TMDL Summary — Appendix B-1

Adams Brook

Watershed Description

This **TMDL** applies to a 1.2 mile section of Adams Brook, located in the Town of Berwick, Maine. The stream begins just upstream of Blackberry Hill Road and flows southeast through forest. The stream continues across Portland Street (Route 4) and turns east before joining Lover's Brook just upstream of Pond Road. The Adams Brook watershed covers an area of 1.1 square miles. The majority of the watershed is located within the Town of Berwick; however, small portions of the watershed lie within the surrounding Town of South Berwick.

- Adams Brook is on Maine's 303(d) list of Impaired Streams as referenced in the 2016 Integrated Report (Maine DEP, 2018).
- The Adams Brook watershed is predominately non-developed (63%). Wooded areas (34%) within the watershed absorb and filter pollutants helping protect both water quality in the stream and stream channel stability. Wetlands (21%) also filter nutrients.
- Non-forested areas within the watershed include agricultural (29.4%) and are concentrated in the southern portion of the watershed along Blackberry Hill Road, Portland Street, and Pond Road.
- Developed areas (7.1%) with impervious surfaces in close proximity to the stream may impact water quality.
- Runoff from agricultural land located in the areas of Blackberry Hill Road, Portland Street, and Pond Road, have been identified as the largest sources of **nonpoint source (NPS) pollution** to Adams Brook. Runoff from cultivated lands, active hay lands, and grazing areas can transport sediment, nitrogen, and phosphorus to the stream.

Definitions

- ***Total Maximum Daily Load (TMDL)*** *represents the total amount of pollutants that a waterbody can receive and still meet water quality standards.*
- **Nonpoint Source Pollution** *refers to pollution that comes from many diffuse sources across the landscape, and are typically transported by rain or snowmelt runoff.*

Waterbody Facts

Segment ID: ME0106000304_625R01

Town: Berwick, ME

County: York

Impaired Segment Length: 1.2 miles

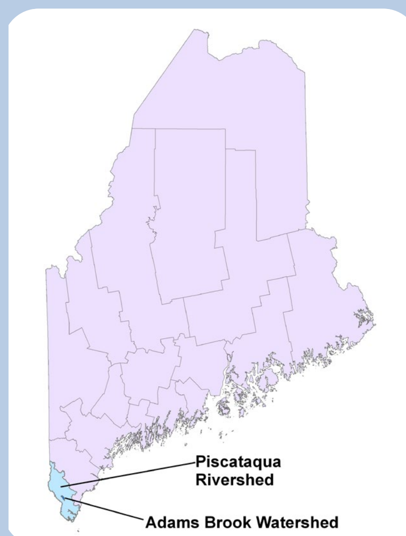
Classification: Class B

Direct Watershed: 1.1 mi^2 (684 acres)

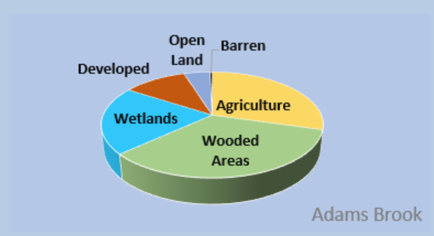
Impairment Listing Cause: Benthic macroinvertebrates

