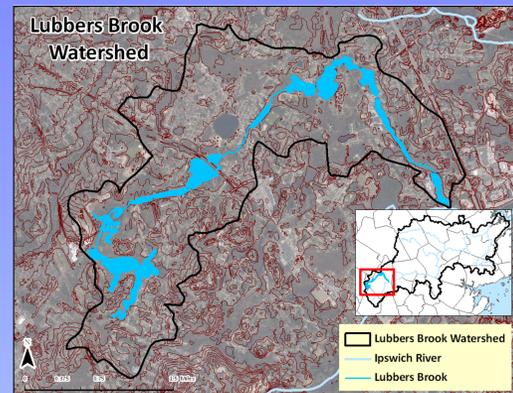


Watershed Management for Lubbers Brook in Wilmington, Massachusetts

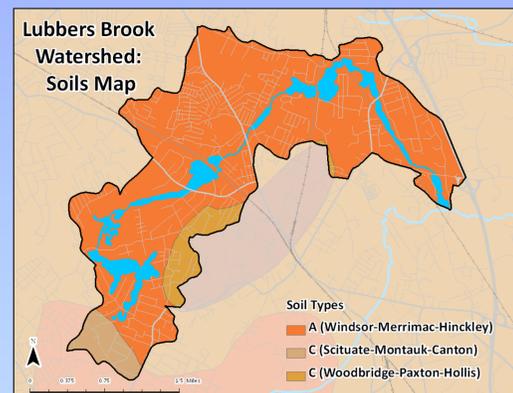
Goal of Analysis

The goal of this watershed analysis is to determine the state of nitrogen pollution in Lubbers Brook, a tributary of the Ipswich River located largely in Wilmington, Massachusetts. Recently the town of Wilmington has begun using wells in this watershed as drinking water sources. The maximum amount of nitrate-nitrogen that is safe in drinking water is 10 parts per million (ppm) according to the EPA with a margin of safety of 5 ppm. The ultimate goal is to return Lubbers Brook to safe drinking water status; therefore, the maximum amount of nitrate-nitrogen should be 5 ppm.

The Watershed



The Lubbers Brook Watershed is part of the Ipswich River Watershed in the North Shore region of Boston. It is located in Wilmington, Burlington, Billerica, and Tewksbury, Massachusetts. The area is 3,569 acres. Lubbers Brook is 6.5 miles long and contains 251 acres of surface water.



Hydrologic Budget

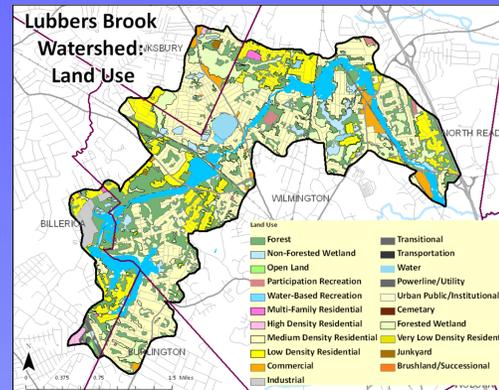
In the Ipswich River Watershed, the average annual precipitation is 44 inches per year. This hydrological budget assumes that half is lost to evapotranspiration. The amount of each soil in the watershed was measured in acres from MassGIS layers and National Resources Conservation Service

(NRCS) soil data. Impervious cover, which included pavement (roads, parking lots, etc) and roofs, was determined by soil type from a MassGIS layer and then subtracted from each soil type to determine an accurate flow.

Table 1: Hydrologic Budget

Soil Type	Area (acres)	Recharge Rate (inches)	Runoff Rate (inches)	Total Recharge (area x recharge) Million ft ³ /yr	Total Runoff (area x runoff) Million ft ³ /yr	Total Flow Million ft ³ /yr
A (Windsor-Hinkley-Merrimac)	2713.7	20	2	197.01	19.70	216,716,082
C (Woodbridge-Paxton-Hollis and Scituate-Montauk-Canton)	276.1	6	16	6.01	16.03	22.05
Impervious	544.3	0	40	0	79.03	79.03
Total	3534.1	26	58	203.03	114.77	317.80 Million ft ³ /yr

Current State of the Watershed



As of 2008, the population of Wilmington was 23,500 and there were 7,500 total households. The average family size was 3 people per household. The total households within the watershed was determined to be 3,967.

Build Out Analysis

This shows what the watershed will look like if it develops as it is currently zoned.

