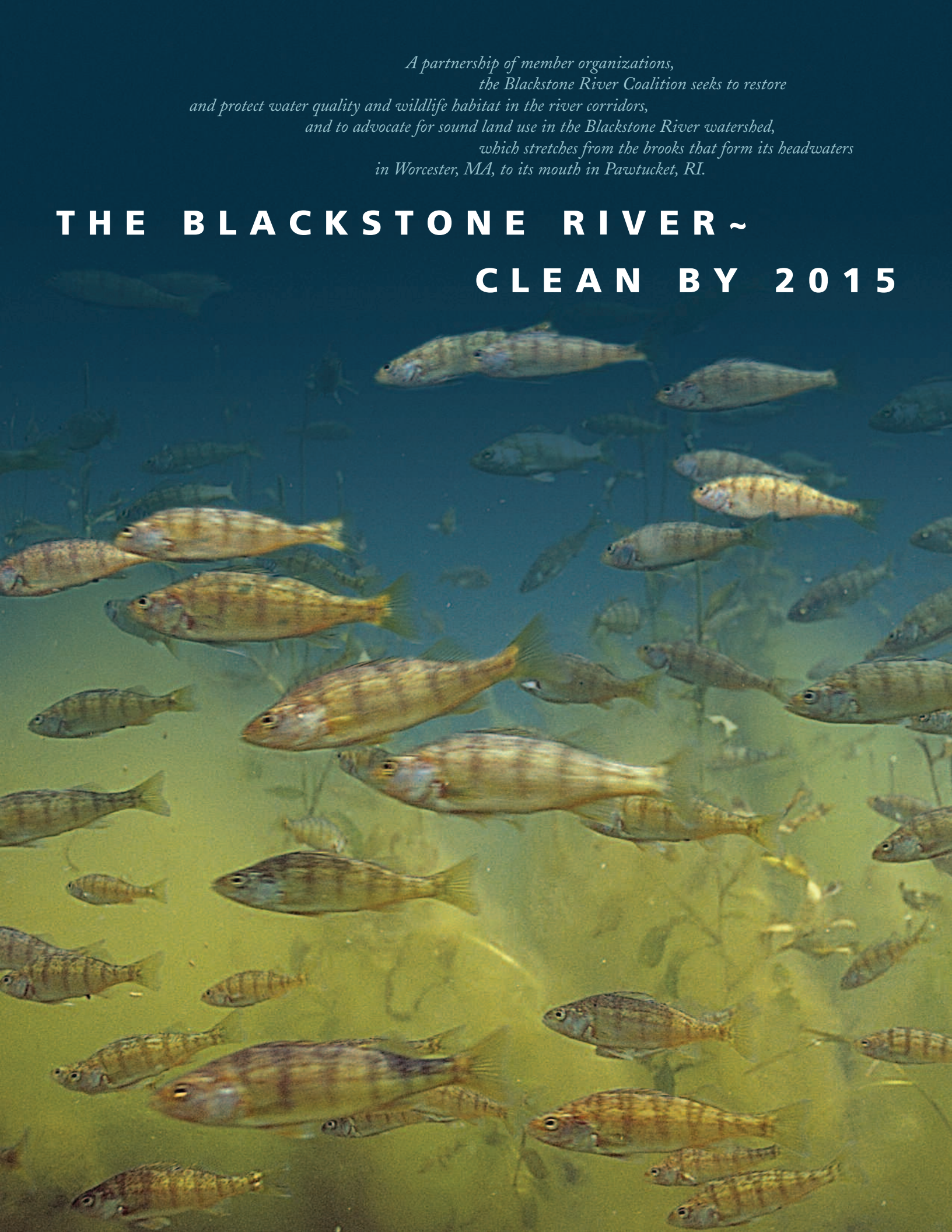
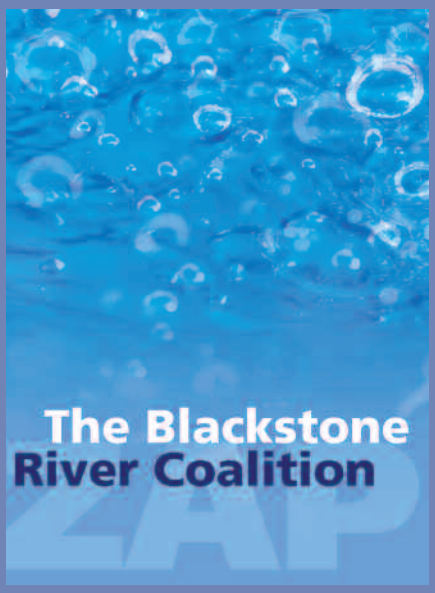
A partnership of member organizations,
the Blackstone River Coalition seeks to restore
and protect water quality and wildlife habitat in the river corridors,
and to advocate for sound land use in the Blackstone River watershed,
which stretches from the brooks that form its headwaters
in Worcester, MA, to its mouth in Pawtucket, RI.

THE BLACKSTONE RIVER~
CLEAN BY 2015





The Blackstone River Coalition is a non-profit organization partnering with numerous organizations working together to restore the Blackstone River and to improve the health of the Blackstone River watershed. We invite you to join us to help make the Blackstone River fishable and swimmable by 2015.

Special thanks to the following for their contributions to this publication: Therese Beaudoin, Mass DEP; Peter Coffin, BRC; Tammy Gilpatrick, BRC; Cindy Delpapa, Mass Riverways Program, Department of Fish and Game; Alan Libby and Veronica Masson, RIDEM Division of Fish and Wildlife; Mauri Pelto, Nichols College; and Donna Williams, Mass Audubon.

Blackstone River Coalition
P.O. Box 70477, Worcester MA 01607
508-753-6087
www.zaptheblackstone.org

BRC STAFF

Peter Coffin, Coordinator, BRC
peter.coffin@zaptheblackstone.org

Tammy Gilpatrick, Coordinator,
BRC Watershed-wide Volunteer
Water Quality Monitoring Program
brcoalition@yahoo.com

COALITION PARTNERS

BLACKSTONE HEADWATERS COALITION
PO BOX 70688, QUINSIGAMOND VILLAGE
WORCESTER, MA 01607
508-753-6087 X24

BLACKSTONE RIVER WATERSHED ASSOCIATION
271 OAK STREET, UXBRIDGE, MA 01569
508-278-5200, INFO@THEBRWA.ORG

BLACKSTONE RIVER WATERSHED COUNCIL / FRIENDS OF THE BLACKSTONE
PO BOX 8068, CUMBERLAND, RI 02864
BRWATERSHEDCOUNCIL@YAHOO.COM

JOHN H. CHAFEE BLACKSTONE RIVER VALLEY NATIONAL HERITAGE CORRIDOR
ONE DEPOT SQUARE, WOONSOCKET, RI 02895
401-762-0250, WWW.NPS.GOV/BLAC

MASS AUDUBON / BROAD MEADOW BROOK CONSERVATION CENTER & WILDLIFE SANCTUARY
414 MASSASOIT ROAD, WORCESTER, MA 01604
PHONE: 508-753-7087, FAX: 508-755-0148
BMBROOK@MASSAUDUBON.ORG
WWW.MASSAUDUBON.ORG

LAKE SINGLETARY WATERSHED ASSOCIATION
C/O BENJAMIN INSURANCE AGENCY
497 CENTRAL TURNPIKE, SUTTON, MA 01590

SAVE THE BAY / SAVE THE BAY CENTER
100 SAVE THE BAY DRIVE, PROVIDENCE, RI 02905
401-272-3540, SAVEBAY@SAVEBAY.ORG

TROUT UNLIMITED, NORTHERN RI CHAPTER

CONSERVATION LAW FOUNDATION
RHODE ISLAND ADVOCACY CENTER
55 DORRANCE ST, PROVIDENCE, RI 02903-2221
401-351-1102

COLLEGE OF THE HOLY CROSS
1 COLLEGE STREET, WORCESTER, MA 01610
508-793-2011

JANUARY 2008

Dear Blackstone River Advocates,

The Blackstone River: Clean by 2015. It has a nice ring to it, doesn't it! And we can make it happen if we all commit to the goals of the Blackstone River Coalition's Campaign for a Fishable/Swimmable Blackstone River by 2015. The Blackstone is our home river, and all of us who live and do business in the Blackstone Valley have a direct connection to it. It's not just being on the banks of the river – it's being anywhere in the watershed, whether in Massachusetts or Rhode Island. It's understanding that whatever we do to the land that drains to our waterways has a direct connection to water quality. It's being aware of our actions and changing our practices that may harm our waterways.

