Keene

Marlboro Street
ZONING AND LAND USE REGULATIONS PROJECT

APPENDIX D | **STORMWATER MANAGEMENT STRATEGY**

Regulatory Alternatives to Address Stormwater Management and Flooding in the Marlboro Street Study Area

Alternative 1: Amend Existing Local Regulations

This proposed alternative provides an incremental step toward addressing stormwater management and flooding issues in the Marlboro Street Study Area. The proposed amendments below build on the foundation of current regulations and provides for improvements to the environmental condition by addressing identified gaps in regulatory control over stormwater control siting, design, installation, and maintenance. In addition, some of the proposed amendments encourage the use of Low Impact Development (LID) technologies and natural vegetated buffers to promote stormwater infiltration to reduce peak flow and overall quantity of overland flow and improve stormwater quality.

Part II – Code of Ordinances – Proposed amendments	
Chapter 70 - Public Improvement Standards	Include maintenance inspections of stormwater controls by Department of Public Works (DPW) staff to ensure stormwater controls are properly functioning supported by an inspection fee. A provision could be included to exempt properties that supply annual inspection reports to the DPW. (Article II – Engineering Inspection Fees)
	Specify that storm drains and conveyance systems must be designed using the most updated precipitation data to a larger storm event (e.g. 50-year storm event) for all areas (Article III – Design and Construction of Streets and Utilities)
	Specify a requirement for permeable surface parking for any proposed on-street parking, vegetated buffer strips along new or redeveloped streets, and rain gardens in proposed drainage ditches (Article III – Design and Construction of Streets and Utilities)
	Specify tax incentives or other zoning considerations for the installation of Best Management Practices (BMPs) that capture and infiltrate roof run-off (e.g. rain barrels or rain gardens) rather than directing run-off to the stormwater system. (Article III – Design and Construction of Streets and Utilities)
Chapter 38 - Environment	Specify that illicit discharges to storm drains are prohibited (Article II – Pollution of Air and Water)
	Specify that unstabilized (unpaved compacted

	dirt) driveways and denuded areas are considered public nuisances and must be stabilized to prevent erosion and sedimentation into stormwater conveyance systems (Article III – Nuisances)
Chapter 54 – Natural Resources, Article II Floodplain Ordinance	Require wetland delineation in accordance with the most current wetland delineation methodology
	Encourage flood hazard mitigation in a manner that would allow a reduction in insurance rates and make mitigation money available to the Marlboro Street neighborhood through a FEMA program such as "Know Your Line: High Water Mark Initiative"
	Identify parcels in the Beaver Brook upper watershed, outside of the Marlboro Street neighborhood, that have significant opportunity to reduce stormwater inputs and/or mitigate flood waters to reduce peak flow discharge. Provide tax or zoning incentives to conduct mitigating projects.
Development Standards	
Planning Board Development Standards	Specify a setback requirement to surface waters and requirements for vegetated riparian and wetland buffers (16 Wetlands & 17 Surface Waters)
	Specify a wetland functions and values assessment method and criteria to evaluate whether flood storage and water quality functions are lost as a result of a proposed project (16 Wetlands & 17 Surface Waters)
	Require stormwater management controls to consider water quality in addition to water quantity (1 Drainage)
	Specify a storm event standard for stormwater controls that is based on the most current precipitation data and future climate change (1 Drainage)
	Establish impervious surface limits on lots (5 Flooding)
	Specify the requirements for a Drainage Analysis and use of a Site-Specific Soil Survey for soils evaluation (1 Drainage)
	Provide tax or zoning incentives to encourage the on-site infiltration of stormwater and/or flood

	water storage on proposed projects located on parcels in the upper portions of the Beaver Brook watershed that would reduce existing stormwater inputs and peak flows. (1 Drainage & 5 Flooding)
	Impose a restriction against any increase in stormwater peak flow rate and/or quantity on parcels in the upper portions of the Beaver Brook watershed to prevent any increase in stormwater discharge to Beaver Brook. (1 Drainage & 5 Flooding)

Alternative 2: Rezone Marlboro Street Study Area to include a Conservation District

This proposed alternative would designate land within the Marlboro Street Study Area as conservation land, Conservation (C) District, that could only be used for recreational uses, nature study areas, harvesting of forestry products, day camps, and trails. All of these uses encourage permeable surfaces, infiltration, and green space. This land would need to be acquired as municipal land or as conservation easements and be protected from development by conservation easement, deed restriction, or other means. This alternative reflects the priorities of the public participants that attended the first public workshop held on March 26, 2013. The priority identified at the public workshop, second only to addressing the flooding issue, was to "develop and preserve green space". Conservation land could serve the dual purpose of creating flood storage and developing a green space within the Marlboro Street Neighborhood.