Watershed Agricultural Land Use: 29.4%

Major Drainage Basin: Piscataqua River



Watershed Land Uses



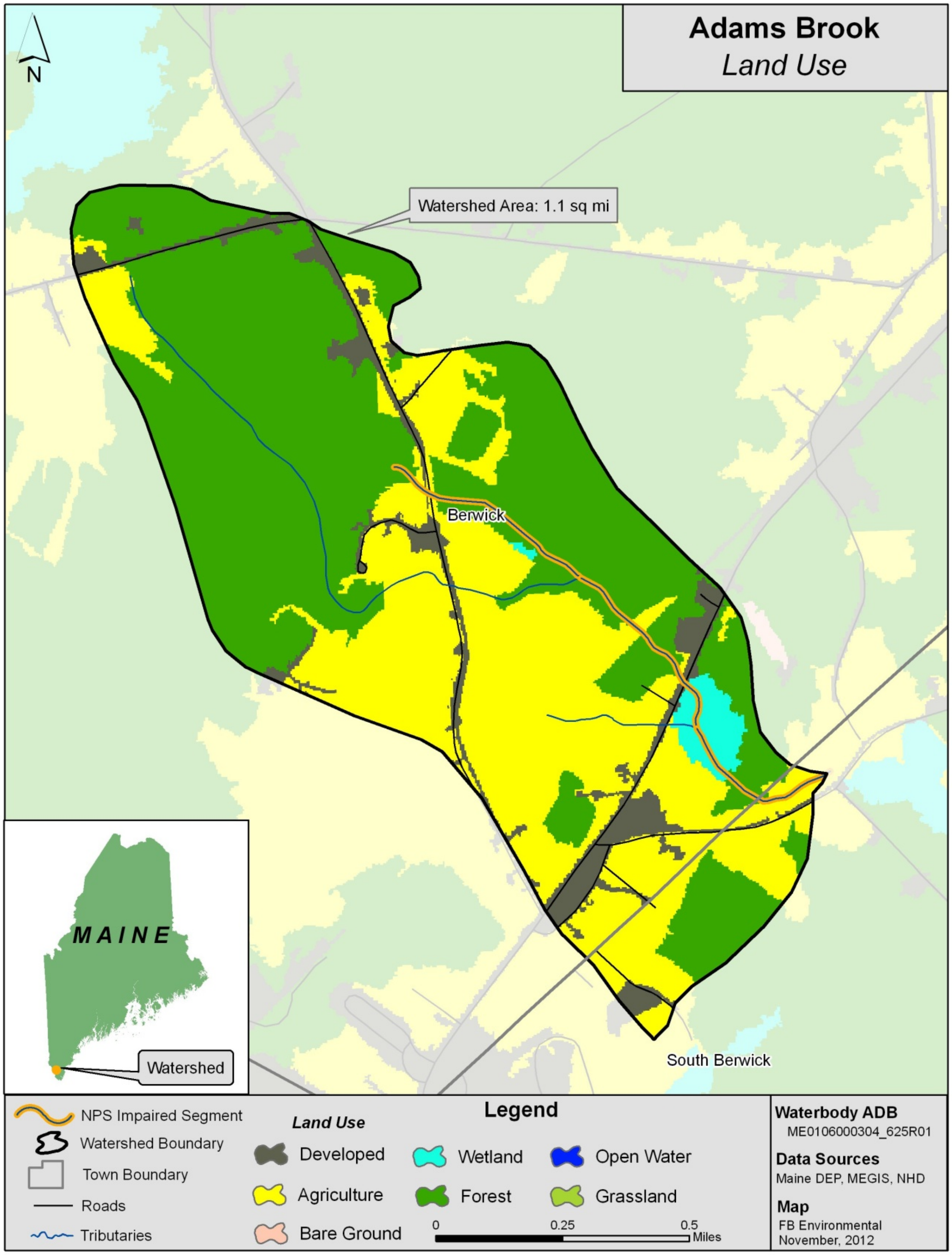


Figure 1: Land Use and Land Cover (from 2011) in the Adams Brook Watershed

WHY IS A TMDL ASSESSMENT NEEDED?

Adams Brook, a Class B freshwater stream, has been assessed by Maine DEP as not meeting water quality standards for the designated use of aquatic life, and placed on the 303(d) list of impaired waters under the Clean Water Act. The Clean Water Act requires that all 303(d)-listed waters undergo a Total Maximum Daily Load (TMDL) assessment that describes the impairments and establishes a target to guide the measures needed to restore water quality. The goal is for all waterbodies to comply with state water quality standards.

Adams Brook *at DEP Sampling Station 267 (Photo: FB Environmental)*

Agriculture land in the Adams Brook watershed makes up 29.4% of the land area, with 29% being hay/pasture land. However, in the southern portion of the watershed, Adams Brook flows through agricultural areas with little or no vegetated buffer for about 0.25 miles (Figure 1). The close proximity of many agricultural lands to the stream further increases the likelihood that nutrients and sediment from disturbed soils, manure, and fertilizers will reach the stream.

WATER QUALITY DATA ANALYSIS

Maine DEP uses a variety of data types to measure the ability of a stream to adequately support aquatic life, including; dissolved oxygen, benthic macroinvertebrates, and periphyton (algae). For benthic macroinvertebrates, DEP makes aquatic life use determinations using a statistical model that incorporates 30 variables of data collected from rivers and streams, including the richness and abundance of streambed organisms, to determine the probability of a sample meeting Class A, B, or C conditions. Biologists use the model results and supporting information to determine if samples comply with the numeric aquatic life criteria of the class assigned to the stream or river (Davies and Tsomides, 2002). Maine DEP uses an analogous model to aid in the assessment of algal communities but makes aquatic life use determinations based on narrative standards.

The aquatic life impairment in Adams Brook is based on macroinvertebrate data collected at Station S-267 in 1995. The segment does not meet the standards for its Class B designation.

TMDL ASSESSMENT APPROACH: NUTRIENT AND SEDIMENT MODELING OF IMPAIRED AND ATTAINMENT STREAMS

NPS pollution is difficult to measure directly because it comes from many diffuse sources spread across the landscape. For this reason, an online nutrient loading model, *Model My Watershed* (v. 1.32.0), was used to estimate the sources of pollution based on well-established hydrological equations (Stroud Water Research Center 2017). *Model My Watershed* makes use of the GWLF-enhanced model engine. The model incorporates detailed maps of soil, land use, and slope, daily weather and localized weather data (from the period 2009-2020), and direct observations of agriculture and other land uses within the watershed. *Model My Watershed* is derived from its parent MapShed developed by Evans and Corradini (2012). *Model My Watershed* replaced MapShed in 2017-2018.

The nutrient loading estimates for the impaired stream were compared to similar estimates for five non-impaired (attainment) streams of similar watershed land uses across the state. The TMDL for the impaired stream was set as the mean nutrient loading estimate of these attainment stream watersheds, and units of mass per unit watershed area per year (kg/ha/year) were used. The difference in loading estimates between the impaired and attainment watersheds represents the percent reduction in nutrient loading required under this TMDL. The attainment streams and their nutrient and sediment loading estimates and TMDL are presented below in Table 1.

Table 1: Numeric Targets for Pollutant Loading Based on Model My Watershed Outputs (2021) for Attainment Streams

Attainment Streams	Town	Total P Load (kg/ha/yr)	Total N Load (kg/ha/yr)	Sediment Load (kg/ha/yr)
Footman Brook	Exeter	0.17	1.73	35.2
Martin Stream	Fairfield	0.13	2.98	57.9
Moose Brook	Houlton	0.18	1.59	48.5
Upper Kenduskeag Stream	Corinth	0.16	1.72	100.5
Upper Pleasant River	Gray	0.16	4.26	86.5
Total Maximum Daily Load		**0.16**	**2.46**	**65.7**

Rapid Watershed Assessment

Habitat Assessment

A habitat assessment survey was conducted in 2012 on both the impaired and attainment streams. The assessment approach is based on the *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al. 1999), which integrates various parameters relating to the structure of physical habitat. The habitat assessments include a general description of the site and physical characterization and visual assessment of in-stream and riparian habitat quality.

Based on rapid bioassessment protocols for low gradient streams, Adams Brook received a score of 117 out of a total 200 for quality of habitat. Higher scores indicate better habitat. The range of habitat assessment scores for attainment streams was 155 to 179. The habitat assessment was conducted on a relatively short sample reach (about 100-200 meters for a typical small stream) and was located near the most downstream Maine DEP sample station. For both impaired and attainment streams, the assessment location was usually near a road crossing for ease of access. In the Adams Brook watershed, the downstream sample station was located in an inactive pasture with minimal trees within a riparian zone dominated by tall grasses with some small trees.