Those of you who have lived here for a long time have seen dramatic changes in the river. It is much improved from the "old days", and people are investing in the river again. In almost every community mills are being restored for retail and residences, more and more businesses have the word "Blackstone" in their title, canoes and kayaks are plying the waters, and there is a tremendous sense of pride in the Valley.

But we're not done yet. We still have some work to do to fully restore the Blackstone River. On these pages you will learn more about the issues, the progress we've made, and what you can do to help make the Blackstone River clean by 2015. We can do it – you can help.

Sincerely,
Donna M. Williams, President
Blackstone River Coalition

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THIS PUBLICATION WAS GRACIOUSLY FUNDED BY THE JOHN H. CHAFEE BLACKSTONE RIVER VALLEY NATIONAL HERITAGE CORRIDOR COMMISSION.

An expedition in the fall of 2000 revealed not only the river's beauty and the issues it faces, but also the hundreds of river stewards who care deeply for its future.

THE BLACKSTONE RIVER CLEAN BY 2015

THE BRC NEEDS YOUR HELP TO ACCOMPLISH OUR GOALS!
This document gives you the information that you need to get involved, discussing land use, water quality, streamflow, aquatic life, and recreation. Not only is it a statement of current conditions, it also highlights BRC accomplishments to date, and what you can do to help make the Blackstone Clean by 2015. **Join Us!**

The Blackstone River, with its headwaters in Worcester, MA and its mouth in Pawtucket, RI, is recovering from centuries of industrial and human discharges. Known as the birthplace of the American Industrial Revolution and called "America's Hardest Working River," the Blackstone's water quality has improved tremendously because of Clean Water Act regulations on point sources of pollution. Prior to 1970, the only two species of fish that could survive in the river were white sucker and carp. Today nineteen species can be found in the mainstem, and 37 throughout the watershed.

Despite this progress, most reaches of the river still do not meet Class B water quality standards. The major causes of this continuing impairment are stormwater, wastewater treatment plants and contaminated sediments.

The Blackstone River Coalition began in September of 2000, when a group of dedicated explorers went on a four-day expedition, paddling the 46 miles of the Blackstone River from Worcester to Pawtucket to see for themselves just what the river was like. During this adventure, the team explored the river's resources and problems, and shared their findings. The expedition revealed not only the river's beauty and the issues it faces, but also the hundreds of river stewards who care deeply for its future. So the team harnessed that energy and created the Blackstone River Coalition (BRC) to revitalize the Blackstone River and improve the health of the watershed.

BRC member organizations include the Blackstone Headwaters Coalition (BHC), Blackstone River Watershed Association (BRWA), Blackstone River Watershed Council/ Friends of the Blackstone (BRWC/FOB), Lake Singletary Watershed Association, Mass Audubon, Trout Unlimited, Save The Bay, Conservation Law Foundation, and College of the Holy Cross. Partners include state and federal agencies, non-profit organizations, municipalities, and businesses. Everyone in the Coalition is working in different ways to improve the quality of the river, from grass-roots volunteers keeping the riverbanks free of debris to business owners recognizing the value of a clean river to successful commercial ventures. Government agencies are working with watershed groups to improve water quality and local educators are using the river as an outdoor classroom. The BRC is newly incorporated, and has received 501(c)(3) status. Its Board of Directors is composed of a representative from each of the member organizations.

Releasing fish into the Blackstone River.

In 2003, the Blackstone River Coalition launched the Campaign for a Fishable/Swimmable Blackstone River by 2015, in response to the seven-million gallon sewage spill from the Upper Blackstone treatment plant in Millbury, and in order to marshal the resources needed to actually clean up the Blackstone River. The Campaign commenced with a set of goals and objectives, then developed a bi-state watershed action plan that identified specific roles for each partner to undertake to accomplish the Campaign's objectives of improving water quality. This campaign has crystallized years of water-quality improvements, pollution studies, and sewage treatment advances, into an ambitious new goal of making the river and its tributaries fishable and swimmable by 2015.

The goals of the BRC Campaign platform include:

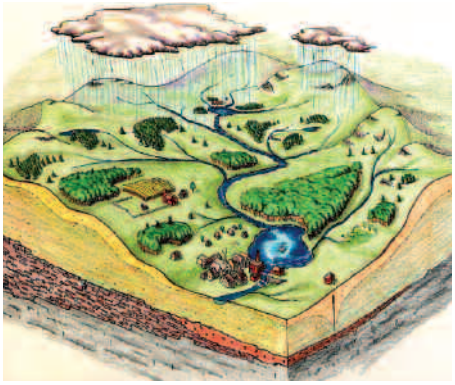
- » Stormwater and polluted runoff – reduce pollutants washed into the waterways and the volume of stormwater
- » Wastewater treatment plants – implement more stringent limits on nutrients such as nitrates and phosphate
- » Land uses – protect undeveloped areas, restore wetlands and riparian areas, protect cold water fishery streams, and encourage Low Impact Development strategies such as reduced impervious surfaces, increased infiltration, and native plantings.
- » Streamflow – restore flow by methods such as: improve impoundment management; breach or remove appropriate dams; and establish fish passage for anadromous species at the four lower-most dams.
- » Recreational Opportunities – continue to build a system of river access points to increase opportunities to fish, paddle and enjoy passive recreation.
- » Education and Outreach – develop programs to increase watershed awareness and appreciation, and to encourage active stewardship.

HISTORICAL PERSPECTIVE

Originally named after the first European resident of the valley, the Reverend William Blaxton, the Blackstone Valley later became known as the "Birthplace of the American Industrial Revolution." In 1793, Samual Slater built the first water-powered, cotton thread spinning mill and took advantage of the river's natural waterpower. As factories grew, every mile of the river was dammed to harness its power, thereby changing every aspect of the river. As a result the Blackstone earned the reputation of being "America's hardest working river." A river of national significance, the Blackstone Valley became a part of the National Heritage Corridor system in 1986, and in 1998, President Clinton designated the Blackstone River watershed as an American Heritage River. It is this industrial history that has left the Blackstone a legacy, which includes a colorful past but also impaired water quality and physical alterations. But like many other New England rivers, we've come a long way in restoring the Blackstone.

Its industrial history left a legacy, which includes a colorful past but also impaired water quality and physical alterations.

THE BLACKSTONE RIVER AND ITS WATERSHED



Originating as a series of streams in the hills of Worcester, Holden, and Paxton (headwater tributaries) the Blackstone River flows 46 miles southeast into Rhode Island, dropping 438 feet before emptying into the tidal Seekonk River in Pawtucket, Rhode Island, and eventually Narragansett Bay.

