Appendix I: WTM Technical Assessment Methodology

Technical Assessment Methodology

Hutchinson River Watershed Plan

Overview & Objective

This appendix summarizes the methodology and results of the pollutant load model developed by Biohabitats for the Westchester County portion of the Hutchinson River watershed plan. The Watershed Treatment Model (WTM), developed by the Center for Watershed Protection, was used to estimate the annual pollutant loads to the Hutchinson River watershed as a component of the baseline watershed assessment.

Watershed Treatment Model

The WTM is a screening level tool that was used to estimate the loads of non-point source pollutants within the watershed based on local land uses and land cover under existing conditions. The model provides annual load estimates of pollutants from primary and secondary sources. Due to the limited available data, Biohabitats did not incorporate secondary sources, and the assessment focused on primary pollution sources that result from land use and impervious cover. Results provided are the annual loads of Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), and Bacteria totals for the watershed and each subwatershed. The WTM may also be used to estimate load reductions associated with management measures within the watershed. Due to limited available data, Biohabitats did not incorporate existing treatment measures in the existing conditions model. Analysis of treatment measures will be conducted during later stages of this project to evaluate recommended interventions throughout the watershed.

Hutchinson River Subwatershed

Dividing watersheds into smaller drainage basins, or subwatersheds, is a common practice to better understand details about pollutant loading within a watershed. The initial boundaries for the Hutchinson River Watershed were provided by Westchester County and were used as the perimeter for the watershed delineation process. The following twelve subwatersheds were identified within the Westchester County portion of the Hutchinson River watershed:

- Arthur Manor
- Chester Heights Park
- Lake Innisfree
- Pelham Lake
- Reservoir Three
- Reservoir Two
- Scarsdale Park
- Secor Lane
- Sprague Terminal Canal
- Twin Lakes Park
- Vernon Park
- Wolfs Lane Park

To identify these twelve subwatersheds, Biohabitats used a combination of approaches:

- In general, existing waterbodies (lakes and reservoirs), primary tributaries, and secondary tributaries were identified as confluence locations in more natural areas. In more urban areas, railroad crossings, highway ramps, and large road features were used as confluence points.
- Once these confluence points were identified, traditional watershed delineation was conduction using high points throughout the watershed.
- The team used 2-foot contour data provided by Westchester County to determine surface water flows to the Hutchinson River throughout the project area.
- In more urban areas, urban stormwater systems were identified and used to delineate when available.

Table 1 summarizes the twelve subwatersheds within the Westchester County portion of the Hutchinson River Watershed and Figure 1 shows a map of the subwatersheds.

Table 1: Subwatersheds within Westchester County portion of Hutchinson River Watershed

Subwatershed	Acronym	Area (acres)	Area (square miles)
Arthur Manor	AM	284	0.44
Chester Heights Park	CHP	441	0.69
Lake Innisfree	LI	586	0.92
Pelham Lake	PL	519	0.81
Reservoir Three	R3	585	0.91
Reservoir Two	R2	215	0.34
Scarsdale Park	SP	298	0.47
Secor Lane	SL	446	0.70
Sprague Terminal Canal	STC	692	1.08
Twin Lakes Park	TLP	374	0.58
Vernon Park	VP	518	0.81
Wolfs Lane Park	WLP	276	0.43
Total in Westchester Co.	**HR**	**5,234**	**8.18**