Figure 2 (right) shows the range of habitat assessment scores for all attainment and impaired streams, as well as for Adams Brook. Though these scores show that habitat is clearly an issue for Adams Brook, but it is also important to look for other potential sources within the watershed leading to the water quality impairment. Consideration should be given to major "hot spots" in the Adams Brook watershed as potential sources of NPS pollution contributing to the water quality impairment.

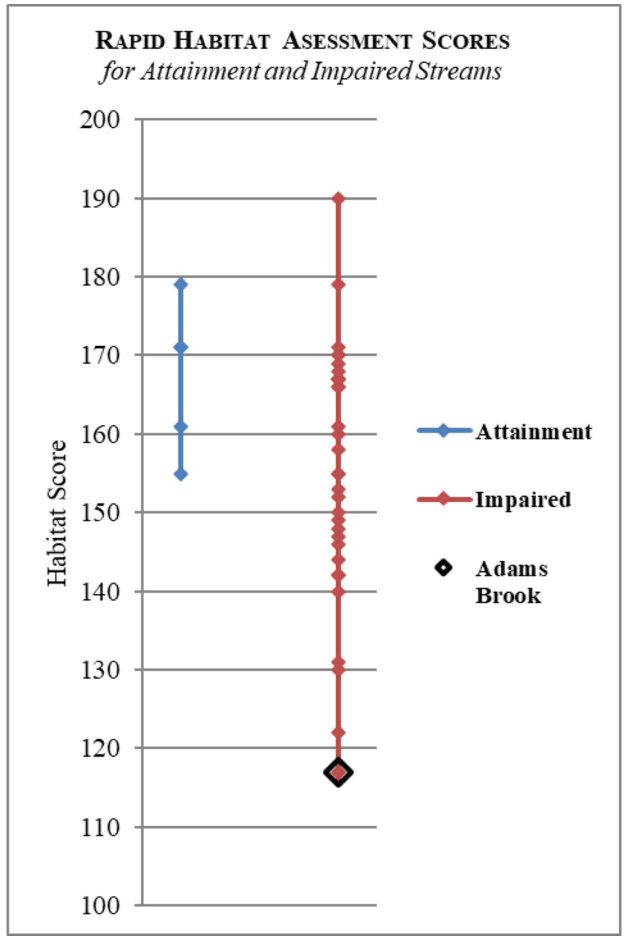


Figure 2: Habitat Assessment Score for Adams Brook (2012) Compared to Region

Pollution Source Identification

Pollution source identification assessments were conducted for both Adams Brook and the attainment streams. The source identification work is based on an abbreviated version of the Center for Watershed Protection's Unified Subwatershed and Site Reconnaissance method (Wright, et al., 2005). The abbreviated method includes both a desktop and field component. The desktop assessment consists of generating and reviewing maps of the watershed boundary, roads, land use and satellite imagery, and then identifying potential NPS pollution locations, such as road crossings, agricultural fields, and large areas of bare soil. When available, multiple sources of satellite imagery were reviewed. Occasionally, the high resolution of the imagery allowed for observations of livestock, row crops, eroding stream banks, sediment-laden water, junkyards, and other potential NPS concerns that could affect stream quality. As many potential pollution sources as possible were visited, assessed, and documented in the field. Field visits were limited to NPS sites that were visible from roads, or within a short walk from a roadway. Neighborhoods were assessed for NPS pollution at the whole neighborhood level including streets and storm drains (where applicable). The assessment does not include a scoring component, but does include a detailed summary of findings and a map indicating documented NPS sites throughout the watershed.

The watershed source assessment for Adams Brook was completed on July 2012. In-field observations of erosion, lack of vegetated stream buffer, extensive impervious surfaces, high-density neighborhoods and agricultural activities were documented throughout the watershed (Table 2, Fig. 3).

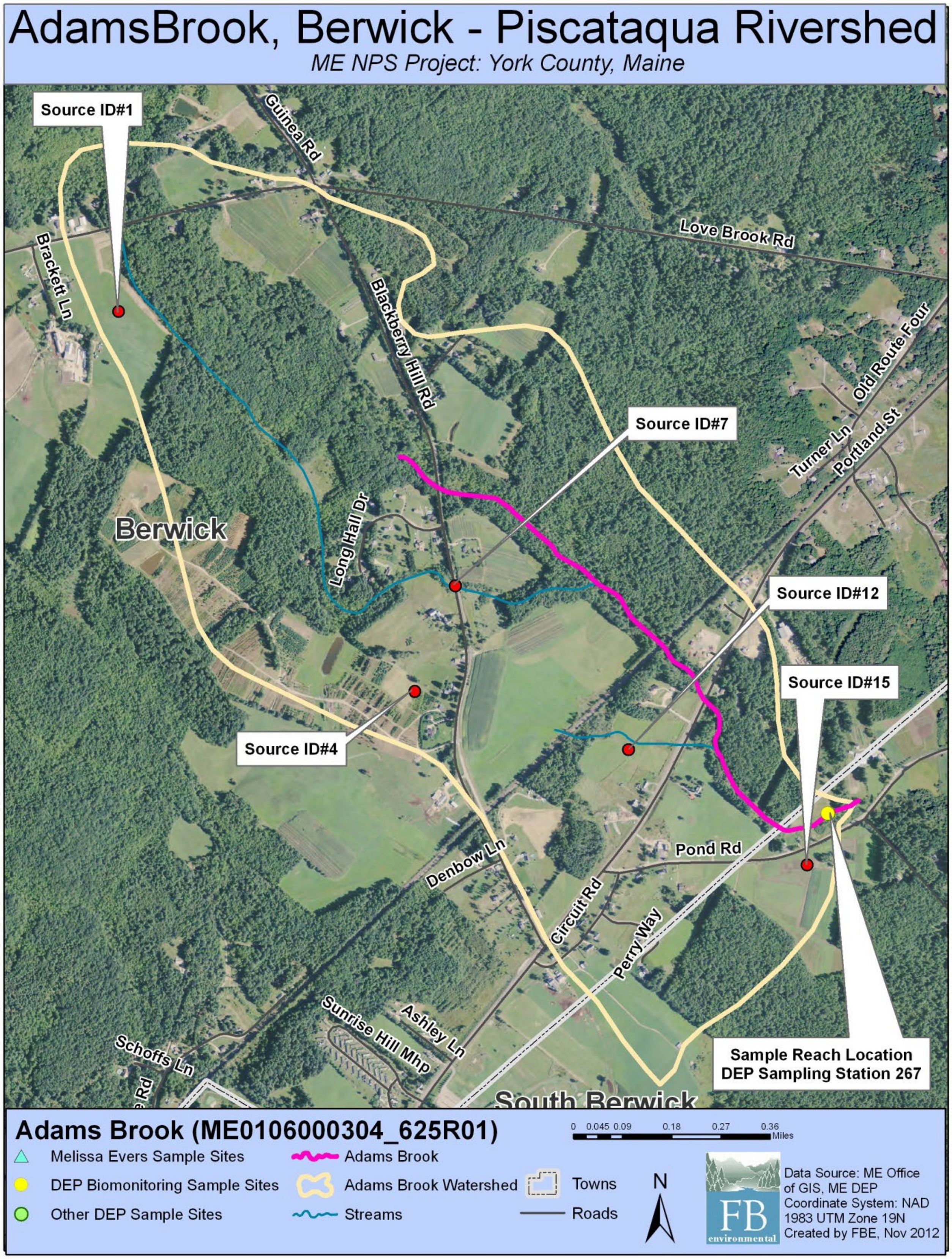
Table 2: Potential Pollution Source ID Assessment (2012) for the Adams Brook Watershed