The watershed includes 1300 acres of lakes, ponds, and reservoirs, 500 square miles, and 29 communities. The headwater tributaries in the Worcester region are Kettle Brook, Tatnuck Brook, Beaver Brook, Mill Brook, Middle River, and Broad Meadow Brook. The major tributaries of the Blackstone are the Quinsigamond, West, Mumford, Mill, and Peters Rivers in Massachusetts, and the Clear and Branch Rivers and Abbott Run in Rhode Island.

WHAT IS A WATERSHED?

A watershed is the land over which rain and snowmelt flow to a particular water body, such as a river or stream, a lake or a pond. Its boundary is the ridgeline, or the highest hills, around that water body. Water either infiltrates to ground water or drains to a waterway, taking with it any substances on the land. There is a direct connection between land use and water quality. Whatever we do to the land, we do to the water.

Everyone lives in a watershed – this is the story of the Blackstone watershed.

Land use, both historical and present day, directly impacts water quality. The major issues facing the Blackstone today are stormwater runoff, wastewater treatment plants, and contaminated sediments.

MAJOR ISSUES FACING THE WATERSHED

STORMWATER QUANTITY AND QUALITY

In urbanized areas, stormwater flows over impervious surfaces such as roads, parking lots, and buildings, enters the stormdrains in the roadways, and flows directly to the nearest waterway. It does not percolate directly into the ground to the water table. This surface runoff gains velocity, pollutants, and seasonally, heat. Impacts include a reduced amount of base flow available to streams and rivers during dry weather conditions. But even more

immediate, however, is the rush of stormwater to rivers and streams. These rapidly flowing, higher than natural, volumes of water can be extremely destructive, causing downstream erosion and resuspending bottom materials, which can have devastating consequences to the aquatic ecosystem.

Throughout the watershed, stormwater runoff gathers pollutants such as fertilizers, herbicides, pesticides, sediments, vehicle drippings, human wastes (from failing septic systems), animal wastes, road sand and salt, and solid waste (e.g., fast food packaging, cigarette butts). Inevitably, these pollutants end up in downstream surface waters. These nonpoint sources of pollution result from human activities, and are typically difficult to address due to their pervasive nature.

Stormwater is one of the greatest threats to the Blackstone River today.

SEDIMENTS

Pollution from historic industrial discharges persist in bank and bottom sediments, and have become incorporated into the aquatic food chain. In numerous areas of the Blackstone, people are advised to refrain from eating the fish caught there due to high levels of pollutants.

Although cleaner material has capped these polluted sediments over time, rapid stream flow fluctuations resuspend these sediments, at sometimes-toxic levels, making them available to aquatic organisms again.

WASTEWATER TREATMENT PLANTS

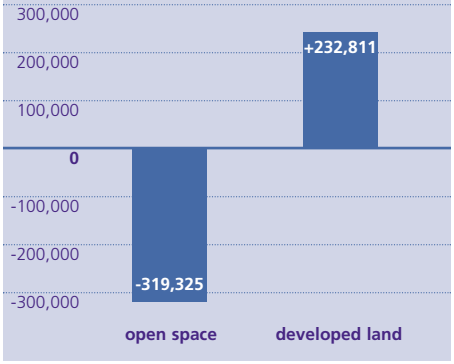
The Blackstone River receives treated effluent from seven wastewater treatment Plants (WWTPs) in Massachusetts, including the Upper Blackstone Water Pollution Abatement District (UBWPAD), Grafton, Northbridge, and Uxbridge, as well as Upton on the West River, Hopedale on the Mill River and Douglas on the Mumford River. In Rhode Island, the City of Woonsocket also discharges effluent to the river. Of the point sources, the discharge from the Upper Blackstone facility is significantly larger than the others.

Phosphorus and nitrogen (i.e., nutrients) in wastewater effluent often overwhelm the receiving waterway, resulting in excess weed and algal growth, which in itself causes a decrease in water and habitat quality.

Flow fluctuations also occur with effluent discharges, although nowhere near as severe as that caused by stormwater runoff from impervious surfaces and improper operation of hydropower facilities.

LAND-USE PATTERNS IN THE WATERSHED

BUILDOUT OF BLACKSTONE RIVER WATERSHED = LOSS OF NATURAL AREAS



The land-use pattern of the Blackstone is unusual in that the major industrial city of Worcester is located on the small headwater streams that are the source of the river. Providence, the other major city, is in the more usual place at the mouth of the river. A densely developed city of over 160,000 people sitting on the headwaters has a tremendous impact on water quality, but it's not just Worcester that impacts the river. In addition, it is all the urbanized areas including Woonsocket, Central Falls and Pawtucket, as well as the development that has taken place throughout the watershed. The more an area becomes developed, the more non-point source pollution and stormwater is generated unless great care is taken to reduce those impacts.

The Blackstone watershed has undergone tremendous residential and commercial development in the past 20 years as people have sought more affordable real estate, moving west from the Boston area and north from Providence. This sprawling growth results in significant increases in paved roadways, driveways, and rooftops, and in significant losses of agricultural lands and forests. Sprawl's resulting dramatic increase in impervious surface area has caused huge volumes of polluted runoff to be channeled directly to our waterways through the stormdrain system, while the loss of vegetated

PROJECTED CHANGE FROM CURRENT CONDITIONS TO ULTIMATE BUILDOUT

Buildout will occur when all land is developed according to current zoning standards.

LAND USE / ZONING	LOSS IN ACRES	GAIN IN DEVELOPED ACRES		IMPERVIOUSNESS BY LAND USE/ZONING		GAIN IN IMPERVIOUS ACRES
NATURAL LANDS/VEGETATION	– 308,970					
VERY LOW DENSITY (1 & 2 ACRE RESIDENTIAL)		150,659	X	2%	=	3,013
ABANDONED/OPEN LAND (LOSE ALL)	– 9,307					
LOW DENSITY RESIDENTIAL		50,732	X	3%	=	1,522
MEDIUM DENSITY RESIDENTIAL		15,588	X	19%	=	2,962
URBAN OPEN/RECREATION	– 1,048					
HIGHER DENSITY RESIDENTIAL		8,232	X	35%	=	2,881
COMMERCIAL		3,916	X	65%	=	2,545
INDUSTRIAL/TRANSPORTATION		3,684	X	77%	=	2,837
TOTAL LAND USE / ZONING	**– 319,325**	**232,811**				**15,760**

Estimated percentage of future impervious surface cover by type of zoning in the Blackstone River watershed, interpreted by Mass. EOEA, based on MassGIS and RIGIS data.

Rivers are our bottom line, our report card reflecting how we use the land in the watershed. The Blackstone is only as healthy as the land in its watershed, since water must flow over and through that land on its path to the river and then on to Narragansett Bay and the Atlantic Ocean.

areas has caused a significant decrease in infiltration to ground water. As a result, our rivers and streams are "flashier", suffering higher high water levels and lower low water levels, with both accompanying the poorest water quality conditions.

Even more development has taken place since 1999, giving the Blackstone watershed the label of the "newest sprawl frontier". These continuing growth pressures will only increase the volume of polluted stormwater reaching our waterways and decrease recharge to groundwater unless we change the way new development happens.