Designated Conservation District land along Beaver Brook could be managed to improve a variety of environmental aspects in the area including restoring segments of the brook to a more natural condition, creating flood benches, planting riparian buffers, and establishing wetlands and other flood storage areas. Conservation land also promotes stewardship of the natural environment, increased pedestrian and bicycle traffic to and from the green space through the Marlboro Street neighborhood, and an increase in the value and aesthetic of the surrounding development.

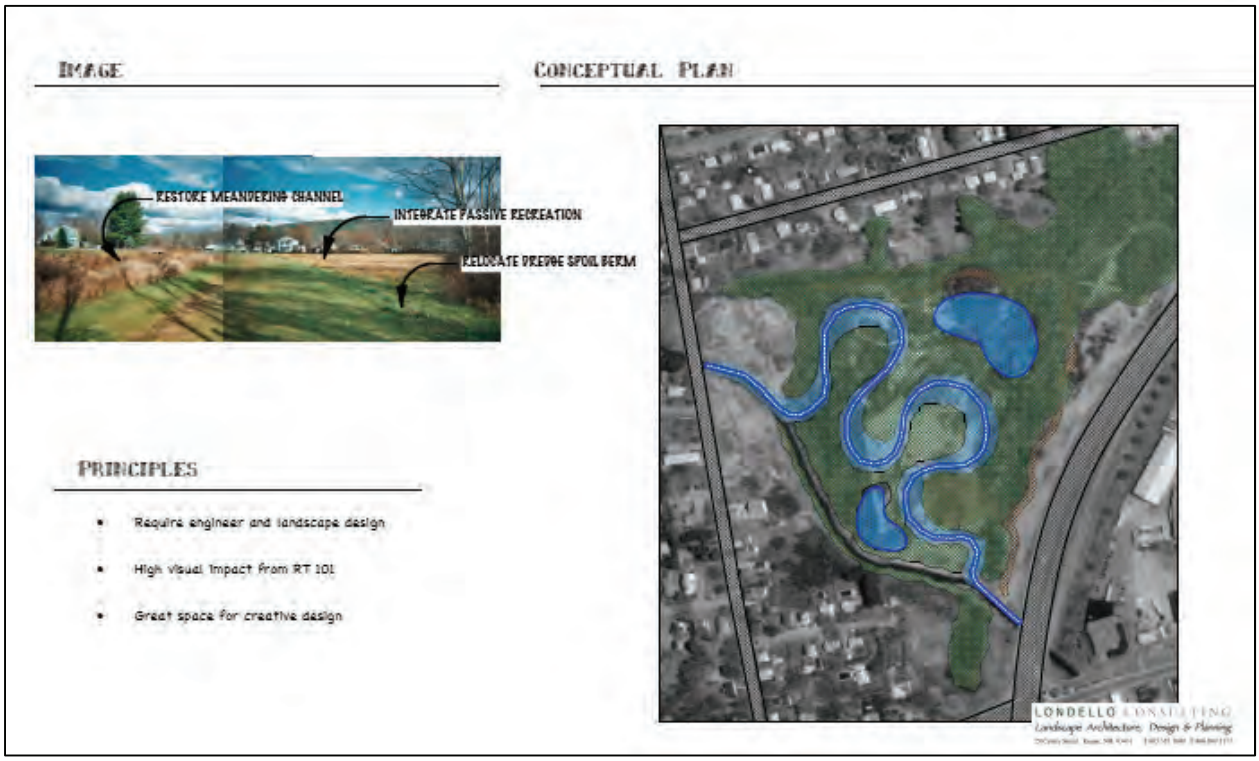
The two prominent parcel choices are the Kingsbury site and Baker Field south of Baker Street. These parcels could be acquired in their entirety or subdivided to accommodate conservation and development. The developed or redeveloped portion of the property could implement Low Impact Development (LID) or other BMPs to address stormwater. Some options for these two properties have already been considered by local groups and are summarized below:

Geography Students at Keene State College presented two alternatives for the partial and full use of the Kingsbury site as conservation land in their report, "Extreme Makeover Marlboro Street Edition: Problems and Prospects of Marlboro Street in Keene, New Hampshire". These uses are presented below.


