Structural Stormwater Treatment Projects

Site Suitability Analysis of Concord, Massachusetts

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Introduction

Stormwater interception and treatment is needed to control against flooding, protect water quality against pollutant and sediment runoff, and absorb and filter precipitation for groundwater recharge. Experts in the field have developed a number of stormwater management projects known as structural Best Management Practices (BMPs) to address these needs. Guidelines outlining BMP selection describe a number of BMPs appropriate for differing soil and land use requirements.

Research Question

This project uses spatial data to identify a number of site options for installing structural stormwater BMPs in the town of Concord, MA. To provide options for the range of land uses in Concord, four BMPs with differing site requirements were chosen for consideration: wet pond, infiltration trench, underground sandfilter, and shallow marsh. These BMPs also have a varying soil drainage and slope requirements, as listed in Table 1.

Additional factors were also considered to focus options in priority areas for water quality consideration, and to select sites more convenient for land acquisition and installation. From these options, town planners could then choose a combination of BMPs and locations based on additional environmental, social, and political concerns.

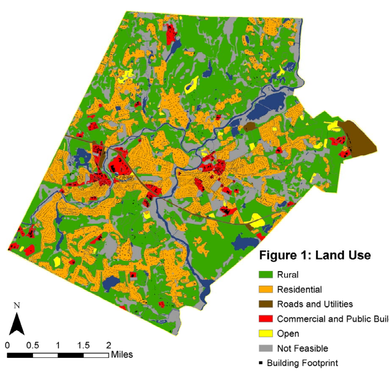
BMP type	Requirements					
	Maximum allowable slope	Soil drainage	Acceptable land use area: *rural*	*residential*	*roads*	*commercial*
Wet pond	15%	not well drained	Yes	Yes	Yes	No
Infiltration trench	6%	well drained	No	Yes	Yes	Yes
Underground sand filter	6%	no restrictions	No	No	No	Yes
Shallow marsh	8%	not well drained	Yes	Yes	No	No

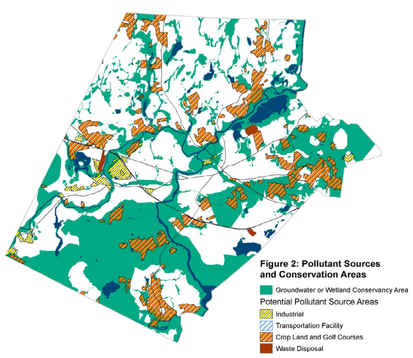
Table 1: Structural stormwater Best Management Practice (BMP) requirements

Methods and Data

Spatial data information was obtained from MassGIS and from the Town of Concord GIS Program. The data was reclassified and analyzed to define feasible areas for each BMP. A ranking of areas of high concern for water quality protection was created for the entire town, and then BMP site options identified were within the priority areas.

Defining feasible areas Land use information for the town of Concord details 37 land use classifications; these areas were reclassified into four broad categories corresponding to the BMP guidelines: rural, residential, roads, and commercial (Figure 1). Town soil survey information was used to identify areas with well-drained soils (required for an infiltration trench) or not well-drained soils (required for a wet pond or shallow marsh). Also using this survey, areas were separated into categories corresponding to maximum acceptable slope for the four BMPs.





Wetland areas as delineated by the Department of Environmental Protection, which are protected by state and federal laws and which already provide natural stormwater protection, were eliminated from consideration. Using building footprints maintained by the town of Concord, a 50 ft buffer was drawn around commercial and public buildings and a 100 foot buffer was drawn around residential buildings; these buffer areas were also eliminated from consideration. All of this information was overlapped to generate four outlines defining the feasible areas for each BMP, as shown in Figure 3.

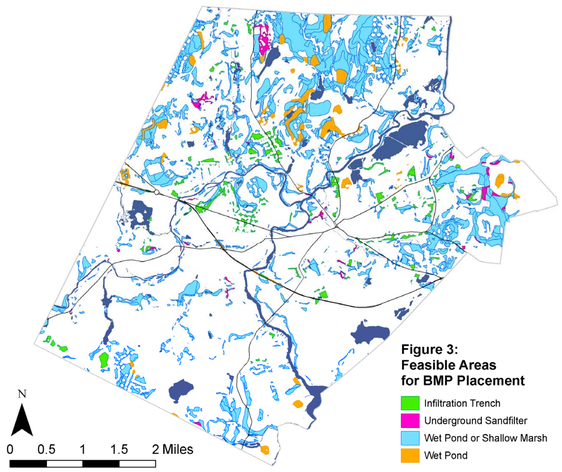
Priority water quality areas To protect water quality, areas near potential pollutant sources and areas identified as conservancy districts should be given priority consideration for choosing BMP locations. Using land use information, roads and transportation facilities, waste disposal sites, and industrial areas were identified as potential pollution sources and assigned a rank of 4; cropland and golf courses were assigned a rank of 2 for potential fertilizer and pesticide runoff. (Figure 2) Buffer areas were also were identified and assigned a slightly lower rank. All areas covered by the town's Groundwater Conservancy District or Wetland Conservancy District were given a rank of 4. This information was combined in a raster file to map an overall priority ranking for the town, shown in Figure 4.

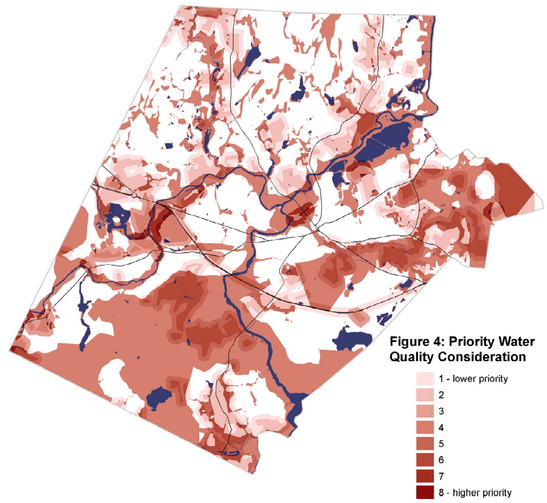
Anaylsis

Both Wet Pond and Shallow Marsh BMPs are feasible over a large area range in the town of Concord. The feasible areas for Sandfilter and Infiltration Trench BMPs are smaller. However, since they are located in commercial zones and small areas near roads where the other BMPs cannot be placed, they offer critical additional options for stormwater management.

A combined map showing the feasible regions within areas of high water quality concern is shown in Figure 5. Wet Pond and Shallow Marsh options are shown that fall within high (rank of 6-8) priority areas. As they have a smaller feasible area, Sandfilter and Infiltration Trench options are shown which fall within medium-high priority areas (rank of 4-8).

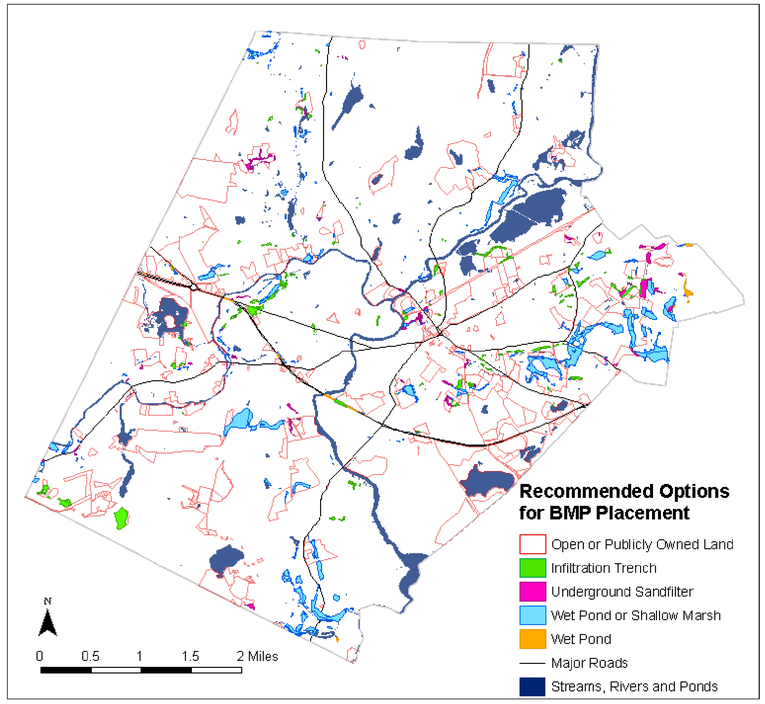
Siting alternatives in areas that are open or owned by the state or municipal government would likely offer an easier process for land acquisition and eventual installation of the BMPs. Drawn from the land use maps and town parcel ownership information, these areas are outlined in red in Figure 5 to help further narrow the options to the most ideal sites.





Conclusions

Overall, this analysis has yielded a number of attractive options for siting structural stormwater BMPs. Studies such as these can be easily performed early in the planning process using only available data, and yet can guide site selection taking a number of considerations into account. By screening out less desirable options with a moderate amount of work early in the process, such studies can save time and lead to a smoother process towards final selection.



Source Data: Massachusetts Office of Geographic and Environmental Information (MassGIS)
Town of Concord Public Works GIS Program.
Projection: NAD 1983 State Plane: Massachusetts Mainland