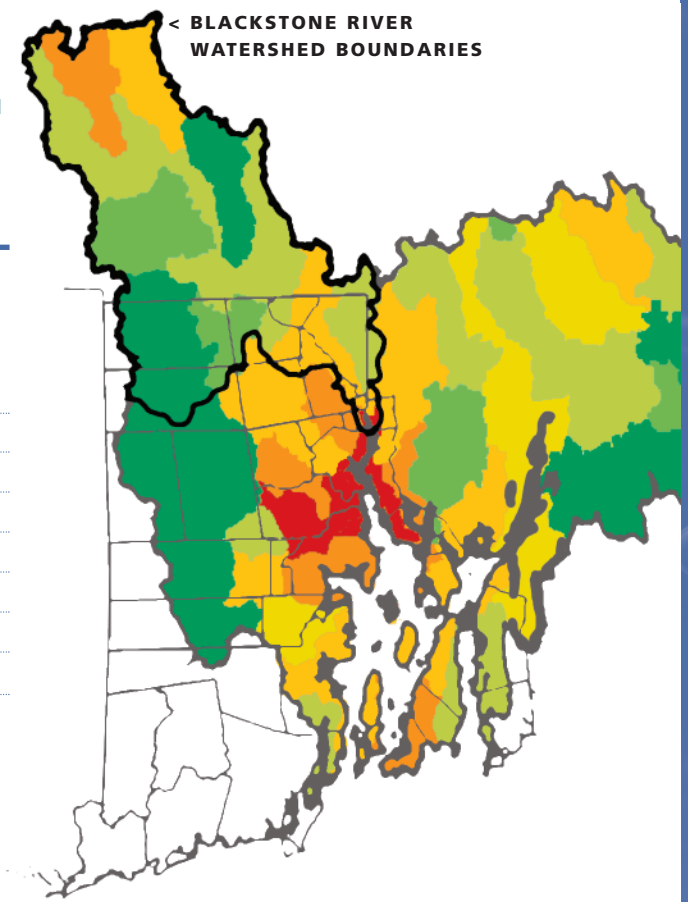
If we don't address zoning issues and plan to grow in a smarter way, then each community will ultimately be developed in the way that it is currently zoned, reaching "Buildout." With "Buildout" comes dramatic increases in impervious cover. Instead, we need to encourage projects to incorporate low impact development practices, such as less paving and more infiltration, in order to mimic the natural hydrology of the site.

This map shows the percentage of impervious cover as of the year 2001. At buildout, there will be 15,760 additional acres of impervious surfaces, and 319,325 fewer acres of open space.

2001 NARRAGANSETT BAY SUB-WATERSHEDS: PERCENTAGE OF IMPERVIOUS SURFACES

	0-3%
	4-6%
	7-10%
	11-16%
	17-26%
	27-38%
	39-54%

Streams start to become stressed at 10% watershed imperviousness.



LOW IMPACT DEVELOPMENT PRACTICES TO REDUCE STORMWATER VOLUME AND INCREASE INFILTRATION

SITE PLANNING TECHNIQUES

Impervious surface reduction

- » Narrower roadways, no curbing
- » Shorter driveways
- » Vegetated centers of cul-de-sacs

Vegetated swales, buffers, and strips

Better parking lot design

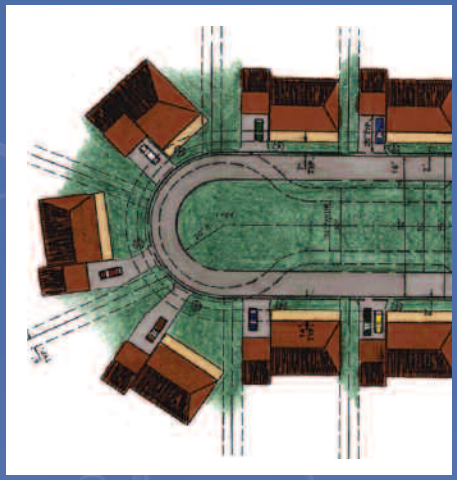
- » Vegetated islands to accept stormwater
- » Permeable pavers for overflow areas
- » Infiltration trenches

REDIRECT ROOF RUNOFF AWAY FROM PAVED AREAS

Rain barrels and cisterns

Rain gardens

GREEN ROOFS



In order to make further progress we need to improve and protect the water quality level of the tributaries in less developed areas.

WATER QUALITY IN THE WATERSHED

VOLUNTEER WATER QUALITY MONITORING PROGRAM

The backbone of the Campaign is the BRC Watershed-wide Volunteer Water Quality Monitoring Program and the resultant Water Quality Report Card, which informs our action plan and outreach efforts. We currently have 78 volunteers monitoring 76 sites. For more information about the program and the report card visit **www.zaptheblackstone.org.**

The water quality of the Blackstone River, though degraded by over two centuries of industrial pollution, and other factors such as loss of riverine wetlands, increased impounded reaches and increased impervious surfaces, has made an incredible comeback. This progress is due to many factors, beginning with federally mandated clean water standards first established in the early 1970's.

The river is now most influenced by stormwater runoff, wastewater treatment plant effluent, and contaminated sediments, each affecting water quality in a variety of ways. The monitoring program (see side bar) reports the following factors: aesthetics, including turbidity, appearance, odor, and visual assessments; temperature (temp); dissolved oxygen (DO); saturation (% Sat); and nutrients, specifically nitrate and orthophosphate.

WATER QUALITY MONITORING PROGRAM, 2006 REPORT CARD — KEY TO COLOR CODES: Excellent, Good, Fair, Poor

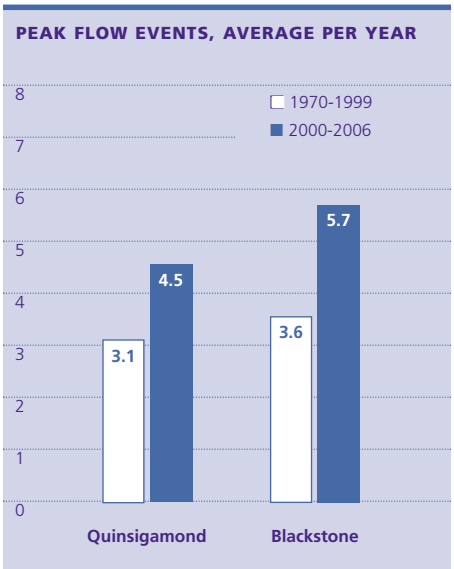
WATER BODY	SITE LOCATION	TOWN	AESTHETICS	TEMP	DO	% SAT	NUTRIENTS
HEADWATERS TRIBUTARIES							
KETTLE BROOK	JAMES STREET	WORCESTER					
DARK BROOK	AUBURN HIGH	AUBURN					
LEESVILLE POND	LEESVILLE OUTFLOW	WORCESTER					
TATNUCK BROOK*CWF	PARK AVE.	WORCESTER					
BEAVER BROOK	PARK AVE. CARWASH	WORCESTER					
MIDDLE RIVER	ST. JOHN'S CEMETERY	WORCESTER					
SALISBURY POND	SALISBURY POND EAST	WORCESTER					
SALISBURY POND	SALISBURY POND WEST	WORCESTER					
BROAD MEADOW BROOK	DOSCO	MILLBURY					
COLD SPRING BROOK*CWF	HATCHERY ROAD	SUTTON					
QUINSIGAMOND RIVER	PLEASANT STREET	GRAFTON					
MISCOE BROOK*CWF	MERRIAM ROAD	GRAFTON					
COAL MINE BROOK	PLANTATION STREET	WORCESTER					
POOR FARM BROOK*CWF	ROBERTO CLEMENTE	WORCESTER					
SEWALL BROOK*CWF	HOLDEN STREET	SHREWSBURY					
TILLY BROOK	VINNY TESTA'S	SHREWSBURY					
BUMMITT BROOK	PRATTS POND	GRAFTON					
SINGLETARY BROOK	SYCAMORE CIRCLE	MILLBURY					
BLACKSTONE RIVER							
BLACKSTONE RIVER	OUTLET OF FISHERVILLE POND	GRAFTON					
BLACKSTONE RIVER	UPSTREAM AT GORGE	BLACKSTONE					
BLACKSTONE RIVER	ALBION DAM	LINCOLN, RI					
TRIBUTARIES							
MUMFORD RIVER	DOWNSTREAM @ DEPOT STREET	UXBRIDGE					
COOK ALLEN BROOK*CWF	UPSTR OF BRIDGE ON JOHNSON RD	SUTTON					
PURGATORY BROOK	UPSTR OF BRIDGE ON JOHNSON RD**	SUTTON					
WEST RIVER*CWF	UNDER RTE. 16 BRIDGE	UXBRIDGE					
CENTER BROOK*CWF	AT MENDON ROAD	UPTON					
EMERSON BROOK*CWF	ABOVE QUAKER HIGHWAY	UXBRIDGE					
BACON BROOK*CWF	EAST OF BRIDGE, SOUTH STREET	UXBRIDGE					
MILL RIVER	PRIVELEGE STREET	WOONSOCKET					
BRANCH RIVER	RTE. 146A/GREAT ROAD	N. SMITHFIELD					
CHERRY BROOK	MASON STREET	WOONSOCKET					
PETERS RIVER*CWF	PAINE STREET	BELLINGHAM					
CLEAR RIVER*CWF	RI 102	BURRILLVILLE					
CHEPACHET RIVER *CWF	GAZZA ROAD	BURRILLVILLE					
MUSSEY BROOK	NEW RIVER ROAD	LINCOLN					
SNEECH BROOK*CWF	ALBION ROAD	CUMBERLAND					
MONASTERY BROOK	MENDON ROAD	CUMBERLAND					