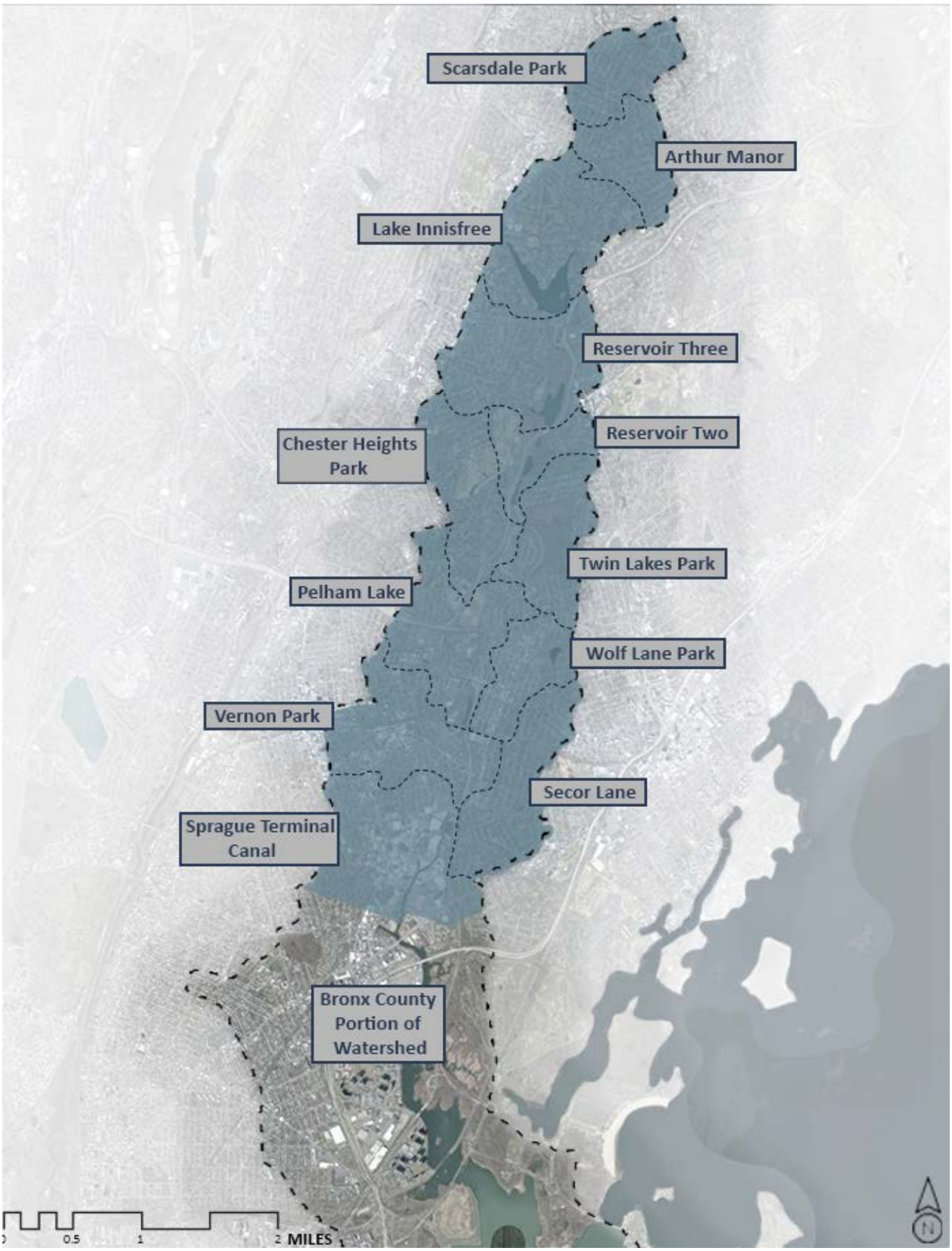

Figure 1: Subwatershed Delineation

Model Inputs

The following section identifies the different data types that were used in the watershed treatment model and any assumptions or modifications that were done to the raw data. Table 2 provides an overview of the data used for the Watershed Treatment Model:

Table 2: Data Inputs for the Watershed Treatment Model

Data Input	Usage	Source
Land Use	Use types that correlate to runoff calculations and to management recommendations.	Westchester County, 2022
Impervious Cover	Determine the land cover and how much is impervious in the watershed. Used in runoff calculations and management recommendations.	Westchester County, 2022
Precipitation	Total precipitation amounts for runoff calculations.	Cornell NRCC, 2021
Base Pollutant Concentrations	Assumptions for the different land use types and their initial concentration of primary pollutant.	Watershed Treatment Model, 2002
Runoff Calculations	Assumptions for the different land use types and their initial concentration of primary pollutant.	Watershed Treatment Model, 2002

Land Use

Initial land use data was obtained from Westchester County's tax parcel data. This dataset provides both primary land use categories and sub land use categories. Within the Hutchinson River watershed, sixteen land use categories were identified. For simplicity and relevance to the watershed assessment, only six land use categories were necessary. The following provides explanations for the creation of each land use category used as inputs to the WTM :

Commercial: This land use category combined *Commercial – Retail, Institutional and Public Assembly, Office and Research, Mixed Use,* and *Vacant/Undeveloped* land parcels identified as *Commercial Vacant*.

Industrial: All the parcels with the land use category *Manufacturing, Industrial, Warehouse* and *Vacant/Undeveloped* land parcels identified as *Industrial Vacant* were added to the Industrial Category. Additionally, the following Sub Land Use Categories from *Transportation, Communication, Utilities* were added to the Industrial Category: *Electric Power Generation – Hydro, Electric Transmission, Sewage Treatment and Water Pollution Control, Solid Wastes, Water, Water – Transportation*.

Open Water: Westchester County provided spatial data for all the lakes and reservoirs located within the watershed. Since the land use data did not identify the water bodies, the open water spatial data was overlayed onto the land use data to define these areas.

Parks: This land use category combined *Public Parks and Parkway Lands, Private Recreation,* the *Common Land Homeowners Association* parcels that were not included in open water, and the *Transportation, Communication, Utilities* with the Sub Land Use Category *Misc ROW,*

Easements. Additionally, parcels that were identified as *Vacant* and confirmed through aerial analysis from within the *Vacant/Undeveloped* category were added to the Parks category.

Residential: This land use category included all the parcels that were defined as *Residential* and all *Vacant/Undeveloped* land parcels defined as *Residential Vacant* in the Westchester County provided data.

Roadways: Roadways included the parcels with the *Roadways* land use category along with the parcels with the sub land use categories *Parking Lots,* and *Non ceiling Railroads*.

Table 3 provides an overview of land use cover amounts within the watershed. Please see the attachments for detailed maps of each sub watershed's land use cover.

