statistical Rollback Method

The statistical rollback method (Ott, 1995) was applied as a method to estimate the reductions in fecal coliform load necessary to meet the water quality standards of 14 MPN/100 mL (geomean) and 49 MPN/100 mL (90^{th} percentile). This method is appropriate when the observed data follow a lognormal distribution (i.e., most observed values are relatively low while a few are significantly higher) which is the case with bacteria population distributions in aquatic environments. Compliance with the most restrictive of the dual fecal coliform criteria determines the reduction necessary. The method compares the observed geomean and 90^{th} percentile values to the corresponding water quality standards. The reduction needed for each target value to be reached is determined by calculating the rollback factor ($f_{rollback}$). For example, the method for determining the geomean rollback factor follows:

$F_{rollback}$ = (Observed geomean – water quality standard)/(Observed geomean)

The same method is applied for the 90^{th} percentile values and standards and the most restrictive of the two (i.e., the greatest percent reduction required) is chosen as the target reduction.

$F_{rollback}$ = (Observed 90^{th} percentile – water quality standard)/(Observed 90^{th} percentile)

6.2 Watershed Treatment Model

The NYSDEC has water quality data from 203 separate sampling stations spread among the 25 water bodies covered by this TMDL. The locations of these sampling stations are presented in Section 2 which contains maps of all 25 water bodies, the sampling stations (NYSDEC and Suffolk County), shellfish closure status, and stormwater contributing zones. The Watershed Treatment Model (Caraco, 2001) has been used to characterize each of the contributing areas associated with the 25 water bodies whether or not they indicate violations of either fecal or total coliform standards. The application of the WTM is simple yet detailed enough in terms of pollution source characterization. A series of spreadsheets quantifies the loading of fecal coliform bacteria (it does not consider total coliform) based on land use, precipitation, and fate and transport information, where available. The model is designed as a planning level tool for watersheds that do not have sufficient data or resources necessary for complex modeling applications. The WTM has several tiers of data specificity; however, this general model has the capacity to be modified to accommodate site-specific characteristics or variable data quantity and quality. In most cases, fecal coliform loading estimates can be produced using readily available land use data. The spreadsheets calculate an annual fecal coliform load through the application of a series of algorithms that are based on statistical relationships associated with the fate and transport of bacteria from sources to receiving waters. These algorithms are based on empirical relationships and comparative studies over a wide array of watershed/water body systems (Caraco, 2001). Inputs into the model are aggregated into primary and secondary sources, described below.

Primary sources in WTM include general land use categories that are assigned either a coefficient that is then multiplied by an annual runoff volume to calculate an annual load (e.g., urban land uses) or an annual unit load that is applied as a function of land use (e.g., rural land uses). See Tables 6-1 and 6-2 for a listing of the WTM model default values. These coefficients were chosen based upon research that is summarized in WTM's user manual (Caraco, 2001). Secondary sources represent a more refined set of model inputs and can include more specific information such as combined sewer overflows or the presence of livestock and wildlife within a watershed. Similar to the primary source calculations, the secondary sources are assigned a loading coefficient based on the extent of the land use activity. Depending on data availability, specific data for point source discharges may be placed in this section of the model as well as head counts for various livestock animals. Watershed areas with specific data on watershed management strategies can use the model to calculate load reductions that are 'discounted' based on the extent and success of implementation. The presence of Best Management Practices (BMPs) such as detention basins or buffer strips, or the use of public education regarding the management of animal waste can be accounted for in existing and future loading scenarios.

Table 6-1. Watershed Treatment Model Default Values for Primary Sources

See Table 4-4 for definitions of land use categories

Land Use	Impervious Cover (%)
Low density residential	11
Medium density residential	21
High density residential	33
Multifamily	44
Commercial	72
Roadway	80
Industrial	53
Forest	0
Rural	0

* These rates assume a fecal coliform concentration of 20,000 MPN/100ml. for areas with impervious surfaces.

Table 6-2. Watershed Treatment Model Default Values for Secondary Sources.

General Sewage Use	
Individuals/Dwelling Unit	2.7
Water Use (gpcd[6])	70
Fecal coliform concentration in wastewater (MPN/100ml)	10,000,000

The goal of applying WTM is to characterize all the point and nonpoint sources of fecal coliform and to determine their relative annually averaged contributions to the water bodies of interest within the Peconic Bay estuary. The derived loading values will serve as the reference point from which reductions could be made toward the TMDL target. Since flow and water quality data for creeks and storm water were not available, the point and nonpoint sources, including storm water (including urban and residential sources) and waterfowl are assessed based on available information. Additional potential nonpoint sources do exist (beach wrack, marine sediment resuspension) but the lack of site-specific or even regional data preclude their consideration at this scale of study. Site-specific studies of local conditions may be necessary to elucidate the potential for these additional sources, particularly if DNA source-tracking studies indicate strong evidence for these sources (See Section 5.3).