WATER QUALITY INDICATORS

WHY IT'S IMPORTANT	IMPACTS	HUMAN CONTRIBUTORS
DISSOLVED OXYGEN (DO) Fish and insects that live in the water need sufficient dissolved oxygen (DO) for respiration.	Aerobic bacteria decomposes organic material, organic wastes and dead aquatic plants, consuming oxygen in the process. The resultant lower levels of DO can be fatal to fish and other aquatic creatures.	CAUSES OF LOW DO LEVELS: Discharge of organic wastes from industrial processes like paper mills, food processing plants; Illegal sanitary sewer connections to storm drains; Pet wastes from streets and sidewalks; Nutrients from lawn fertilizers; Leaves, grass clippings, paper litter dumped into storm drains or waterways.
NITROGEN In the form of ammonia and nitrates, nitrogen acts as a plant nutrient and causes eutrophication. Eutrophication, meaning a body of water has higher than natural nutrient levels, can cause excessive plant growth. This excessive plant growth reduces dissolved oxygen in the water when dead plant material decomposes and can cause the organisms to die. Nitrogen is not a major factor in freshwater streams, but is in downstream water bodies.	Increased plant growth and algal blooms: Entire lake or river stretch may fill with aquatic vegetation; Aerobic bacteria decompose dead aquatic plants, and other organic material, consuming oxygen in the process and harming fish and other aquatic life; Advanced stages can produce anaerobic conditions in which oxygen in water is completely depleted – "rotten egg" smell; Ammonia can be highly toxic to aquatic organisms.	CAUSES OF EXCESSIVE NITROGEN: Inadequately treated wastewater from sewage treatment plants; Illegal sanitary sewer connections; Improperly maintained septic systems; Animal waste from feedlot/barnyard runoff; Runoff of fertilizer used for crops, lawns and home gardens; Atmospheric deposition.
PHOSPHOROUS An essential element for life that occurs naturally. Excess phosphorous can causes extensive algal growth, called "blooms". Phosphorous is the limiting factor in freshwater streams i.e., the more we can reduce sources of phosphorous, the more we can "clean up" these systems.	Increased plant growth and algal blooms: Entire lake or river stretch may fill with aquatic vegetation; Aerobic bacteria decompose dead aquatic plants, and other organic material, consuming oxygen in the process and harming fish and other aquatic life; Advanced stages can produce anaerobic conditions in which oxygen in water is completely depleted – "rotten egg" smell.	CAUSES OF EXCESSIVE PHOSPHOROUS: Effluent from wastewater treatment plants; Illegal sewer connections; Improperly maintained septic systems; Animal waste from feedlot and barnyard runoff; Industrial wastes; Runoff of fertilizer used for crops, lawns and home gardens.
TEMPERATURE Water temperature in a river is very important for water quality. Many of the physical, biological and chemical characteristics of a river are directly affected by temperature.	Warmer water temperatures can decrease the amount of oxygen dissolved in the water, affecting fish, other aquatic life, and ecosystem processes.	CAUSES OF INCREASED TEMPERATURE: Industries discharging warmer water used for cooling processes; Stormwater running off warmed urban surfaces, such as streets, parking lots, etc.; Cutting down trees that help shade the river; Soil erosion increasing the amount of suspended solids carried by the river, making the water cloudy, which absorbs the sun's rays, causing water temperature to rise; Increasing shallow depths due to sediment build up in impounded reaches.
TURBIDITY Turbidity is a measure of relative clarity of water: the greater the turbidity, the murkier the water. Turbidity increases as a result of suspended solids in water that reduce the transmission of light and absorb heat from sunlight, causing water to become warmer and lose dissolved oxygen. Suspended solids can be clay, silt, plankton, industrial wastes, sewage, etc.	Decrease in number of aquatic species due to warmer water, less light, oxygen depletion. Suspended solids can: » Clog fish gills; » Reduce growth rate; » Decrease resistance to disease; » Prevent egg and larval development.	CAUSES OF HIGH TURBIDITY: Soil erosion; Urban runoff; Abundant bottom feeders (such as carp) that stir up bottom sediment; Algal growth; Improper operation of dams.

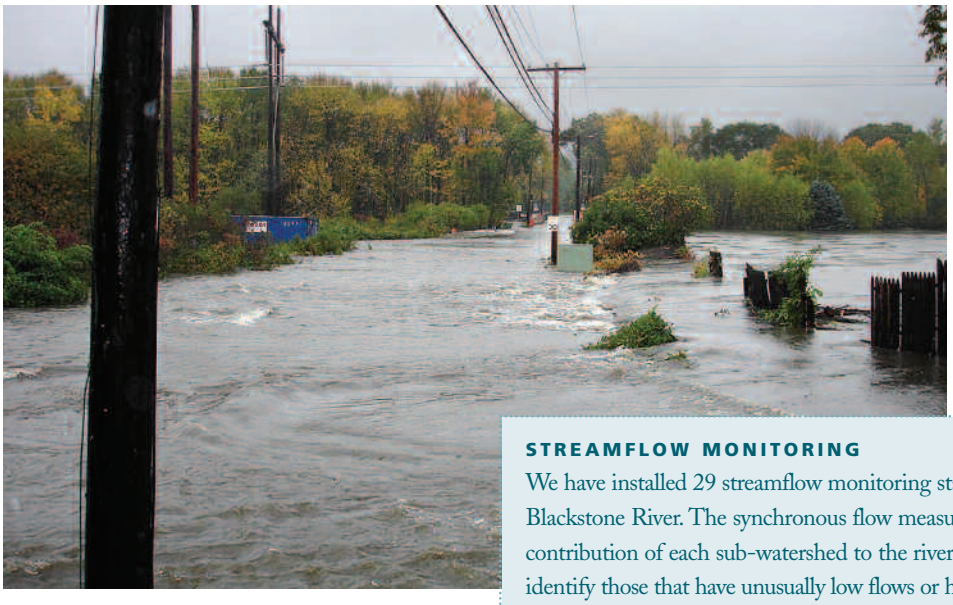
Why should we care about and measure stream flow? Sufficient streamflow is essential to recreation, aquatic life, water quality, water supply and adjacent wetland habitats.