Table 3: Acreage associated with each land use in the Westchester County portion of the Hutchinson River Watershed

Land Use	Acreage in Watershed	Percent of Watershed
Commercial	472	9
Industrial	185	3.5
Open Water	117	2.25
Parks	716	13.7
Residential	2,634	50.4
Roadways	1,110	21.15
Total	**5,234**	**100**

Impervious Cover

The base understanding of impervious cover in the Hutchinson River Watershed was identified through Westchester County's planimetric spatial data. This dataset provided accurate accounts of the bridges, buildings, driveways, parking lots, railroads, roadways, sidewalks, and transportation structures throughout the county. These features were delineated as 100% impervious surfaces. The team did a detailed review of the project area and added approximately 25 structures that were not included in the GIS assessment.

Table 4 provides the percentage of impervious cover that was calculated for each Land Use Category:

Table 4: Percent Impervious Cover by Land Use Category

Land Use	Percentage Impervious
Commercial	57.6%
Industrial	84.5%
Open Water	0%
Parks	5.1%
Residential	31.1%
Roadways	100%

Because of imperfect data, there are some locations where practitioners made assumption decisions including the following:

- Roadways were assumed to be completely impervious.
- Open water was assumed to have no impervious cover.

Precipitation

To calculate annual runoff, the average annual precipitation amount was calculated from the weather station at the Westchester County Airport in Harrison, New York, as provided by the Northeast Regional Climate Center (Cornell NRCC, 2021). The airport has datasets that range from 1946 to today. All years missing more than one day of precipitation were discarded to create the most accurate depiction of precipitation. In total, 22 years of precipitation data were discarded, and the average annual rainfall amount was calculated as 49.77 inches per year. Appendix B to the Baseline Assessment provides the monthly rainfall sums that compiled into the precipitation data that was used in this assessment.

Pollutant Concentration

Pollutant concentration values were provided in the Water Treatment Model (WTM) assessment manual (Caraco, 2002). Urban and rural pollutant concentrations and how they impact run off calculations are explained below.

Urban Pollutants

The pollutant concentration values were provided for four urban land use types: *Residential, Commercial, Roadway, and Industrial* pollutant concentration values were used for the same respectable land use categories. Given the characteristics of cemeteries, these land use types were also mapped to the residential land use values. Table 5 summarizes the pollutant concentrations used for each land use category.

Table 5: Land Use Category Pollutant Concentrations

Land Use Category	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Suspended Solids (mg/L)	Fecal Coliforms (MPN/100 mL)
Commercial	2	0.2	75	20,000
Industrial	2.5	0.4	120	20,000
Residential	2.2	0.4	100	20,000
Roadway	3	0.5	150	20,000

Non-Urban Pollutants

Non-urban pollutant concentrations were provided through the WTM as pollutant loading rates and use a simple storm load fraction to factor in the impact of rainfall. The categories provided were *Forest* and *Rural,* assumed to be pastureland rather than row crops, to determine runoff load amounts. Because the region is primarily urban and suburban and rural calculations will incorporate high amounts of fertilizers, pesticides, and animal waste, only the forest values were used for the Parks land use category. Table 6 provides the loading rates and partitioning coefficients used for forested areas.

Table 6: Pollutant Annual Loading Rates and Partitioning Coefficients

Pollutant	Annual Loading Rate (lb/acre/yr)	Partitioning Coefficient
Total Nitrogen	2.0	0.50
Total Phosphorus	0.2	0.70
Total Suspended Solids	100	0.90
Bacteria Coliform	12 (# billion/acre/yr)	1.00

Open water loading rates were taken from atmospheric deposition rates provided by the WTM. These values were calculated by combining multiple sources and are presented in Table 7.

Table 7: Atmospheric Deposition Rates

Pollutant	Annual Loading Rate (lb/acre/yr)
Total Nitrogen	12.8
Total Phosphorus	0.5
Total Suspended Solids	155
Bacteria Coliform	---

Runoff Modeling

For urban land use areas, the WTM recommends using the Simple Method to calculate the runoff loading rates. First, the annual runoff is calculated, based on impervious cover and runoff coefficients as follows:

$R = P * P_j * Rv$ where:

R = Annual runoff

P = Annual rainfall

P_j = Fraction of annual rainfall events producing runoff (0.9)

Rv = Runoff coefficient

Where the runoff coefficient is calculated based on impervious cover as:

Rv = 0.05 + 0.9 * (Impervious fraction)

Loading rates are then calculated to convert runoff depths to pollutant concentrations as follows:

L = CF*R*C*A where:

L = loading rate (lbs/year)

CF = conversion factor

R = annual runoff

C = pollutant concentration

A = Acreage

To assure that that runoff rates are not being under predicted, the urban runoff load values were compared to the forest runoff rates and the maximum was selected for each land use. After the maximum value was selected, the annual load rate was multiplied by acreage to determine the loading rate for each land use category and subwatershed.

Results

The Watershed Treatment Model provided the team with estimates of pollution loads in pounds per year and bacteria loads in billions of colonies per year to better understand the impacts that land cover has on the pollution in the watershed. The results can be seen in Appendix C.