Percent reductions required to achieve the water quality goals are derived by analyzing the water quality data using the statistical rollback method (Ott, 1995). Once the targeted reductions for point and nonpoint sources are derived, specific and general management strategies can be identified for the watersheds of interest.

6.2.1 Modeling of Primary Sources

A land use analysis was performed for the drainage areas to the Peconic Bay water bodies and described in Section 4 of this report. The overall land use map was intersected with the drainage areas for each of the water bodies under current TMDL consideration, and land use distribution within these water bodies were determined. The stormwater contributing areas, as determined by the Peconic Estuary Program, were used as the drainage area for each subwatershed. Wetlands and surface water areas were omitted from the analysis because the spreadsheet model considers these land uses as non-contributing sources of pathogens.

The WTM requires an annual rate of precipitation for the study areas. Precipitation data from the National Climatic Data Center were available for the Riverhead Research Farm and Bridgehampton stations (Station Numbers: 307134 and 300889, respectively). As described in Section 4, the Riverhead and Bridgehampton stations are assumed to be adequately representative of conditions at most of the water bodies within the study area.

Primary source inputs required by the WTM include the following:

- Residential
    - Low Density Residential (LDR) (<1dwelling unit (du)/acre)
    - Medium Density Residential (MDR) (1-4 du/acre)
    - High Density Residential (HDR) (>4 du/acre)

[6] Gallons per capita per day.

  - Multifamily
- Commercial
- Roadway
- Industrial
- Forest
- Rural
- Open Water
- Vacant Lots
- Annual Rainfall (inches)

The Suffolk County land use data is based on a tax assessor parcel scale. The individual tax assessor codes have been aggregated into 13 more general land use categories (Table 4-4). Further aggregation of some of these categories was performed to adequately meet the input requirements of the WTM model. Institutional is grouped with Commercial and Industrial contains Utilities and Waste Handling & Management classes. Two unclassified categories (14 and 15) were not documented in the Suffolk County land use report and were found to be infrequent in the study area. However, when these unclassified categories (BTCAMP codes) were encountered they were found to often occur as open coastal waters or forested areas, respectively, when compared to regional land use data and USGS topographic maps. These classifications should be reconciled by the creators of the data. The open water areas were omitted for reasons explained above, and the forested areas were incorporated into the WTM input values where necessary.

6.2.2 Modeling of Secondary Sources

Secondary sources available for input into the WTM are shown in Table 6-3. Several of these secondary sources were found to be inappropriate or unnecessary for this study. The number of households were attained from county parcel data (described above). The rate of septic failure was set at zero in the model, therefore the percent of unsewered households was not a required input. Partially treated or untreated sewage can be released to surface waters due to sanitary sewer overflows (SSOs) or combined sewer overflows (CSOs). However, none exist in the Peconic Bay study area and, therefore, not factored into the WTM. Marinas do exist within Peconic Bay, however, as described in Section 5.2.2, the No Discharge Zone (NDZ) designation and the increasing effectiveness of pumpout facilities renders value estimates for discharges from this source unnecessary. Waterfowl estimates have been made independently of the WTM and incorporated into the final calculation of fecal coliform loads to each water body. These are based on “occupancy rates” reported by Horsely and Witten (2003) and references within. Although some livestock exist in some of the contributing zones in the study area, only county-wide estimates were available and, therefore, difficult to apply at the local scale. More study is required to assess the role of livestock in several of the water bodies, particularly in light of some of the *E. coli* source-tracking results reported by Hasbrouck (2004) (See Section 5.3). Sewage treatment plants (STPs) were accounted for in Flanders Bay only, and maximum permitted flows were applied as input. Fecal coliform concentrations in STP flows were set at 200 MPN/100 mL which is the SPDES permit requirement.

Table 6-3. Summary of Secondary Sources Associated with the WTM Model.

# of House-hold Units	Un-Sewered Units (%)	Miles of SSOs	CSOs			Marinas		**Livestock/Wildlife**		**Non-Stormwater Point Source**	
			Median Storm Event (inches)	Sewer-shed Area (acres)	Sewershed Imper-vious Cover (%)	Berths	Season Length	**Water Fowl**	Horses	**Flow (MGD)**	**FC (MPN/100mL)**

Note: Those sources directly applied in this study are shown in bold. Other potential sources were evaluated but found not to be directly relevant to the load assessment (e.g., no CSOs present).

6.2.3 Load Characterization

The primary and secondary sources listed above were applied to the WTM to determine their relative distribution within each of the water bodies.

The WTM uses default values for source loadings where the user does not have site-specific data. Default values for terrestrial loading were set at 20,000 MPN/100 mL of surface runoff and influenced by additional factors such as land uses and their relative areas, precipitation and impervious surfaces. Rates of pet and waterfowl loads, and loads that are not yet quantifiable (e.g., wrack), are described in Section 5.