FLOW IN THE BLACKSTONE RIVER AND ITS TRIBUTARIES



Sufficient streamflow is essential to recreation, aquatic life, water quality, water supply and adjacent wetland habitats. The Blackstone River watershed is experiencing substantial new development, increasing two streamflow problems...low flow and peak flow.

Both low flows and peak flows are exacerbated by increased amounts of impervious surfaces, which prevent rain and snow from seeping into the ground and recharging groundwater supplies. Instead of filtering through the earth, this water flows over the surface, carrying with it pollutants and sediments from parking lots, roads, lawns, roofs and other land features. These pollutants are carried to the nearest steam, river or lake where, at peak flow, the increased volume erodes stream banks, roads, and hillsides as it rushes downstream. Because this water did not permeate the soil, groundwater supplies are not recharged. While during periods of low precipation, the absence of groundwater recharge will cause low flows in streams, and eventually depletion of drinking water aquifers.



Pleasant Street, Grafton, MA
October 2005 flood.

STREAMFLOW MONITORING

We have installed 29 streamflow monitoring stations on every significant sub-watershed of the Blackstone River. The synchronous flow measurements allow determination of the specific contribution of each sub-watershed to the river system at a particular moment in time and identify those that have unusually low flows or high flows. In order to intelligently manage water resources and establish rational flow regulations we must understand the hydrology of the Blackstone River.

For example ongoing development and water withdrawal in the Quinsigamond River Basin has led to substantial declines in August monthly flow, 55% since 1979. In the Quinsigamond River discharge has fallen below 10 gallons per second six of the last 10 years for seven consecutive days. In four of those years it has run dry in some stretches. This lack of flow is insufficient for aquatic life to prosper in both the lake and the river.

Dry stream bed, Poor Farm Brook, Worcester, MA

THE NEED FOR WATER CONSERVATION TO PROTECT LOCAL STREAMS

Late summer in New England, 2007; next to no rain in August and September. Most of the smaller, intermittent streams have no flow, which is not unusual in times of drought. Unfortunately, at times like these our water consumption increases dramatically as homeowners try to keep their lawns green. The increase in demand during summer's low flows heightens the impacts from water-supply wells on downstream aquatic habitat. While there may be sufficient capacity in the aquifer to continually provide drinking water from the bottom of the well, the cone of depression caused by extended pumping may be drawing much needed water away from surface waterways. As more demands are placed on a shrinking water supply, animals and plants that depend on water in streams and rivers will find it harder to survive unless we can learn to use our precious water wisely.

LOW FLOWS
CAUSES
» DEFORESTATION
» INCREASES IN PAVED AND DEVELOPED LAND
» INCREASE WATER WITHDRAWALS
» POOR IMPOUNDMENT MANAGEMENT OPERATIONS
RESULTS
» LOW DISSOLVED OXYGEN
» HIGHER WATER TEMPERATURE
» HIGHER POLLUTANT CONCENTRATIONS
» HIGHER NUTRIENT (NITROGEN AND PHOSPHOROUS) CONCENTRATIONS
» ALGAL BLOOMS
» DIMINISHED AQUIFERS

PEAK FLOWS
CAUSES
» DEFORESTATION
» INCREASES IN PAVED AND DEVELOPED LAND
RESULTS
» FLOODING
» EROSION
» THE INCREASED SUSPENDED SEDIMENTS AND POLLUTANTS IMPAIRING WATER QUALITY
» SEDIMENTATION (FILLING-IN) OF PONDS AND LAKES

AQUATIC LIFE IN THE WATERSHED

WHAT IS A MACROINVERTEBRATE?

Benthic macroinvertebrates are organisms without a backbone (invertebrate), that can be seen with the naked eye (macro). They live on the river bed (benthic) rather than in the water column. Examples of macroinvertebrates found in the streambeds of fresh water rivers include larval damselflies, dragonflies, midges, and other insects. In short, macroinvertebrates are fish food. Macroinvertebrates are excellent indicator organisms of overall river health, because they don't move very far, and are exposed to all the river brings their way, good and bad. We can learn a great deal about the health of sections of the Blackstone River and its tributaries by identifying the macroinvertebrates there.

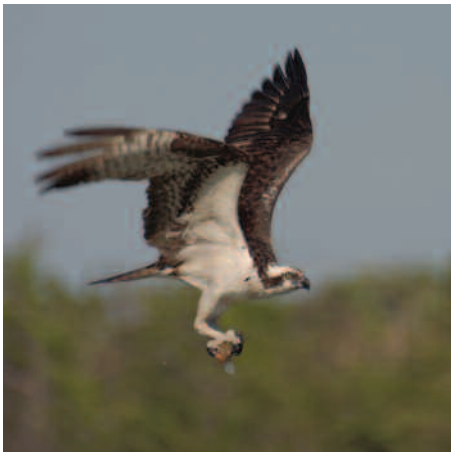
One of the greatest outcomes of improving the water quality of the Blackstone River and its tributaries is the benefit to aquatic life. Aquatic life ranges from tiny microscopic plants (plankton) to fish, amphibians and reptiles. They all depend on our rivers and streams to provide them homes, food, and life. Low flows, low dissolved oxygen levels, and increasing development can have negative impacts, particularly for fish and macroinvertebrates. Therefore, macroinvertebrates and fish are most often used to assess the health of aquatic ecosystems.

In 2004 macroinvertebrate samples were collected as part of a study conducted for the John H. Chafee Blackstone River Valley National Heritage Corridor Commission. Macroinvertebrate community conditions varied. At the Blackstone River, Broad Meadow Brook and Mill River sites macroinvertebrate communities were found to be moderately impaired. Some of the sites sampled were heavily covered by algae, indicating organic enrichment. The study stated that nutrients and organic enrichment problems occurring in the Blackstone River watershed appear to be contributing to the degradation of biological health. Organic enrichment occurs when dissolved or suspended organic materials (natural and synthetic) enter surface waters in rainfall, runoff, or ground water. Natural decomposition of these materials can deplete dissolved oxygen levels. Dissolved oxygen is vital to fish and other aquatic life. On the other hand, the Mumford River and Kettle Brook sites were found to be unimpaired, with good habitat. We need to continue to protect these areas and our cold water fishery streams.

STORM DRAIN STENCILING

Stenciling the message "Don't Dump – Drains to River" on stormdrains helps people make the connection between land use and water quality. What we do on the land may negatively affect water quality within the watershed. For example, runoff from our roadways flows into the storm-drain system, which is a major route for pollutants to flow directly to the nearest waterway.

Osprey, Kingfisher, and Great Blue Heron are flocking to the river because there are more fish for them to eat.



Prior to 1972 and the Clean Water Act there were only two species of fish that could survive in the mainstem. Now there are 19 different species in the mainstem and a total of 37 species found throughout the watershed.