Kingsbury Corporation
Kingsbury Corporation
Bike Path
Beaver_Brook
Dry Pond
Grass/Shrubbary
Construction


Benches
Trees
Bike Path
Ball Fields
Playground
Dry Pond
Parking
Recreational Use
N
W
E
S

Moosewood Ecological LLC, and affiliates, presented two plans for stream enhancement and restoration in Baker Field in the Beaver Brook Restoration Plan, dated May 2009. These concepts are presented below.



Alternative 3: Develop and Adopt Stormwater Management Ordinances

This alternative directly addresses the stormwater management issues that contribute to flooding events in the Marlboro Street Study Area. There are several models for stormwater ordinances that can be utilized to affect stormwater quantity and quality. The model that is chosen for the development of a Stormwater Management Ordinance will be dependent on the desired outcomes and the willingness of the public to accept and participate in stormwater management within the municipality. Three case examples of ordinances from three separate municipalities are summarized below to provide options for discussion.

Establishment of a Stormwater Utility

In New Hampshire the development of a stormwater utility is permitted under RSA 491-I:6-b. This relatively new statute, passed in 2008, has only been used by two communities in New Hampshire to date, the Cities of Manchester and Nashua. A stormwater utility is defined as a special assessment district established to generate funding specifically for stormwater management. In accordance with RSA 149-I:6-c, a stormwater utility shall address flood and erosion control, water quality management, ecological preservation, and annual pollutant load contained in stormwater discharge. Both Manchester and Nashua are still in the early stages of developing the goals and structure for their stormwater utility, therefore, in order to review exiting utilities and benefit from lessons learned, it is necessary to look outside of New Hampshire.

The City of Lewiston, Maine has an established stormwater utility under Chapter 74 Utilities of the Code of Ordinances. Lewiston is regulated as an urbanized area under National Pollution Discharge Elimination System permit (NPDES) and applicable regulations, 40 CFR 122.26 for storm water discharges. This means that the City of Lewiston must meet water quality standards for its direct discharges to surface waters from its municipal separate storm sewer system (MS4). In order to maintain compliance with the applicable regulations, Lewiston needed to adopt ordinances that provided it the authority to control stormwater discharges. The City of Keene has a MS4; but it is not considered an urbanized area. Keene is, however, considered an urbanized cluster and may be regulated in the next phase of NPDES regulations. Therefore, it is important to consider the development of a stormwater utility.

The Stormwater Ordinance in Lewiston enables the City to:

1. determine the necessary level of municipal stormwater management services required;
2. maintain and improve the drainage facilities to ensure that they perform to design capacity;
3. mitigate the damaging effects of uncontrolled and unmanaged stormwater runoff;
4. support and promote sound stormwater management practices that mitigate nonpoint source pollution, reduce flooding, and enhance area drainage within the city and;
5. support the goals and objectives of the city ordinances addressing stormwater management in other sections of this Code of Ordinances.

More specifically, the City can adopt and enforce regulation over stormwater controls, establish stormwater standards, assess fees, and expend funds to maintain and improve stormwater controls. The stormwater utility may collects fees that are directly related to the cost of providing stormwater management services and offers credits for on-site management of water stormwater that goes beyond state and local regulations. Fees are based on the forecast of the annual cost of each component in the district's stormwater management program. The fee units are assessed as follows:

- Residential (single family): flat fee $40.00 annually
- Residential (duplex): flat fee $60.00 annually
- All Other Properties: base rate of $40.00 for the first 2,900 square feet of impervious cover plus $0.045 per square foot for each additional square foot over 2,900, annually.