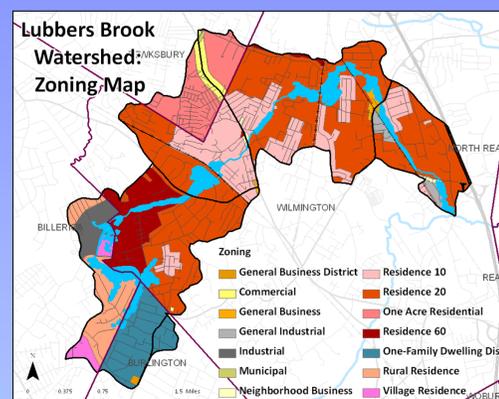


Table 2: Build Out Analysis

Zoning	# of Lots at Build Out
Commercial	106
Residential	4342
Industrial	70
Municipal	2

Total Maximum Daily Loads

Nitrogen is a naturally occurring nutrient in freshwater. However, in drinking water, a high concentration of nitrogen can be dangerous. Human consumption can lead to severe health problems, especially for infants and pregnant women.

In this TMDL analysis, the following assumptions were used: each household has lawn area of 5000 square feet and a roof area of 1000 sq ft; 25% of nitrogen from lawns leaches into groundwater; wastewater flow is 165 gallons per day per household and 75 gallons per 1000 sq ft per day for commercial and industrial sites. Pavement area in the watershed was determined by subtracting roof area from total impervious area.

Using this information, nitrate-nitrogen in Lubbers Brook is at 7.2 ppm. When including a 5 ppm margin of safety, this amount is not within the EPA's recommended levels. In addition, if the watershed reaches build out, the concentration of nitrogen in Lubbers Brook will increase to 8.3 ppm. A management plan is necessary to restore this watershed to 5ppm in order for it to be at drinking water standards.

Introduction to GIS for Urban and Environmental Analysis
 Tufts University Department of Urban and Environmental Planning and Policy
 Cartographer: Kiersten von Trapp
 Professor: Barbara Parmenter
 Projection: NAD 1983 State Plane Massachusetts Mainland FIPS 2001
 Sources: MassGIS and NRCS, accessed November 2009

INPUT	Calculation	Results (lbs/year)
Sewage – Residential 654,555 gal/day	x 40 mg/l x 3.785l/gal x 1lb/454000mg x 365	79,673
Sewage – Commercial/Industrial 627,395 gal/day	x 40mg/l x 3.785l/gal x 1lb/454000mg x 365	76,367
Lawn Area 19,835,000 sq. ft.	x .9lbs/1000 sq. ft x .25	4,463
Roof Area 3,967,000 sq. ft.	x .15 lbs/1000 sq. ft.	595
Pavement Area 19,742,708 sq. ft.	x .42 lbs/1000 sq. ft.	8,292
Precipitation 10,933,560 sq. ft.	x .05 lbs/1000 sq. ft.	547
Total		169,937
		Recharge (million gallons/year)
Sewage	1,281,950 gal/day x 365	467.9
Impervious	23,709,708 sq. ft. x 40in/12in x 7.48 gal/cubic ft	591.2
Pervious	130,235,688 sq. ft. x 22in/12in x 7.48/1 cubic ft	1785.9
Total		2845
Total Nitrogen Load/Total Recharge x 454000 mg./lb x 1MGAL/3,785,000l		7.2ppm

MANAGEMENT STRATEGY RECOMMENDATIONS:

Improve Wastewater Infrastructure

- Sewage is the largest contributor to nitrogen loading in the watershed.
- Update and maintain sewage treatment plants, pumping stations and pipes in order to avoid inflow and infiltration, thereby reducing nitrogen loading.
- Funding: 1) Drinking Water State Revolving Fund (DWSRF) focuses on small towns that need support in cleaning up their drinking water supply. 2) Clean Water State Revolving Fund (CWSRF). This fund is set up to assist with high priority wastewater infrastructure projects.

Stormwater Fee to Reduce Impervious Cover

- According to the Center for Watershed Protection, a watershed begins to see a negative impact once it reaches 15% impervious cover. The Lubbers Brook Watershed is currently at 15.4% impervious cover.
- Enact a stormwater fee based on the amount of impervious cover for commercial and industrial lots; residential lots have a flat fee based on a lot's zoning category.
- Simultaneously, establish incentives in the form of rebates or discounts for those lots that reduce or remove impervious cover and stormwater runoff.
- This will encourage more green infrastructure in the watershed.
- Use collected fees to improve municipal stormwater infrastructure.

Public Education to Reduce Demand

- Public education campaigns to reduce demand on the water supply.
- Lubbers Brook is part of the Ipswich River Watershed Association (IRWA) which provides support and experience in public education.
- IRWA is also part of Greenscapes North Shore, a coalition of nonprofits that work together to protect the waters on the North Shore of Boston. Greenscapes is focused on educating the public about water quantity and quality issues.

Smart Growth

- Wilmington is nearing build out; the remaining open space in the town is currently zoned as residential.
- Establish a transfer of development rights (TOD) program to allow for mixed uses on lots that are already developed and maintain open space in the watershed.