Potential Source			Notes
ID#	**Location**	**Type**	
1	Blackberry Hill Road	Agriculture	• Estimated 25 dairy cows observed.
4	Blackberry Hill Road (just north of RR tracks)	Agriculture	• Active corn crops and hayfields. • Estimated 60 dairy cows observed grazing.
7	Blackberry Hill Road	Road Crossing/ Agriculture	• Active row crops on surrounding properties. • Bare soil. • Nearby electric fence indicates livestock on adjacent property.
12	Portland Street	Agriculture	• Active hayfields. • 2 horses observed grazing. • Tributary is drainage from agricultural fields in Location #4 and flows through active hay fields in location #12. Ephemeral.
15	Pond Road	Agriculture	• 2 horses observed grazing. • Active row crops.
16	Pond Road	Sampling Location	• Location of sample reach. • Inactive fields surrounding. • DEP Sample Station 267.

NUTRIENT AND SEDIMENT LOADING – *MODEL MY WATERSHED* ANALYSIS

The *Model My Watershed* model was used to estimate stream loading of total phosphorus, total nitrogen, and sediment in Adams Brook watershed. The model estimated nutrient loads over a 12-year period (2009-2020), which was determined by local (Sanford 2 NNW USC00177479) weather data inserted into *Model My Watershed*. This extended period captures a recent but wide range of hydrologic conditions to account for variations in nutrient and sediment loading over time. Loads for the attainment watersheds (five total; Table 1) were computed using the same model with the same recent inputs (i.e., regional weather, 2016 land use and land cover, 2016 wetland extent, and BMPs similar to the impaired watersheds).

Figure 3: Aerial Photo of Potential Source Locations (identified in 2012) in the Adams Brook Watershed



Many quality assured and regionally calibrated input parameters are provided with *Model My Watershed*. However, several updates to some of the default parameters were made in this TMDL effort, and namely more recent land use/cover using **MRLC-NLCD 2016** [1], more recent and local weather (precipitation and temperature) data (as described above), and more regional estimates of Best Management Practices (BMPs; see ensuing discussion). Because land use/cover is more recent, the estimated filtration fraction of wetland and open water and the amount of stream buffer in agricultural land should be more accurate. It is also worth noting that improved classification algorithms were employed by MLRC in the NCLD 2016 and these new algorithms were used in the revisions of all previous NLCD versions (including the first version in 2001).

Livestock Estimates

Livestock waste contains nutrients which can cause water quality impairment. The nutrient loading model considers numbers and types of animals. Table 3 (right) provides livestock (numbers of animals) in the watershed based on the USDA National Agricultural Statistics Service (NASS) estimation for 2012. Some of these totals were modified by direct observations made in the watershed in the 2012 survey. To generate watershed-based livestock counts, NASS county-based livestock totals are converted to a per unit area (based on the total area of the county). The unit area amount is then multiplied by the total watershed area to derive a watershed total count (as seen in Table 3).

Table 3: Livestock Count in the Adams Brook Watershed

Type	Adams Brook
Dairy Cows	85
Beef Cows	--
Broilers	2
Layers	--
Hogs/Swine	--
Sheep	1
Horses	4
Turkeys	--
Other	--
Total	**92**

The Adams Brook watershed contains substantial mixed agricultural land uses. Areas of active corn and hayfields were commonly observed, and two dairy farms were documented on Blackberry Hill Road. An estimated total of 85 cows were observed on these properties. Four horses were also observed during the watershed survey.

Vegetated Stream Buffer in Agricultural Areas

Vegetated stream buffers are areas of trees, shrubs, and/or grasses adjacent to streams, lakes, ponds or wetlands which provide nutrient loading attenuation (Evans and Corradini, 2012). *Model My Watershed* considers natural vegetated stream buffers within agricultural land areas as providing nutrient load attenuation. A width of approximately 98 feet (30 m) on one side of a stream is required to be considered a streamside buffer per the *Model My Watershed* technical manual (Stroud Water Research Center 2017). Analysis of recent aerial photos was used to estimate the number of agricultural land stream miles with and without vegetative buffers, and these estimates were directly entered into the model.

Adams Brook is a 1.2 mile-long impaired segment as listed by Maine DEP. As modeled, the total stream miles (including tributaries) within the watershed was calculated as 2.05 miles.