Some examples of the services that the utility may provide in exchange for collecting the service fee are:

- Administer the stormwater management program for the city;

- Perform necessary studies and analysis of the service area or potential service area(s);
- Acquire, construct, operate, maintain, manage, protect, and enhance the stormwater infrastructure, including betterments and connections to the public drainage system; mapping of natural and man-made features affecting stormwater management;
- Perform inspections of stormwater management structures and facilities to detect and eliminate illicit discharges to the stormwater management system;
- Periodically inspect properties to determine contribution to municipal stormwater load;
- Maintain an up-to-date database of residential and non-residential properties in the service area, billing class codes for each parcel, runoff contributions of each property to the stormwater system for non-residential properties, and charges and payments for each account;
- Perform master planning and engineering for watershed management and capital improvements;
- Make recommendations regarding acquisition of property, easements and rights-of-way in critical areas serving as buffers, retention or infiltrating areas, or providing means to gain access to properties to perform utility duties; and
- Educate and inform the public about the impacts of stormwater runoff and the components of a stormwater management plan.

<u>Establishment of a Stormwater Control Ordinance</u>

Fayetteville, North Carolina established a Stormwater Control Ordinance that is administered through the Engineering and Infrastructure Department. The purpose of the ordinance is similar to that of the stormwater utility to:

- protect, maintain, and enhance the public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse effects of the increase in stormwater quantity and the stormwater runoff quality from development,
- manage the quantity and quality of stormwater runoff to minimize damage to public and private property,
- ensure a functional drainage system to reduce the effects of development on land and stream channel erosion,
- promote the attainment and maintenance of water quality standards,
- enhance the local environment associated with the drainage system,
- reduce local flooding,

- maintain as nearly as possible the predeveloped runoff characteristics of the area, and,
- facilitate economic development while mitigating associated flooding and drainage impacts.

However, this ordinance controls stormwater management by establishing a requirement for a stormwater permit for all development and redevelopment unless exempt pursuant to the ordinance. In Fayetteville, exemptions include single-family residences, new developments with less than 20,000 square feet of impervious surface, new construction to existing development that does not require more than 2,000 square feet of impervious surface and other agricultural and forestry uses. As part of the permit process, a stormwater design plan (as part of the construction plans) for each development activity shall be submitted for review by the city engineer for the entire development activity. The ordinance establishes the standards for stormwater quantity and quality that must be adhered to in development of the stormwater design plan. In addition, the ordinance requires a maintenance agreement, inspection rights, a performance guarantee for installation, and enforcement actions. The ordinance allows for fees to be assessed to pay for the stormwater management program. In the case where a permit is required, an application fee may be set to fund the program.

Establishment of a Low Impact Development Ordinance

Although Los Angeles is on the opposite side of the country and significantly different in most facets to the City of Keene, it is considered the "best" (most comprehensive, effective and well established) example of LID Ordinance in the United States. In addition, the specific concepts used in their Ordinance are intended for small scale, community efforts, which fit the size of Keene. Therefore, there is value in reviewing this example.

Los Angeles, California established a LID Ordinance administered by the Bureau of Sanitation. LID is a leading stormwater management strategy that seeks to mitigate the impacts of runoff and stormwater pollution as close to its source. LID consists of site design approaches and BMPs that can effectively remove nutrients, bacteria, and metals while reducing the volume and intensity of stormwater flows. The purpose of the ordinance is to integrate LID practices and standards for stormwater pollution mitigation into construction activities and facility operations of development and redevelopment projects to comply with local stormwater regulations and maximize open, green and pervious space.

The LID ordinance requires rainwater from a three-quarter inch rainstorm to be captured, infiltrated and/or used onsite at most developments and redevelopments where more than 500 square feet of hardscape is added. Single family residences can comply in simpler ways by installing adequate BMPs such as rain barrels, permeable pavement, rainwater storage tanks, or infiltration swales to contain the water. Los Angeles has established a tier system for compliance that minimizes the burden for residential projects, establishes incremental compliance for partial redevelopment, and full compliance for projects impacting greater than 50% of the existing site. Projects must comply with the standards established in the ordinance and utilize BMPs presented in the *Development Best Management Practices Handbook.* Each development must submit a

LID plan to the Bureau of Sanitation for review and approval. A fee is assessed for the review of the plan based on the size and scope of the proposed project.

The following is an excerpt from the Residential LID Handbook, published on the LA Stormwater website.

SMALL SCALE RESIDENTIAL
RAIN BARREL FACT SHEET

Rain barrels capture runoff from roof downspouts during storms and temporarily store that runoff for later use. They are low-cost, effective, and easily maintained devices that can be sized for a specific volume of water. Retained water may be used for garden watering, and other outdoor non-potable uses. Rain barrel storage can reduce the amount of stormwater pollutants that are picked up and conveyed to local streams and the ocean. In addition, harvested water conserves precious City-supplied potable water and, if directed to unpaved surfaces, can recharge groundwater. Rain barrels are typically made of heavy duty plastic and can range in size from the standard 55 gallons to more than 80 gallons.