FISH SPECIES FOUND IN THE BLACKSTONE RIVER AND ITS TRIBUTARIES

ALEWIFE	CHAIN PICKEREL	RAINBOW SMELT
AMERICAN BROOK LAMPREY	CHANNEL CATFISH	RAINBOW TROUT
AMERICAN EEL	COMMON CARP	REDFIN PICKEREL
BANDED KILLIFISH	COMMON SHINER	ROCK BASS
BANDED SUNFISH	CREEK CHUBSUCKER	SMALLMOUTH BASS
BLACK CRAPPIE	FALLFISH	SWAMP DARTER
BLACKNOSE DACE	GOLDEN SHINER	TESSELATED DARTER
BLUEGILL	GOLDFISH	WHITE CATFISH
BRIDLE SHINER	HYBRID BLUEGILL/PUMPKINSEED	WHITE PERCH
BROOK TROUT	LARGEMOUTH BASS	WHITE SUCKER
BROWN BULLHEAD	LONGNOSE DACE	YELLOW BULLHEAD
BROWN TROUT	NORTHERN PIKE	YELLOW PERCH
	PUMPKINSEED	

ANADROMOUS FISH PASSAGE

Anadromous fish, species that spend all or part of their adult life in salt water and return to their native freshwater streams and rivers to spawn, have been waiting for centuries to return to the Blackstone. With improved water quality and habitat restoration, now is the time to create and install fish passages on the four lowermost dams to bring shad, alewives and river herring to the Valley Falls Marsh and beyond. The Blackstone River Watershed Council in Rhode Island is spearheading this effort.

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Libby, A.D. 2004. A preliminary summary of fish surveys that were conducted in Rhode Island's streams and ponds between 1993 and 2002. Research Reference Document No, 2004/1, RIDEM Division of Fish and Wildlife, West Kingston, RI , Federal Aid in Sport Fish Restoration, Project F-20-R.

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COLD WATER FISHERY STREAMS NEED PROTECTION: 31 IN MASSACHUSETTS, 17 IN RHODE ISLAND

CHARACTERISTICS:

- Cold and highly oxygenated water (gradient, free stone bottom and reproducing aquatic insects)
- Buffer area of shading vegetation on the banks
- Buffer areas of natural ground cover and wetlands
- Sections of riffles, plunges and pools to add oxygen
- Stream continuity for gene pool sustainability

WHY ARE THEY IMPORTANT?

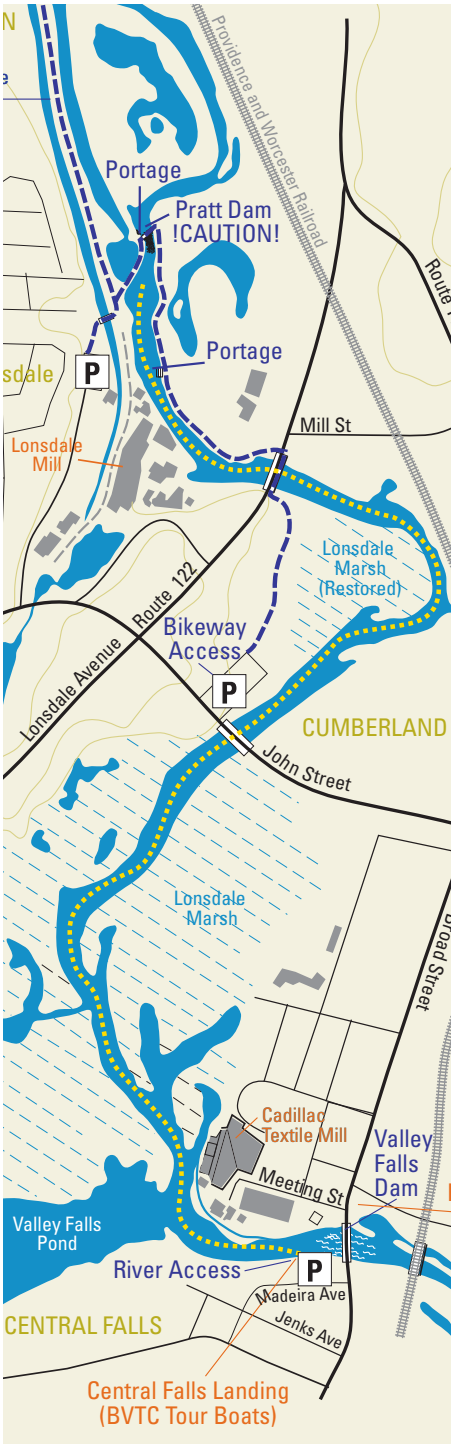
- Contribute the highest quality of water to the tributaries and mainstem of the Blackstone River
- Provide habitat for trout and other sensitive aquatic organisms – cooler, more highly oxygenated water
- Maintain colder temperature water to feed the mainstem and offset thermal pollution sources
- Source of woody vegetation that forms the base of the aquatic food chain
- Provide important places of refuge for trout to escape warmer temperatures during warmer months

HOW TO PROTECT THEM?

- Preserve vegetated buffers to keep water cool and provide cover
- Insist that your Conservation Commission enforce DEP's Stormwater Management Standard #6 for new and redevelopment projects.
- Encourage redesign of projects impacting cold water fishery streams to include Low Impact Development BMPs

On a river once dominated by industry, there are now industrious fun seekers enjoying the marked progress in accessibility, water quality, and diversions.

RECREATION AND RIVER ACCESS



Both Massachusetts and Rhode Island have developed State Parks along the banks of the Blackstone. The Kelly House in Lincoln, RI and River Bend Farm in Uxbridge, MA are both part of larger state parks and provide historic interpretation in idyllic settings overlooking watered stretches of the Blackstone Canal. Access at these areas provide "loop" trails that allow boaters to travel down the river and return via the more slow-moving canal stretches. The visitor centers located along the river in Pawtucket and Woonsocket provide much needed tourist facilities within their urban settings.

To provide access for both paddlers and larger tour boats, Rhode Island is developing a system of river landings with docks and public greenspaces along the Blackstone River. One landing has been completed in Central Falls (below). Two more – one in Woonsocket and one in Cumberland – are designed and ready for construction, and three more are proposed in Lincoln, North Smithfield and Pawtucket. For smaller (car-topped) boats, there are many informal access points and a plan to develop more in each state over the next three years.

River Tour maps for paddlers were developed for eight sections of the river, four in each state. Shown here is the tour through Lonsdale Marsh, the largest fresh-water marsh in Rhode Island, created by the impoundment at the Valley Falls Dam. Once the Lonsdale Drive-In, a portion of the Lonsdale Marsh was recently restored through a partnership between state and federal agencies. Download copies of the River Tour maps at www.nps.gov/blac/planyourvisit/get-on-the-river.htm.

The status and breadth of recreational opportunities in the Blackstone River Valley often comes as a surprise to those who have not rediscovered its lakes, rivers, streams, and greenways.

FISHING

The improved waters of the Blackstone can now support greater numbers and species of fish. From the cold-water fisheries of upland streams, through warmer waters in the mainstem impoundments with thriving bass populations, the waters of the Blackstone have improved to the point where state and federal efforts are working together to provide passage for the return of anadromous (those fish that must return to fresh water to spawn) species like shad and blueback herring. Both states have increased their efforts at stocking trout and other game fish. This resurgence provides increased opportunities for anglers to enjoy fishing their local waters. However, elevated levels of pollutants are still found in the Blackstone River fish today, and fish advisories in specific areas are in place to alert fishermen to the potential dangers of eating their catch.

BOATING

Thousands of boaters now enjoy their time on the Blackstone, ranging from families paddling to organized events. Crew regattas at the olympic quality race course on Lake Quinsigamond, the increasingly popular fast water races in Uxbridge and Woonsocket, and even Dragon Boat races in Central Falls testify to the regional demand for water-based recreation. Increased sales of kayaks and canoe rentals show that more people wish to see the rivers "up close and personal."

BIKING

The successful completion of several stretches of the Blackstone Bikeway has created a strong demand for one long continuous Bikeway from Worcester to Providence, with connection to the East Bay Bikeway along Narragansett Bay. The existing Blackstone Bikeway is used by more than bicyclists; joggers, parents with strollers, and roller-bladers all use this resource for exercise, recreation and transportation. The construction of the bike path also creates opportunities to develop river access sites for car-topped boating.

While there are still days, particularly after rain, when bacteria levels in the river are unsafe for contact, the Blackstone River and its tributaries still offer tremendous recreational possibilities.

Your actions can help transform the Blackstone River into a river full of promise for the

TACKLING STORMWATER IN THE BLACKSTONE

To further implement the Campaign for a Fishable/ Swimmable Blackstone River by 2015, the Blackstone River Coalition is targeting polluted runoff and stormwater volume as the major issue impacting water quality. The "Tackling Stormwater" initiative is a four-pronged approach partnering with municipal decision makers, developers, businesses, and homeowners. This program is grounded in the data generated by the BRC's well-respected, watershed-wide volunteer water quality monitoring program, which has an EPA/MA DEP/RIDEM approved Quality Assurance Project Plan, and supports 78 volunteers monitoring 76 sites throughout the watershed on a monthly basis.

HOMEOWNERS

The BRC provides watershed-based outreach materials for homeowners to help them understand their role in improving water quality in the watersheds. This information is distributed at many events such as the Blackstone Valley Home and Business Expo, Heritage Homecoming, CanalFest, the Greenway Challenge etc., as well as through the Blackstone Valley Tourism Council's distribution system and the BRC website www.zaptheblackstone.org

BUSINESS OWNERS

The BRC's "In Business for the Blackstone" initiative is a voluntary leadership program that educates small and mid-size companies on the detriments of polluted stormwater runoff and encourages the adoption of good housekeeping practices that can reduce the risk of pollutants in their runoff. They are easy to adopt, have little or no related implementation cost, and can benefit the company's bottom line. Companies that adopt these practices earn the distinction of being "In Business for the Blackstone" and are recognized as such with window decals, publicity, and advertising opportunities. This voluntary program is vital to Blackstone watershed communities to help them meet their EPA Phase 2 Stormwater Management permits.

ACTIONS FOR HOMEOWNERS: TO REDUCE POLLUTED RUNOFF

- Limit use of fertilizer and lawn chemicals
- Dispose of pet waste properly
- Properly maintain vehicles
- Maintain septic system
- Compost lawn clippings and leaves rather than dumping on bank of waterway

TO INCREASE GROUNDWATER AND DRINKING WATER SUPPLIES

- Redirect rooftop runoff to vegetated areas
- Use rain barrels to harvest rain
- Make a rain garden, irrigate with roof runoff
- Wash car on lawn, not driveway

ACTIONS FOR BUSINESS OWNERS: TO REDUCE POLLUTED RUNOFF

- Practice good dumpster management
- Provide trash bins, sweep outdoor areas
- Avoid excessive salting/sanding in winter
- Put nothing down stormdrains
- Clean out stormdrains

TO INCREASE GROUNDWATER AND DRINKING WATER SUPPLIES

- Reduce impervious surfaces
- Increase vegetated areas
- Divert runoff from pavement to vegetation
- Put breaks in curbs to disperse runoff

fish, wildlife, and people who live in its watershed.

RIVER WATERSHED

LOCAL DECISION MAKERS

Using the historic October '05 flood as a "teachable moment", the BRC sponsored a highly successful Blackstone Watershed Stormwater Management conference, which highlighted Low Impact Development (LID) practices and Open Space Residential/ Conservation Design (OSR/CD) to reduce stormwater impacts. To further spread the word, we offer "Stormwater 101" presentations to help communities develop a stormwater management bylaw and revise bylaws and regulations to allow and encourage LID and OSR/CD. These designs drastically reduce the amount of impervious surfaces, thus reducing the volume of stormwater that is generated, treated and managed. The BRC provides technical assistance with developing bylaw and regulation revisions to targeted communities. The recent floods have boosted stormwater management to a much higher municipal priority.

DEVELOPERS

Not only do we need to have the appropriate regulatory structure in place, but developers, engineers, landscape architects, and other professionals also must be trained in creative solutions to stormwater management by incorporating Low Impact Development best management practices. In collaboration with the Mass. Executive Office of Energy and Environmental Affairs and University of Rhode Island Nonpoint Education for Municipal Officials (NEMO), we are creating the Blackstone Watershed LID Manual as a guide to illustrate how developers can save money both in construction and in permitting costs and minimize the environmental impacts of their activities.

ACTIONS FOR LOCAL DECISION MAKERS: TO REDUCE POLLUTED RUNOFF AND INCREASE GROUNDWATER AND DRINKING WATER SUPPLIES

- Propose and adopt a strong stormwater management bylaw that encourages/ requires Low Impact Development strategies such as reduced impervious surfaces, increased infiltration, more natural drainage and native plantings
- Revise other bylaws and regulations as appropriate

ACTIONS FOR DEVELOPERS: TO REDUCE POLLUTED RUNOFF AND INCREASE GROUNDWATER AND DRINKING WATER SUPPLIES

- Create development designs that group residences, have narrower roadways, shorter driveways, no curbing, country drainage, innovative cul-de-sacs with vegetated islands, and protect cold water fishery streams
- Create parking lot designs that have vegetated islands to accept stormwater, pervious surface in overflow areas, and infiltration under pavement

WHY IS THIS ISSUE IMPORTANT

We've come a long way in restoring the Blackstone River, but there's still more to do to help make the Blackstone River clean by 2015. If you live or own a business in the Blackstone watershed, a cleaner river begins in your yard or business by reducing polluted runoff and increasing groundwater and drinking water supplies.

Polluted stormwater runoff is the most significant, unaddressed cause of water quality problems today. Rain and snow melt travels over paved surfaces and collects contaminants such as chemicals, nutrients, oil, metals, litter, and debris. These contaminants are then carried to the storm drain, which often discharges directly into local lakes and rivers that drain to the Blackstone, causing high turbidity as pictured above.

Small changes at home or in your company's practices can help improve the quality of our drinking water and protect rivers and lakes that are used for recreational purposes and provide important habitats for the fish, birds, turtles and other wildlife that call the Blackstone River watershed their home.

The Blackstone River Coalition

P.O. BOX 70477
WORCESTER MA 01607

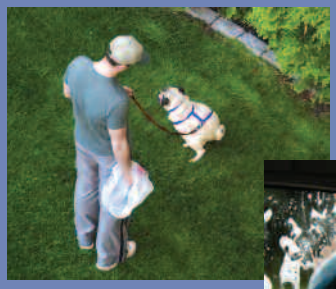
www.zaptheblackstone.org

Let's work together to restore the Blackstone River and improve the health of the Blackstone River Watershed.

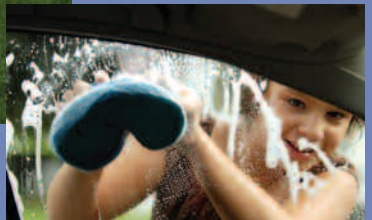
TOP 5 THINGS YOU CAN DO TO PROTECT THE BLACKSTONE

1 Limit the use of fertilizer and pesticides. When they are washed into the stormdrain, they harm aquatic life in nearby waterways.

2 Dispose of pet waste properly. Pet waste is raw sewage that can be washed into nearby streams. It should be disposed of in a toilet or trash can.



3 Carefully choose where to wash your car and properly maintain vehicles. Washing your car on the lawn will reduce the amount of dirty water that runs down your driveway. Avoid oil leaks that can run into waterways.



4 Redirect rooftop runoff to vegetated areas or collect in rain barrels. Keeping rainwater on site reduces runoff and helps irrigate landscaping.

5 Use no-phosphate dishwashing detergent. Whether you have a septic system or are on public sewer, phosphates accelerate plant growth in waterways.