[1] MRLC-NLCD 2016 : Multi-Resolution Land Characteristics – National Land Cover Dataset (version 2016) provided by the MRLC Consortium (Jin et al. 2019).

Of this total, 0.82 stream miles are located within agricultural areas and 0.57 miles of that area *appear* to have a 98 foot or greater vegetated buffer (Table 4, Figure 4). From a watershed perspective, this equates to 0.25 miles or 12.2% of the total stream length running through agricultural land with less than a 98 foot buffer. By contrast, for attainment stream watersheds the percentage of total stream miles running through agricultural land without a 75 foot vegetated buffer ranged from 0% to 3.9% with an average of 1.3%. Note, a minimum vegetated buffer width of *75 feet* was used in an earlier (2012) effort to produce Figure 4 shown here. Differences in stream length estimates using a 98-foot or 75-foot buffer were practically insignificant.

Table 4: Summary of Vegetated Buffers in Agricultural Areas (2012)

Adams Brook
• Agricultural Land Stream Length = 0.82 mi • Agricultural Land Stream Length with Buffer = 0.57 mi (or 70% of total agricultural land stream length) • Percentage of total stream length flowing through non-buffered agricultural land = 12.2%

Home Septic System Loads

Loads for "normally functioning" septic systems are calculated in *Model My Watershed* using an estimate of the average number of persons per acre in "Low-Density Mixed" areas. In these areas, it is assumed that the populations therein are served by septic systems rather than centralized sewage systems. All homes in such areas are assumed to be connected to "normally functioning" systems rather than those that experience "surface breakouts" (surface failures), "short-circuiting" to underlying groundwater (subsurface failures), or have direct conduits to nearby water bodies. Non-functioning systems would be modeled with a higher load contribution to the waterbody.

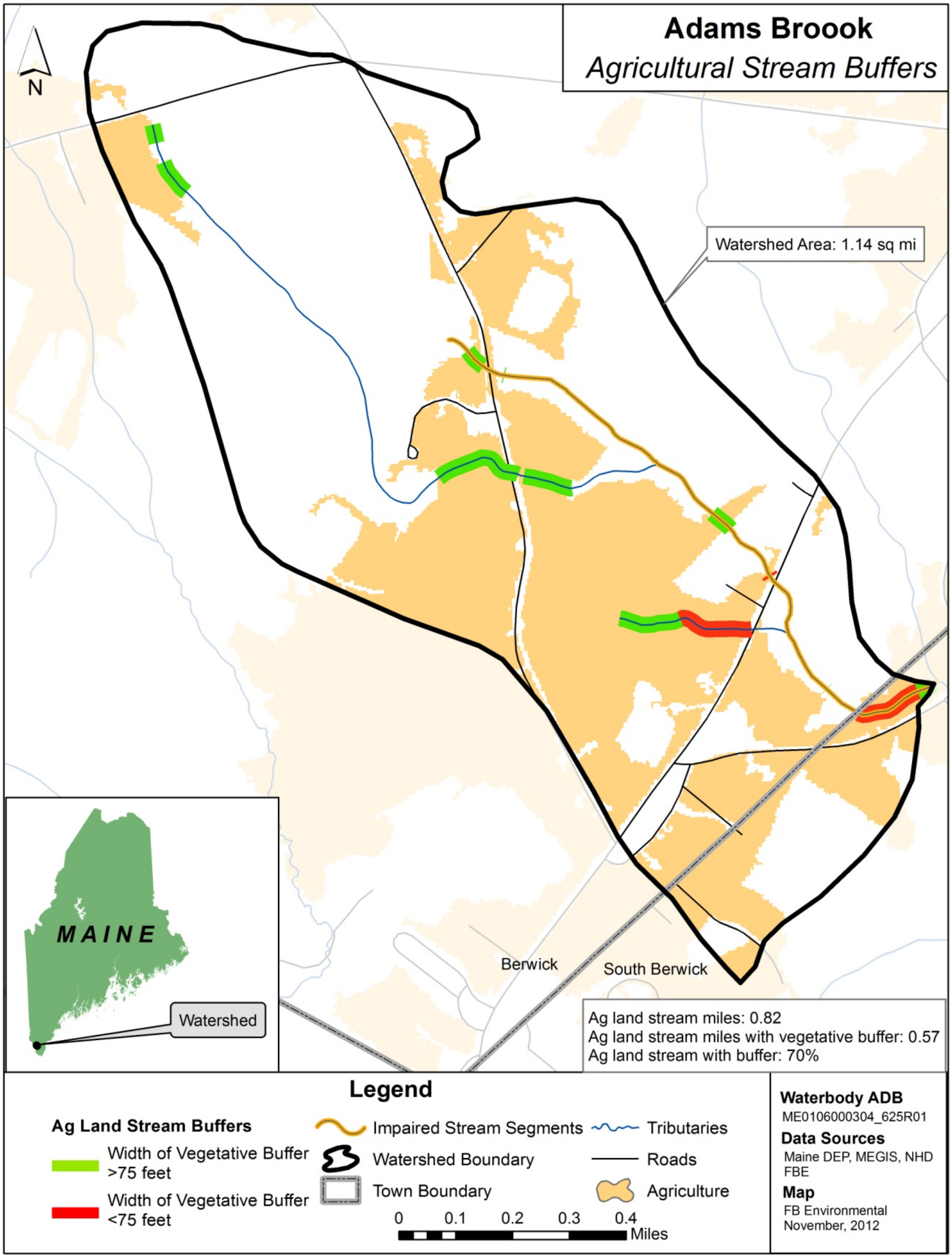
Best Management Practices (BMPs)

Best management practices (BMPs) are typically instituted to reduce the loading of sediment and nutrients from upland (i.e., non-point) sources. Ideally, information on BMPs for a specific watershed from local and regional sources would improve this component of the water quality model. Maine DEP sought information on BMP use in early 2021 from local, regional, and state agricultural agencies for rural BMPs and from nearby municipalities for urban BMPs. Very little to no information was returned in the solicitation. Hence, estimates for typical New England watersheds were derived from information available from Vermont. An upper limit of BMP use was garnered from watersheds entering the Chesapeake Bay where BMP use is intensive.

Four agricultural BMPs were used in this modeling effort and in the following manner:

- *Cover Crops:* Cover crops are the use of annual or perennial crops to protect soil from erosion during time periods between harvesting and planting of the primary crop. The percent of cropland area in a cover crop BMP deployed was estimated at 25% and selected as the low end of the range (25 to 30 percent) expected for cropland in New England. This value was assigned to the five attainment watersheds.
- *Conservation Tillage:* Conservation tillage is any kind of system that leaves at least 30% of the soil surface covered with crop residue after planting. This reduces soil erosion and runoff. This BMP was estimated to occur in 25% of cropland. This value was assigned to the five attainment watersheds.

Figure 4: Agricultural Stream Buffers (from 2012) in the Adams Brook Watershed



- *Strip Cropping / Contour Farming:* This BMP involves tilling, planting and harvesting perpendicular to the gradient of a hill or slope using high levels of plant residue to reduce soil erosion from runoff. Both interview sources suggest this practice is minimal to non-existent for New England watersheds. Hence, no BMP of this type was used in this modeling effort. This value was assigned to the five attainment watersheds.
- *Grazing Land Management:* This BMP consists of ensuring adequate vegetation cover on grazed lands to prevent soil erosion from overgrazing or other forms of over-use. This usually employs a rotational grazing system where hays or legumes are planted for feed and livestock is rotated through several fenced pastures. Both interview sources were not aware of this practice being active and is likely minimal for New England watersheds. Hence, no BMP of this type was used in this modeling effort for both impaired and attaining watersheds.

Note that other agricultural and development BMPs likely exist in the watershed but their location and type were not available in a watershed-wide format that is necessary to include in the model. Agricultural BMPs recommended by Maine DEP to reduce sediment and nutrient loads include vegetated buffers, covered manure storage facilities, and stream exclusion fencing. BMPs for developed areas recommended by the Maine DEP include vegetated buffers, stormwater BMPs, and minimization of impervious cover.

Pollutant Load Attenuation by Lakes, Ponds and Wetlands

Depositional environments such as lakes, ponds, and wetlands can attenuate watershed sediment and nutrient loading. This information is entered into the nutrient loading model by a simple percentage of watershed area draining to a lake, pond, or wetland. The Adams Brook watershed is 20.8% wetland and open water, per the 2016 NLCD land use/cover and including a large wetland south of Portland Street. It is estimated that 41.6% of land area within the watershed drains to wetlands and open water. The percent of watershed draining to a wetland in the attainment watersheds, based on the 2021 analysis, ranged from 26 to 58 percent, with an average of 40%.

NUTRIENT AND SEDIMENT MODELING RESULTS

Selected results from the watershed loading model are presented here. The TMDL itself is expressed in units of kilograms per hectare per year. The additional results shown below assist in better understanding the likely sources of pollution. The model results for Adams Brook watershed indicate significant reductions of phosphorus and nitrogen are needed to improve water quality. No reductions in sediment are needed. Below, loading for nitrogen, phosphorus and sediment are discussed individually.

There are two categories of loads – sources and pathways. Sources are determined by land use/cover and the overland flow they generate, livestock counts by animal type, and home sewage treatment systems in developed areas. Pathways represent additional loads derived from subsurface flow and streambank erosion. Subsurface loads are calculated using dissolved N and P coefficients for shallow groundwater and are mainly derived from atmospheric inputs. Sediment and nutrient loads produced by eroding streambanks are estimated using an approach developed by Evans et al. (2003). This pathway is comprised of loads originating from five sources, and listed in order of decreasing importance: amount of developed land area, soil erodibility (K-factor), density of livestock, runoff curve number, and topographic slope. For any given model run, the amount of developed land in the watershed is responsible for just over 72% of the total streambank load, whereas soil erodibility and animal density are responsible for 21% and 7% of the total streambank load, respectively.

Sediment

Sediment loading in the Adams Brook watershed is mainly derived from stream bank erosion which contributes almost 55% of the total watershed sediment load. Combined agricultural sources (hay/pasture and cropland) make up 67% of the source load (Table 5 and Figure 5). Residential areas contribute 22.4% of the source load.

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient Levels for Adams Brook* below for loading estimates that have been normalized by watershed area.

Table 5: Total Sediment Load by Source

Adams Brook	**Sediment (1000 kg/year)**	**Sediment (%)**
Source Load		
Hay/Pasture	4.8	60.9%
Cropland	0.5	5.9%
Wooded Areas	0.2	2.9%
Wetlands	0.1	1.4%
Open Land	0.5	6.4%
Barren Areas	0.001	0.013%
Low-Density Mixed	0.7	9.4%
Medium-Density Mixed	0.5	6.4%
High-Density Mixed	0.1	0.7%
Low-Density Open Space	0.5	5.9%
Farm Animals	0.0	0.0%
Septic Systems	0.0	0.0%
Source Load Total:	**7.9**	**100%**
Pathway Load		
Stream Bank Erosion	9.3	-
Subsurface Flow	0.0	-
Total Watershed Mass Load:	**17**	

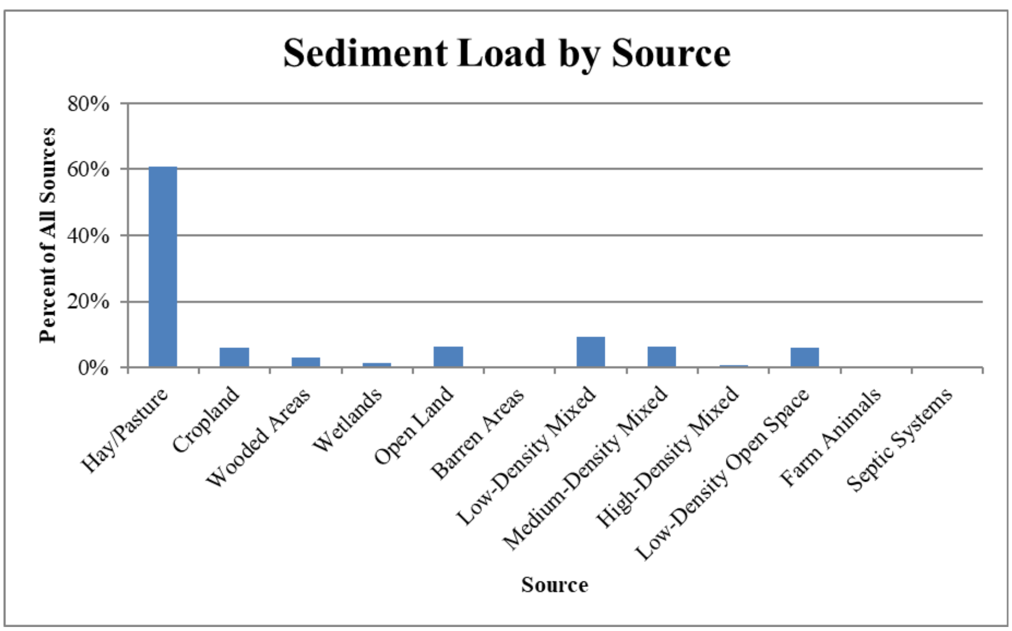


Figure 5: Total Sediment Load by Source in the Adams Brook Watershed

Total Nitrogen

Nitrogen loading is attributed primarily to farm animals (73%) and to some extent hay/pasture land (9.9%) (Table 6 and Figure 6). Residential areas contribute 6.5% of the source load.

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient Levels for Adams Brook* below for loading estimates that have been normalized by watershed area.

Table 6: Total Nitrogen Load by Source

Adams Brook	**Total N (kg/year)**	**Total N (%)**
Source Load		
Hay/Pasture	94	9.9%
Cropland	7	0.7%
Wooded Areas	25	2.6%
Wetlands	46	4.9%
Open Land	12	1.3%
Barren Areas	1	0.1%
Low-Density Mixed	29	3.0%
Medium-Density Mixed	14	1.4%
High-Density Mixed	1	0.1%
Low-Density Open Space	18	1.9%
Farm Animals	693	73.0%
Septic Systems	9	1.0%
Source Load Total:	**949**	**100%**
Pathway Load		
Stream Bank Erosion	11	-
Subsurface Flow	326	-
Total Watershed Mass Load:	**1,286**	

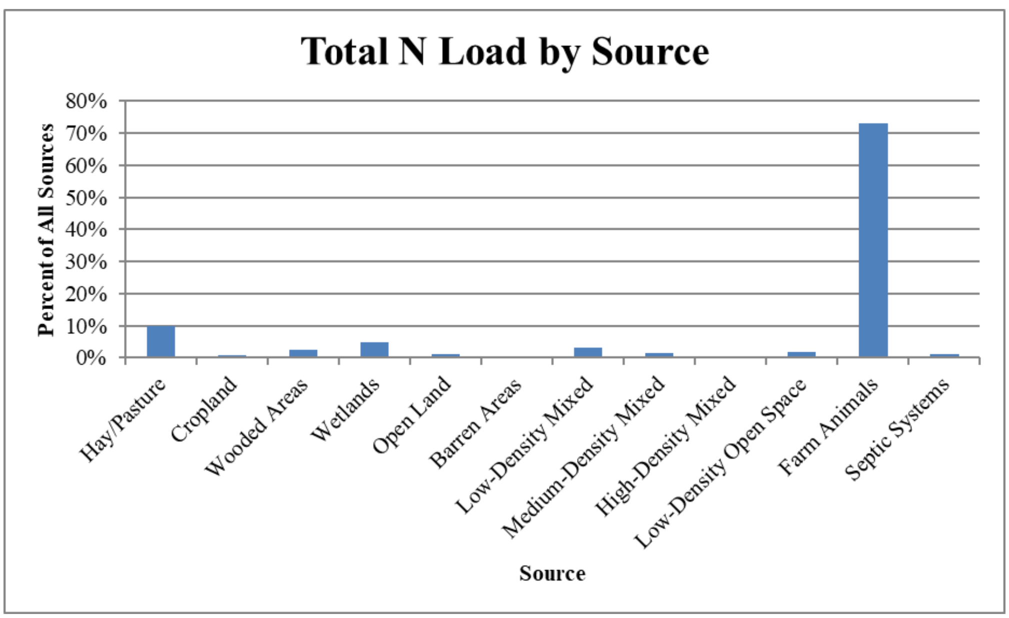


Figure 6: Total Nitrogen Load by Source in the Adams Brook Watershed

Total Phosphorus

Phosphorus loading within the watershed is attributed primarily to farm animals and hay/pasture land with combined agricultural sources accounting for over 93% of the total phosphorus load to Adams Brook. Residential areas contribute 3.7% of the source load. Phosphorus loads are presented in Table 7 and Figure 7.

Note that total loads by mass cannot be directly compared between watershed TMDLs due to differences in watershed area. See section *TMDL: Target Nutrient Levels for Adams Brook* below for loading estimates that have been normalized by watershed area.