How many rain barrels do I need?

The number of rain barrels required to capture runoff from a given roof or impervious area is shown in the following table.

Are Rain Barrels Feasible at My Residence?

Rain barrels are appropriate where the following site characteristics are present:

- Roof areas with downspouts are required.
- A level, firm surface for support of the rain barrel(s) is required. Rain barrels should only be elevated with solid construction materials and kept away from retaining walls as a full 55-gallon rain barrel will weigh over 400 lbs.
- An area where the captured water can be used is required to be present within a reasonable distance from the rain barrel(s).
- Design of an appropriate area for overflow from the barrel is necessary.

For sites within, immediately adjacent to, or discharging to an environmentally sensitive area, see the LID Manual for applicable criteria

Roof or Impervious Area (sq.ft.)	Number of 55 Gallon Rain Barrels*
500 – 1,000	4
1,001 – 1,500	8
1,501 – 2,000	10
2,001 – 2,500**	14

* Or equivalent capture using larger rain barrels.
** Projects adding roof or impervious areas in excess of 2,500 sq. ft. shall add 3 rain barrels per every 500 sq. ft. of additional area.

The following is an excerpt from the Developers LID Handbook, published on the LA Stormwater website.

Bioinfiltration Sizing Example

Given: 100,000 ft^2 commercial development, 100% impervious (negligible landscaping). Design a bioinfiltration BMP to treat runoff from the entire development ($K_{sat,media}$= 5 in/hr; Factor of Safety = 2.).

1) Determine V_{design}
   Catchment Area = (100,000ft^2 x 0.9) = 90,000ft^2
   V_{design} = 1.5 x 0.0625ft x 90,000ft^2 = **8,500 ft^3**

2) Determine $K_{sat,design}$
   $K_{sat,design}$ = (5 in/hr) /2 = **2.5 in/hr**

3) Determine d_p
   d_p = (2.5 in/hr * 48 hrs)/12 = 10.0 ft

   Adhering to the max ponding depth requirements of Table 4.5, d_p **= 1.50 ft**

4) Calculate the infiltrating surface area, A_{min}

$$A_{min} = \frac{8{,}500\ cuft}{[(3hr * 2.5\ in/hr\ /12) + 1.5\ ft]} = \textbf{4,000 ft}^2$$

For a full capture system, bioinfiltration units must be designed with a combined surface area of 4,000 ft^2.

Alternative 4: Establishment of a Natural Resources Overlay District

This alternative will create an overlay district that can provide flexibility and apply to specific districts or natural resources depending on the desired outcome and the desired extent of regulatory control. The overlay district would be established under Chapter 102 Zoning. The established overlay district could include several different elements that were previously discussed under Alternative 1, but could include incentives similar to the Keene Sustainable Energy Efficient Development (SEED) Overlay District.

The purpose of the Natural Resource Overlay (NRO) District would be to encourage environmental stewardship of wetlands and surface waters by creating an overlay district within which property owners will have the option of implementing BMPs, flood mitigation, stream restoration, vegetated buffers, and LID in exchange for zoning incentives. The NRO would revitalize the Marlboro Street neighborhood through the provision of zoning incentives that will make it attractive for property owners within the overlay to expand upon Keene's existing mixed-use, urban environment while improving the natural environment and increasing the aesthetic appeal of the neighborhood. The same density, height, dimensional, and parking incentives established for SEED could be applied to the NRO.