Table 7: Total Phosphorus Load by Source

Adams Brook	Total P (kg/year)	Total P (%)
Source Load		
Hay/Pasture	35.2	21.2%
Cropland	1.4	0.8%
Wooded Areas	1.5	0.9%
Wetlands	2.4	1.4%
Open Land	1.0	0.6%
Barren Areas	0.0	0.00%
Low-Density Mixed	2.9	1.8%
Medium-Density Mixed	1.3	0.8%
High-Density Mixed	0.1	0.1%
Low-Density Open Space	1.8	1.1%
Farm Animals	118.1	71.3%
Septic Systems	0.0	0.0%
Source Load Total:	**165.7**	**100%**
Pathway Load		
Stream Bank Erosion	4.0	-
Subsurface Flow	12.6	-
Total Watershed Mass Load:	**182**	

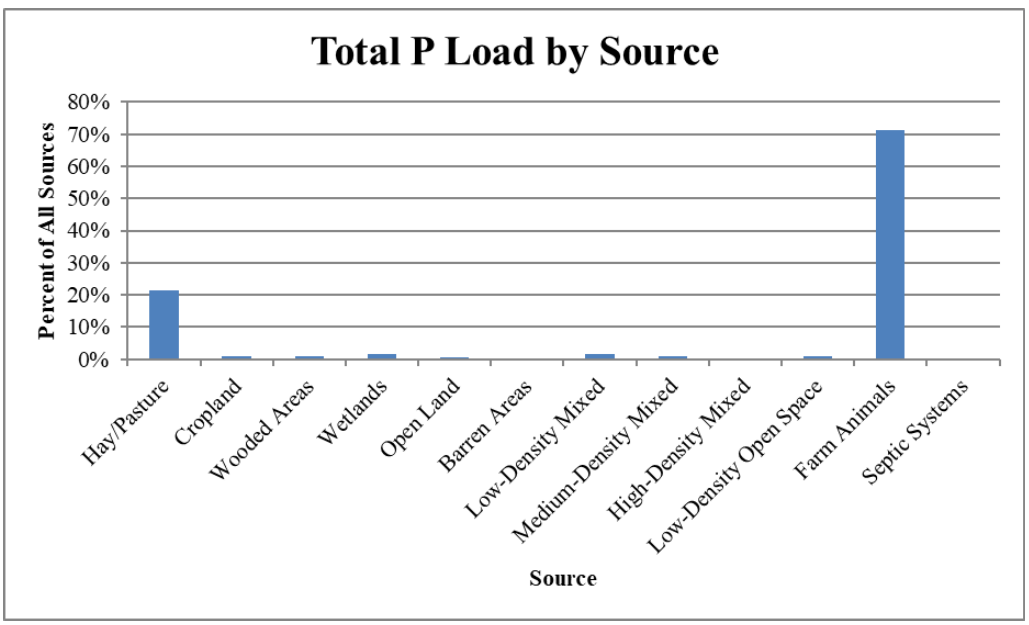


Figure 7: Total Phosphorus Load by Source in the Adams Brook Watershed

TMDL: TARGET NUTRIENT AND SEDIMENT LEVELS FOR ADAMS BROOK

The existing loads for nutrients and sediments in the impaired segment of Adams Brook are listed in Table 8, along with the TMDL (the allowable load) which was calculated from the average loading estimates of five attainment watersheds throughout the state. Table 8 also shows required reductions (as a percent) for each of sediment, total N, and total P pollutants. Table 9 presents a more detailed view of the modeling results and calculations used to compute the existing loads in Table 8. An annual time frame provides a mechanism to address the daily and seasonal variability associated with nonpoint source loads.

Table 8: Adams Brook Pollutant Loading Compared to TMDL Targets

Adams Brook			
Pollutant Load	**Existing Load**	**TMDL**	**Reduction Required**
Total Annual Load per Unit Area		Attainment Streams	
Sediment (kg/ha/yr)	58.8	65.72	None
Total N (kg/ha/yr)	4.40	2.46	44.1%
Total P (kg/ha/yr)	0.62	0.16	74.3%

Future Loading

The prescribed reduction in pollutants discussed in this TMDL reflects reduction from estimated existing conditions. Expansion of agricultural and development activities in the watershed have the potential to increase runoff and associated pollutant loads to Adams Brook. To ensure that the TMDL targets are attained, future agricultural activities will need to meet the TMDL targets. Between 2012 to 2017 in York County, the area of agricultural lands was decreasing, with a 5.6% decrease in the total number of farms and a 5.4% decrease in total farm area. Average farm size did not change during this time period. These values are extracted from the most recent (2017) Census of Agriculture (USDA 2017). Human population in York County increased by 5.3% from 2000 to 2019 (US Census 2020). Future activities and BMPs that achieve TMDL reductions are addressed below.

Next Steps

The use of agricultural and developed area Best Management Practices (BMP's) can reduce sources of polluted runoff in Adams Brook. It is recommended that municipal officials, landowners, and conservation stakeholders in Berwick work together to develop a watershed management plan to:

- Encourage greater citizen involvement through the development of a watershed coalition to ensure the long term protection of Adams Brook;
- Run a "Hot-Spot Analysis" in *Model My Watershed* to determine sub-watershed locations of higher existing contributions of sediment and nutrients to the outlet of Adam Brook watershed; then focus BMP mitigation in these hot-spot sub-areas of the watershed;
- Address existing nonpoint source problems in the Adams Brook watershed by instituting BMPs where necessary; and
- Prevent future degradation of Adams Brook through the development and/or strengthening of a local Nutrient Management Ordinance.

Table 9: Annual Loads by Land Use, Other Sources, and Pathways for Adams Brook Based on Modeling

Adams Brook				
	Area (ha)	**Sediment** (1000 kg/yr)	**Total N** (kg/yr)	**Total P** (kg/yr)
Land Uses				
Hay/Pasture	85	4.8	94	35.2
Cropland	1	0.5	7	1.4
Wooded Areas	99	0.2	25	1.5
Wetlands	61	0.1	46	2.4
Open Land	13	0.5	12	1.0
Barren Areas	1	0.001	1	0.0
Low-Density Mixed	18	0.7	29	2.9
Medium-Density Mixed	2	0.5	14	1.3
High-Density Mixed	0	0.1	1	0.1
Low-Density Open Space	11	0.5	18	1.8
Total Area	293			
Other Sources				
Farm Animals		0.0	693	118.1
Septic Systems		0.0	9	0.0
Pathway Load				
Stream Bank Erosion		9.3	11	4.0
Subsurface Flow		0.0	326	12.6
Total Annual Load		17	1,286	182
Total Annual Load per Unit Area		0.06	4.40	0.62
		1000 kg/ha/yr	kg/ha/yr	kg/ha/yr

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