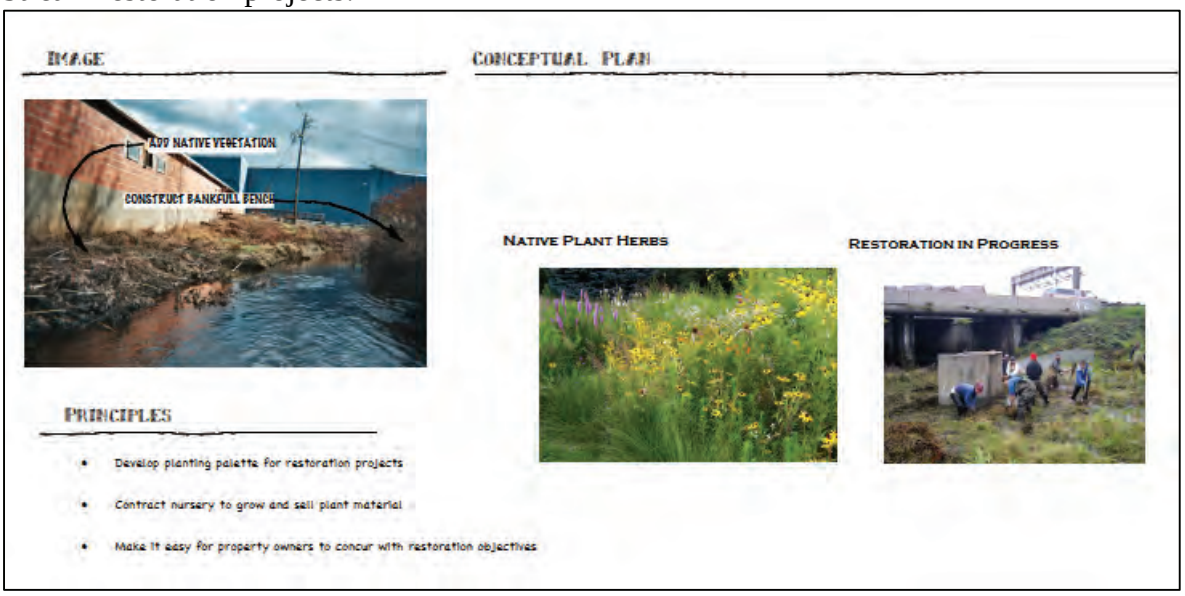
The NRO would have specific requirements for the establishment of riparian buffers and wetland buffers, limits on impervious surfaces and/or flood storage requirements. If the project occurred along Beaver Brook the NRO could require the establishment of vegetated flood benches as flood mitigation.

Moosewood Ecological LLC, and affiliates, outlined many of the above mentioned concepts in the Beaver Brook Restoration Plan, dated May 2009. Below are excerpts of the plan that illustrate some of these concepts.

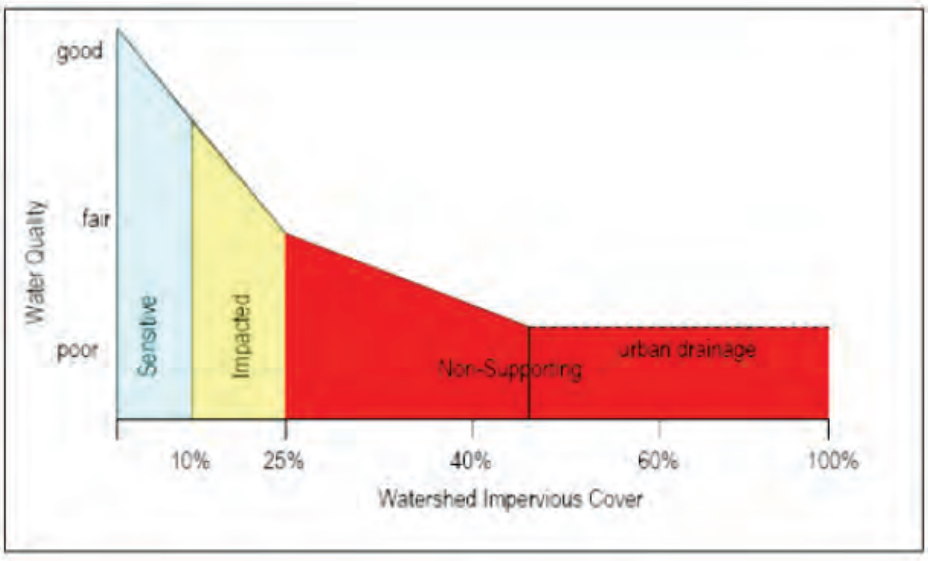
Establishment of vegetated buffers:

A "good" buffer is comprised of an upper canopy or overstory (trees), a midstory (shrubs), and groundcover (grasses, duff, mulch, flowers). It also stretches the entire length of the parcel with very limited pathways for erosion to enter the stream, shades the stream, and extends 100 feet back away from the stream.

Stream restoration projects:



Establishment of effective impervious surface limit:



Implementation of LID and vegetative stabilization: