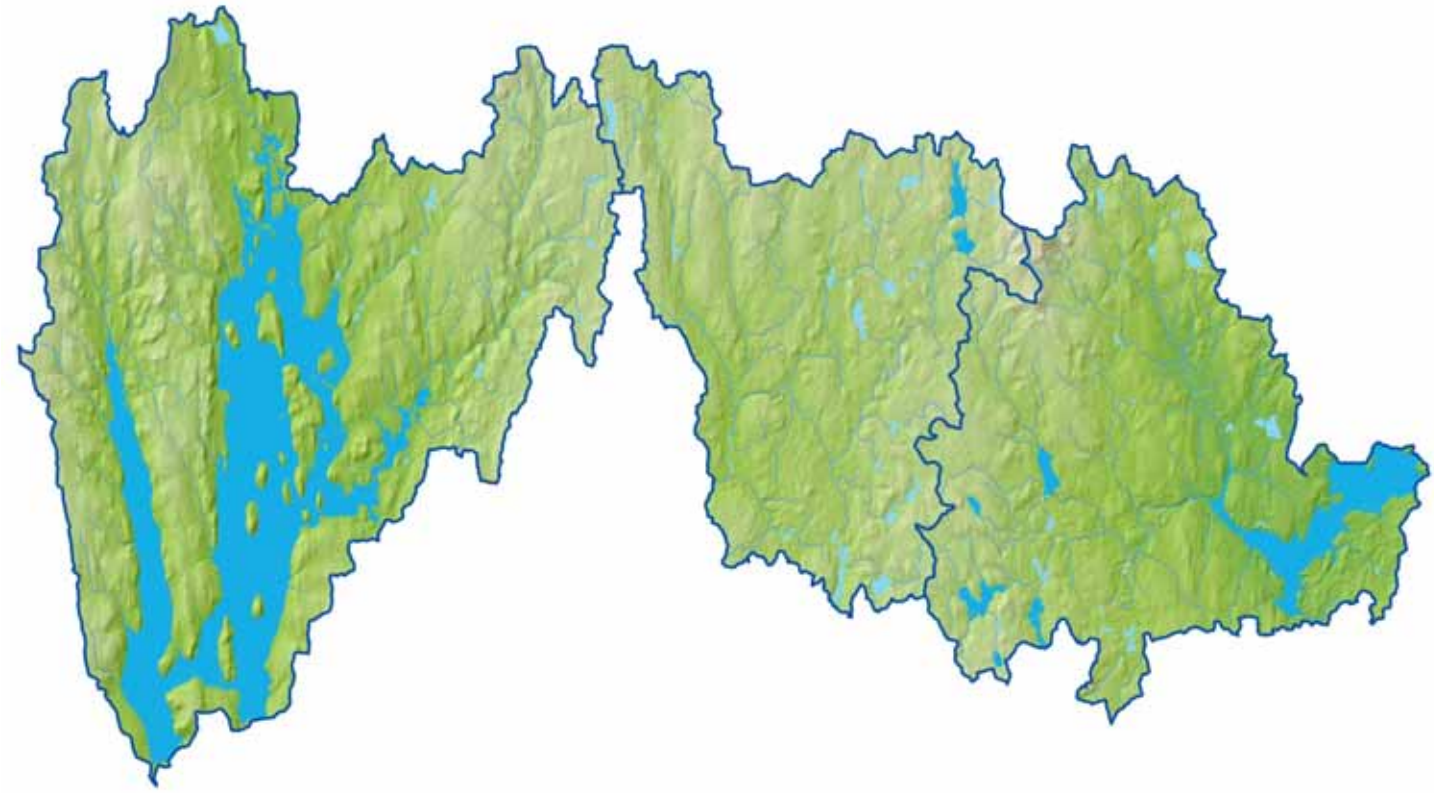
dcr
Massachusetts

2013
Watershed Protection Plan Update



July 2013

Massachusetts Department of Conservation and Recreation
Division of Water Supply Protection
Office of Watershed Protection

Abstract

The Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management manages and protects the drinking water supply watersheds that provide water for approximately 2.5 million Massachusetts residents. This Watershed System is comprised of three active water supply watersheds, the Quabbin Reservoir, Ware River, and Wachusett Reservoir, and an emergency supply comprised of the Sudbury and Foss Reservoirs. Watershed Protection Plans were initially developed for the active supply watersheds in 1991, with updates in 1998 and 2003 for the Wachusett Reservoir and 2000 for Quabbin Reservoir and Ware River. The Sudbury and Foss Reservoirs had a plan prepared in 1997. The *2008 Watershed Protection Plan* updated and unified all of these documents.

The *2013 Watershed Protection Plan* continues DCR's successful efforts of managing the source of an unfiltered water supply. This plan update provides a structured methodology to assess changes in watershed threats, develops programs to address the threats, and prioritizes staff assignments so they are congruent with current watershed management issues. The plan concludes with a five year implementation strategy that summarizes objectives for the Division of Water Supply Protection to achieve from Fiscal Years 2014 to 2019.

Acknowledgements

This plan was prepared by the staff of the Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management. Principal authors are: Patricia Austin, Lisa Gustavsen, Rebecca Budaj, Lawrence Pistrang, Kelley Freda, and Joel Zimmerman. The plan was produced under the supervision of DCR/DWSP senior staff: Jonathan Yeo, Division Director; John Scannell, Regional Director, Wachusett/Sudbury Section; William Pula, Regional Director, Quabbin/Ware Section; and Dan Clark, Natural Resources Section Director. MWRA contributions and review by Stephen Estes-Smargiassi, John Gregoire, David Coppes, and Michael Hornbrook.

All maps were produced by DCR/DWSP Office of Watershed Management GIS staff Craig Fitzgerald, Phil Lamothe, and Paul Penner, using DWSP and MassGIS data.

Cover Image: Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds shown with 1:25,000 hydrography and 1:5000 digital elevation and shaded relief. Dark blue bodies of water are drinking water supplies.

Commonwealth of Massachusetts
Deval L. Patrick, Governor
Richard K. Sullivan Jr., Secretary, Executive Office of Energy and Environmental Affairs
John P. Murray, Commissioner, Department of Conservation and Recreation
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2013 DCR Watershed Protection Plan Update

Tables

Figures

Acronyms

ACOE	US Army Corps of Engineers
ADA	Americans with Disability Act
AIS	Aquatic Invasive Species
ALB	Asian Longhorned Beetle
AST	Aboveground Storage Tank
ATV	All-terrain Vehicle
BLA	Quabbin Reservoir Boat Launch Area
BMP	Best Management Practice
CFI	Continuous Forestry Inventory
cfu	Colony Forming Units
CMR	Code of Massachusetts Regulation
CVA	Chicopee Valley Aqueduct
DAR	MA Department of Agricultral Resources
DCR	MA Department of Conservation and Recreation
DEP	MA Department of Environmental Protection
DFW	MA Department of Fish and Wildlife
DWSP	DCR's Division of Water Supply Protection
EOEEA	MA Executive Office of Energy and Environmental Affairs
EPA	US Environmental Protection Agency
EPO	MA Environmental Police
EQ	DWSP Environmental Quality Section
EQA	Environmental Quality Assessment
FCPA	MA Forest Cutting Practices Act
FoQ	Friends of Quabbin
ICS	Incident Command System
LAP	Land Acquisition Panel
MassDOT	MA Department of Transportation
MassGIS	Commonwealth's Office of Geographic Information
MCP	Mass Contingency Plan
mgd	Million gallons per day
MGL	MA General Law
MS4	Municipal Separate Storm Sewer Systems
MWRA	Massachusetts Water Resources Authority
NGO	Non-governmental Organization
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
OAG	MA Office of the Attorney General
ORV	Off-road Vehicle
PILOT	Payments in Lieu of Taxes
PPCP	Pharmaceutical and Personal Care Products
Res Ops	Reservoir Operations Group
ROW	Right of Way
STAC	Science and Technical Advisory Committee
SWPPP	Stormwater Pollution Prevention Plan
SWTR	Federal Surface Water Treatment Rule
USDA	US Department of Agriculture
USGS	United States Geological Survey
UST	Underground Storage Tank
WPR	Watershed Preservation Restriction
WQSWAT	Water Quality Sampling and Analysis Team
WsPA	Watershed Protection Act

1. Introduction

The Massachusetts Department of Conservation and Recreation (DCR), Division of Water Supply Protection, Office of Watershed Management (DWSP) manages and protects the drinking water supply watersheds that provide water for approximately 2.5 million Massachusetts residents. DWSP provides the Massachusetts Water Resources Authority (MWRA) source water for treatment and distribution to 51 communities in the Commonwealth (Figure 1-1).

The mission of the DWSP is to utilize and conserve water and other natural resources to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations. This important mission requires a thoughtful and deliberative approach to develop programs that can achieve this very broad goal. Watershed Protection Plans are an important tool used by DWSP to implement programs that enable staff to carry out this mission. The purpose of this report is to update the *2008 Watershed Protection Plan*. It summarizes a year-long assessment process conducted by DWSP staff and updates watershed control programs in order to continue effectively protecting the drinking water supply.

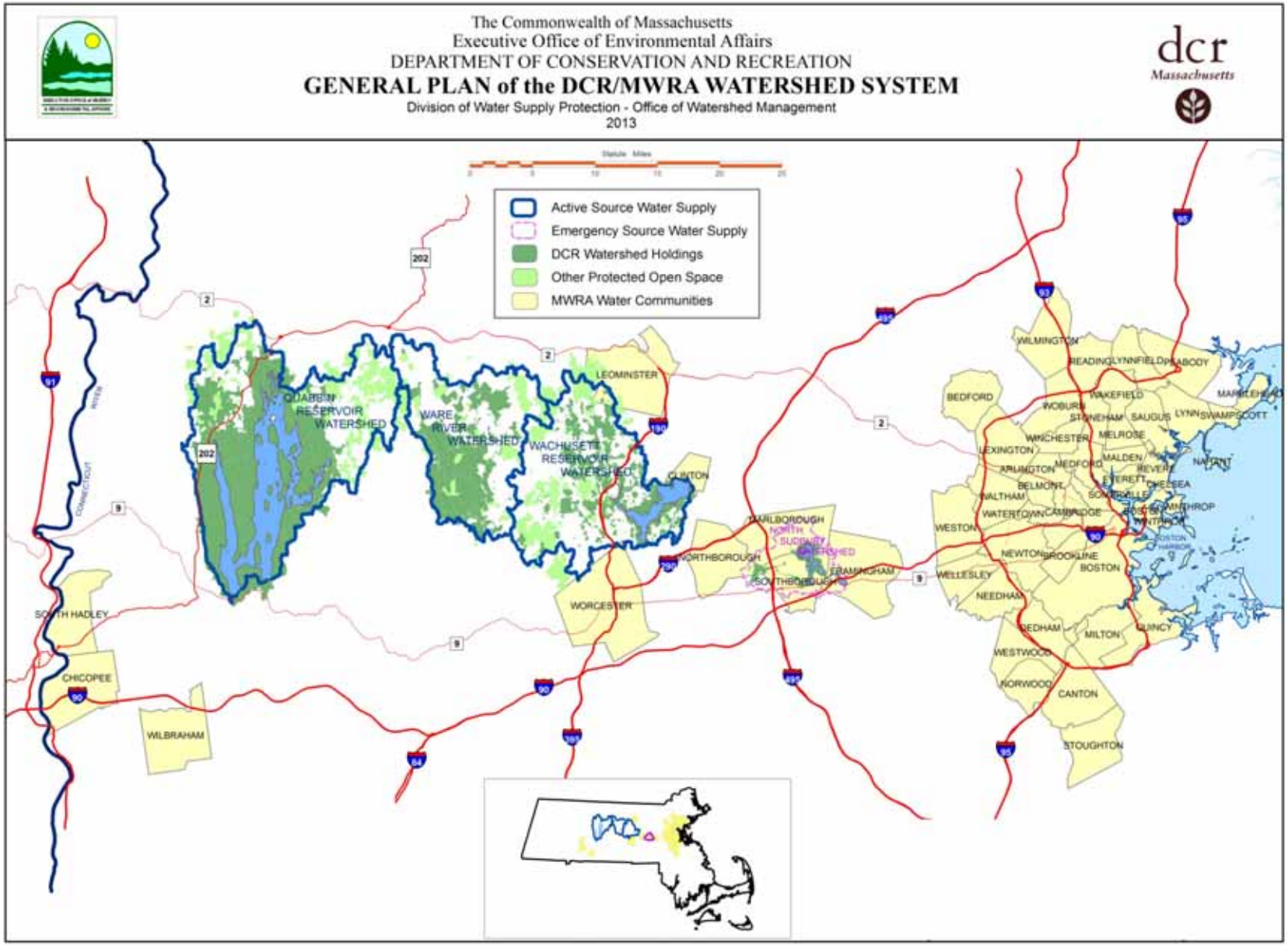
The watershed protection planning process and implementation of plan recommendations has been on-going since DCR's first Watershed Protection Plans were completed in 1991. Since that time, significant accomplishments have been made to greatly increase protection of the water supply, including:

- Acquisition of approximately 22,000 additional acres of land.
- Passage of the Watershed Protection Act's comprehensive land use regulations.
- Implementation of successful bird harassment programs at both Quabbin and Wachusett Reservoirs.
- Construction of sewers (with transport to a treatment plant outside the watershed) in areas no longer suitable for on-site wastewater disposal.
- Implementation of monitoring and control programs for invasive species.
- Redesign of roadway drainage to remove stormwater and eliminate risk from transportation releases.

Priorities for watershed control programs change as water quality threats are contained and new issues emerge. The process used to develop Watershed Protection Plans provides a structured methodology to assess changes in watershed threats, develop programs to address the threats, and review staff assignments to ensure that staff priorities align with current watershed issues.

The *2013 Watershed Protection Plan Update* is organized into eight chapters. After this Introduction, Chapter 2 describes the watershed system. Chapter 3 analyzes potential sources of pollution and presents the goals of DWSP's watershed control programs. The manner in which these control programs are implemented in each of the four distinct watersheds is discussed in Chapters 4-7. The Organization and Management of DWSP, including a five year Implementation Plan, are discussed in Chapter 8. This document integrates information from an array of detailed plans, reports, and other publications. Most of the referenced materials are available on the DWSP website, www.mass.gov/dcr/watershed.

Figure 1-1: DCR/MWRA Watershed System Map



2. The Watershed System

The first step in developing a watershed protection program is to delineate the watershed and assess major characteristics of the watershed, including stream hydrology, reservoir characteristics, land use, water quality, soil characteristics, and population trends. This information has been collected and updated by DWSP staff since the preparation of the first watershed protection plans. A brief summary is presented in this section.

2.1 Reservoir System

The source of water for the DCR/MWRA Water Supply System comes from three separate watersheds: Quabbin Reservoir, Ware River, and Wachusett Reservoir. The system also has an emergency water supply source, the Sudbury and Foss Reservoirs. The watershed system, shown in Figure 1-1, is large and well protected. Table 2-1 presents a summary of acreage information for the system.

The system was built over two centuries from east to west, as engineers and planners expanded the system to meet demands of the growing metropolitan Boston area. This chapter and the remainder of the plan describe the system's components from west to east, which chronologically follows from the newest to the oldest portions of the system.

Quabbin

Quabbin Reservoir is located in the valley of the Swift River, a tributary to the Connecticut River, in central Massachusetts. The reservoir was created in 1939 when the Swift River was impounded by the newly constructed Winsor Dam. Quabbin Reservoir has a watershed area of 95,466 acres (excluding the reservoir surface area). At full capacity, when its elevation is 530 feet above sea level, the reservoir covers an area of approximately 24,469 acres. The reservoir has 39 square miles of surface area and is 18 miles long. It has 118 miles of shoreline and holds 412 billion gallons when filled to capacity. The mean depth of the reservoir is 45 feet and the maximum depth is 141 feet. The Quabbin Reservoir is an oligotrophic drinking water reservoir, very clear and rich in oxygen with low nutrient levels so it does not support algal or plant growth. It functions as both a terminal supply reservoir for the Chicopee Valley Aqueduct system in central Massachusetts and as a storage reservoir for the Quabbin Aqueduct system serving metropolitan Boston to the east.

Ware

The Ware River watershed encompasses 61,737 acres in the Central Uplands of north central Massachusetts, east of Quabbin Reservoir. The Ware River watershed essentially functions as a tributary to Quabbin Reservoir via a diversion structure along the Ware River in Barre. There is no permanent reservoir located in the Ware River Watershed.

Wachusett

The Wachusett Reservoir watershed is located in central Massachusetts east of the Ware River. The reservoir, completed in 1906, was created by constructing a dam across the South Branch of the Nashua River. The reservoir surface area is 4,122 acres and the watershed consists of 74,800 acres. Like Quabbin, Wachusett is an oligotrophic reservoir. Quabbin water is transferred to the Wachusett Reservoir through the Quabbin Aqueduct.

Sudbury

The seven reservoirs that comprise the Sudbury Reservoir System were constructed over several decades in the late nineteenth century, with the largest component, the Sudbury Reservoir, completed in 1896. Over the course of the twentieth century, five reservoirs – Hopkinton, Whitehall, Ashland, Brackett, and Stearns – have been removed from the watershed system due to a combination of limited yield, poor water quality, contamination, and superior supplies from the west. The Foss and Sudbury Reservoirs, which are hydrologically separated from these other reservoirs, while removed from the active water supply system in the 1960s, remains as an emergency source supply. The watershed surrounding the Sudbury and Foss is much more developed than any other part of the system. The reservoir is classified as meso-eutrophic, with more nutrients available for plant and algal growth compared to the active reservoirs. The water is suitable for drinking water in emergency situations; the Sudbury Reservoir was most recently put into service very briefly in 2010.

Table 2-1: DCR/DWSP Watershed System Acreage

	Watershed	Land Area (acres)	Reservoir Area (acres)	Total Watershed Area (acres)
Active System	Quabbin Reservoir	95,466	24,469	119,935
	Ware River	61,737	0	61,737
	Wachusett Reservoir	70,678	4,122	74,800
Emergency System	Sudbury Reservoir	13,153	1,215	14,368
	Foss Reservoir #3	3,197	217	3,414

2.2 Land Use and Land Protection

Land use within the watersheds varies. Quabbin Reservoir watershed is sparsely populated and has a small percentage of developed land. The watersheds become more populated and developed as one travels from west to east in the system. The relative proportion of protected lands also decreases from west to east. Overall, however, the active system is characterized by large tracts of undeveloped land with low population densities in the developed portions of the watersheds (Figures 2-1 to 2-4).

Land use data are an important tool for developing watershed protection strategies. Detailed analyses have been conducted for each of the previous watershed protection plans. An updated digital dataset of land use was completed in 2009 by Commonwealth's Office of Geographic Information (MassGIS) using semi-automated methods and digital ortho-imagery captured in April 2005. The classification scheme, comprising thirty-three land use codes, is based on the coding scheme used for previous Massachusetts land use datasets. It was aggregated into seven major categories by DWSP staff for ease of analysis (Table 2-2). Changes in land use classification methodology have resulted in some large areas previously shown as forest now correctly identified as forested wetland (red maple swamp). Large neighborhoods are no longer considered residential in their entirety but are classified as a mixture of residential, forest,

Figure 2-1: Quabbin Reservoir Watershed Land Use and Land Cover

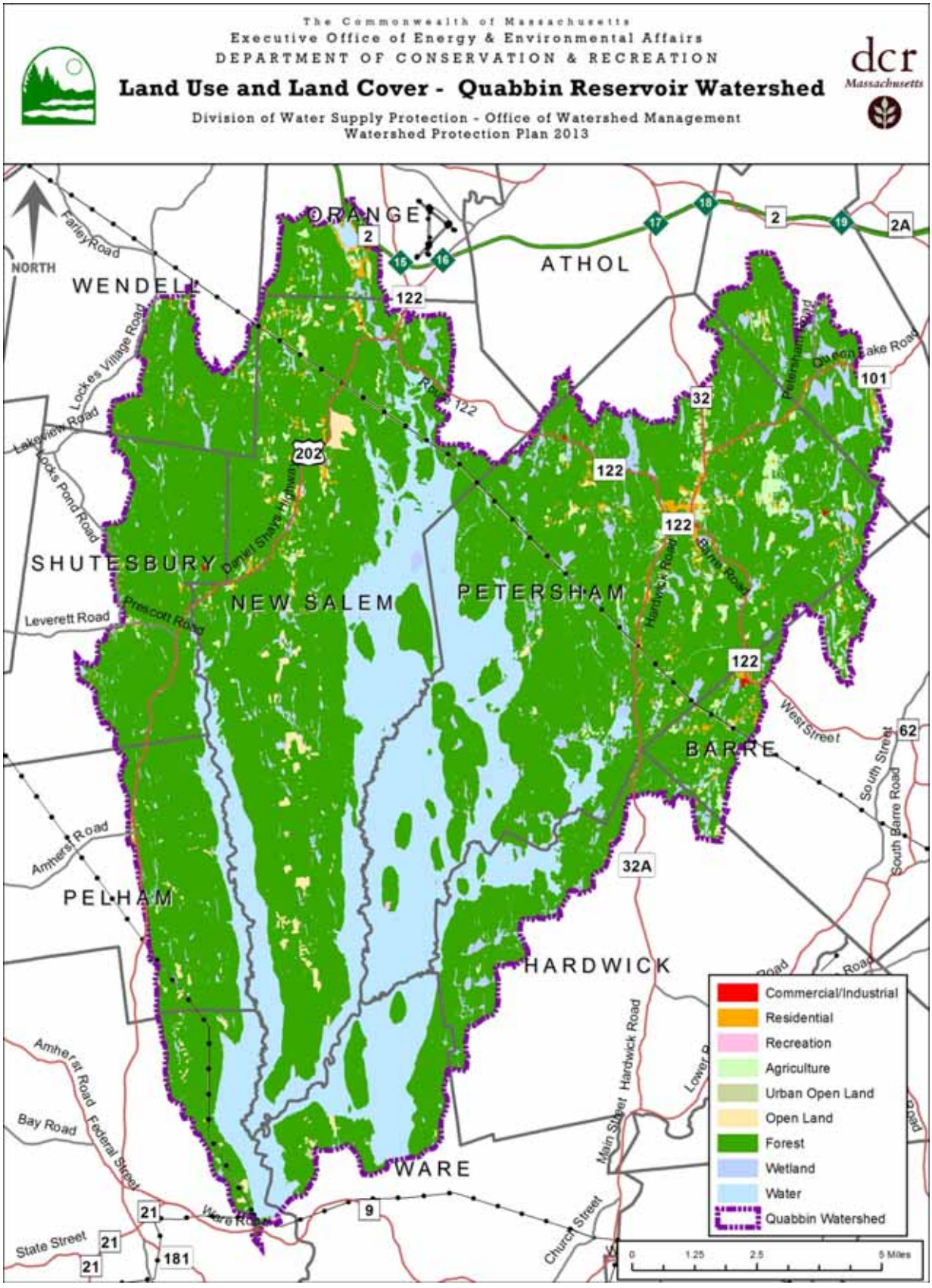


Figure 2-2: Ware River Watershed Land Use and Land Cover

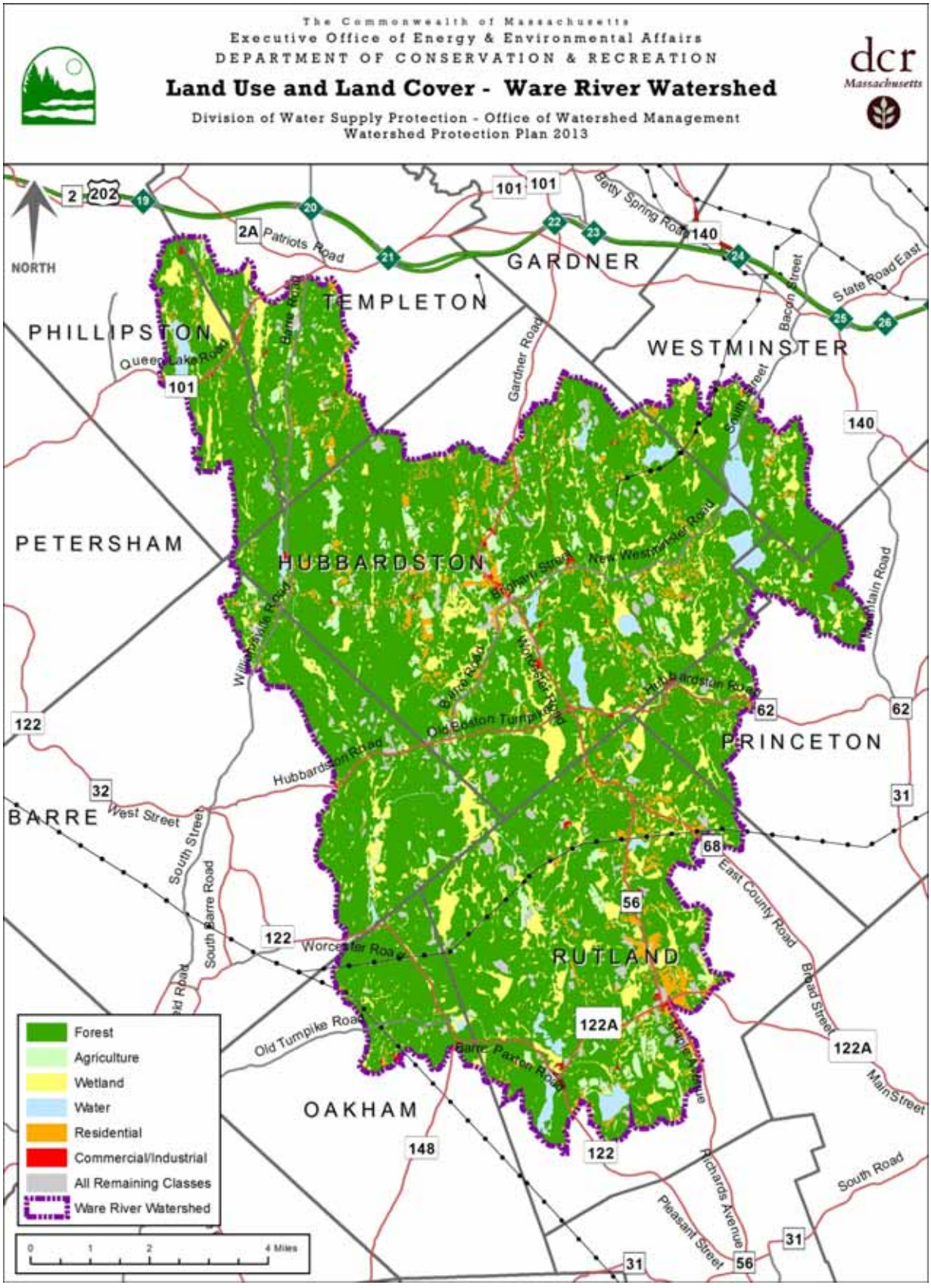


Figure 2-3: Wachusett Reservoir Watershed Land Use

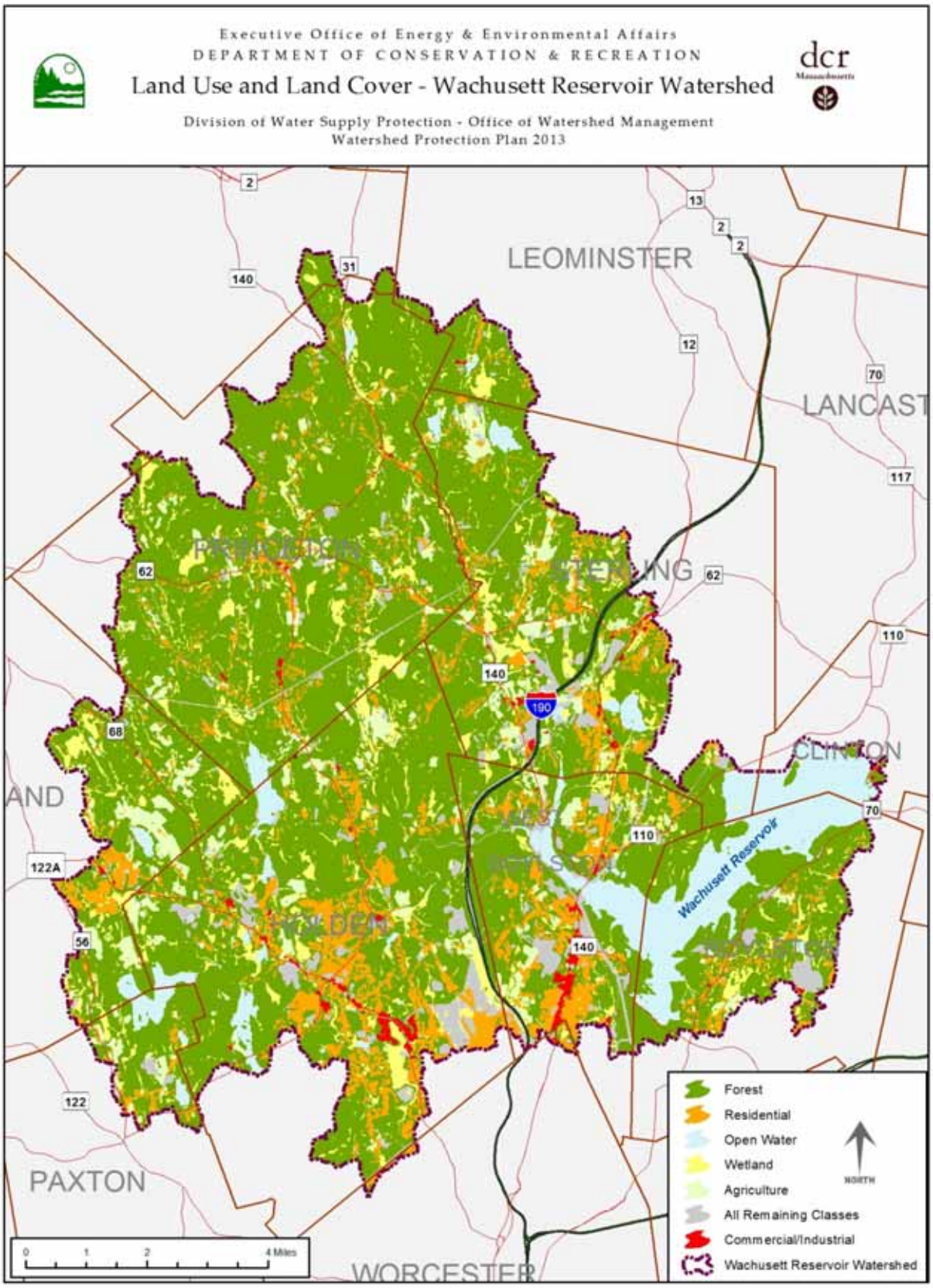
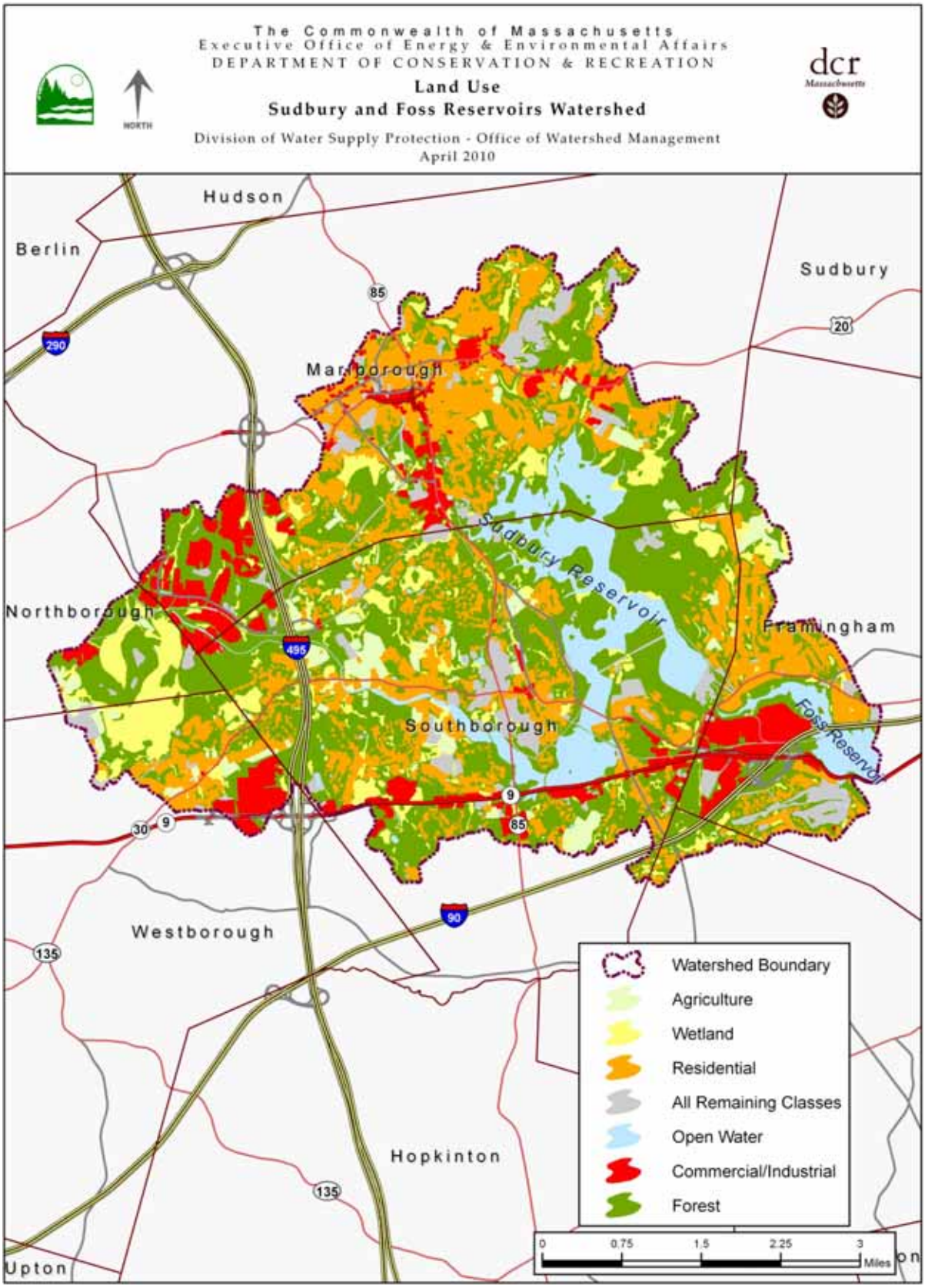


Figure 2-4: Sudbury Reservoir Watershed Land Use



wetland, and open space. This is a much more accurate representation of actual land use, but it makes it difficult to compare current land use with earlier data in order to assess land use changes.

Table 2-2: Summary of Land Use in the DCR/DWSP Watershed System

		Land Use (%) *(excluding the reservoirs)*						
	Watershed	**Forest**	**Wetland**	**Agriculture**	**Residential**	**Commercial Industrial**	**Open Water**	**Other**
Active System	Quabbin	88.2	5.6	2.2	1.5	0.2	0.4	1.9
	Ware	75.6	11.4	3.2	4.2	0.6	2.6	2.5
	Wachusett	67.3	7.7	5.7	10.8	2.3	2.7	3.4
Emergency System	Sudbury and Foss	40.8	1.3	6.2	30.5	12.2	0.2	8.8

Source: DCR and MassGIS. Open Water excludes reservoir area.

The Watershed System is well protected, as shown in Table 2-3. DWSP has an extensive Land Protection Program which has spent $131 million since 1985 to acquire 22,000 acres in both fee and Watershed Preservation Restriction as described in Chapters 3.2.1 and 3.2.2. Detailed accomplishments within each watershed are presented in Chapters 4.1-4.2, 5.1-5.2, and 6.1-6.2. Small scale maps displaying DWSP and other protected lands are displayed in the respective watershed's program chapters (Figures 4-1, 5-1, 5-2, 6-1, and 7-1).

Table 2-3: Summary of Protected Lands in the DCR/DWSP Watershed System

	Watershed	**DWSP Fee (acres)**	**DWSP WPR (acres)**	**Other Protected (acres)**	**Total Protected (acres)**	**Land Area (acres)**	**Protected as % of Land Area**	**Off-Water-shed (acres)**
Active System	Quabbin	53,278	2,077	13,589	68,944	95,466	72.2%	4,301
	Ware	23,313	919	6,533	30,765	61,737	49.8%	
	Wachusett	17,802	2,431	12,350	32,583	70,678	46.1%	
	Total	**94,393**	**5,427**	**32,472**	**132,292**	**227,881**	**58.1%**	
Emergency System	Sudbury and Foss	2,381	0	1,715	4,096	16,350	25.1%	

Source: DCR GIS and Deed Descriptions. WPR = Watershed Preservation Restriction, similar to a Conservation Restriction.

Quabbin

The Quabbin Reservoir watershed is the least developed in the system. In addition, Quabbin was the beneficiary of the most aggressive land acquisition program at the time of its construction. Approximately seventy-three percent of the Quabbin Reservoir Watershed is protected lands with fifty-six percent of the Quabbin Reservoir Watershed Land Area directly controlled by DWSP. Other state agencies, non-governmental organizations (NGOs), and watershed communities own the remaining protected lands. Eighty-eight percent of the land in the Quabbin watershed is forested, making it the dominant land use. Wetlands are the second most present

land cover (six percent) and residential land uses are ranked third (two percent). The percent of impervious cover in the watershed as a whole is a remarkable less than one percent.

Ware

In the Ware River watershed, fifty percent of the land is classified as protected open space. Of this total, DWSP controls 25,484 acres, or forty one percent of the watershed. DWSP owns approximately 23,374 acres in fee, with an additional 919 acres controlled through Watershed Preservation Restrictions. Other government agencies, local governments, and non-government organizations own the remainder of protected open space. There is a long history of cooperation among these agencies and organizations and DWSP to further watershed protection goals. The Ware River watershed is still largely undeveloped and forested (seventy five percent), with approximately four percent in residential, and less than one percent classified as commercial or industrial. Wetland, cropland and pasture comprise the majority of remaining uses. Ownership patterns have changed in recent years for private lands, with average parcel size declining as larger parcels are subdivided for residential development or through the estate probate process as large landowners die and their land is passed on to multiple descendents. The Ware River watershed is under three percent impervious.

Wachusett

Land use in the Wachusett Reservoir watershed remains dominated by undeveloped forest, open water, and wetlands. Residential development is relatively common, with updated assessment methodology indicating just less than eleven percent of the watershed currently in residential use. Agricultural is less common, and has remained constant between five and six percent. Commercial and industrial land uses are very uncommon and tend to be located in distinct areas such as in town centers or along major roadways. Forty-six percent of the land is classified as protected open space. This is a much greater percentage of protected land than when the first watershed protection plans were written due to DWSP's aggressive land acquisition program and work with other land protection groups. The overall amount of impervious land in the Wachusett watershed is estimated to be 5.5 percent.

Sudbury

The Sudbury watershed, located just twenty miles from metropolitan Boston, is much more developed than other parts of the system. A major highway crosses Foss Reservoir, and several industrial/commercial developments exist in the watershed. Nevertheless, approximately forty percent of the watershed is forested. A quarter of the watershed is protected, with DWSP lands comprising over half of this amount. Approximately 22 percent of the Sudbury Reservoir watershed land area is impervious.

Population

Twelve municipalities are wholly or partially located in the Quabbin Reservoir's watershed: Athol, Barre, Belchertown, Hardwick, New Salem, Orange, Pelham, Petersham, Phillipston, Shutesbury, Ware, and Wendell. Portions of Barre and Phillipston are also in the Ware River Watershed. Additional communities located in the Ware River Watershed are Hubbardston, Oakham, Rutland, Princeton, Templeton, and Westminster. Portions of Princeton and Rutland also lie in the Wachusett watershed, along with most or all of Boylston, Holden, Paxton, Sterling,

and West Boylston. Framingham, Marlborough, Northborough, Southborough, and Westborough comprise the Sudbury watershed.

Table 2-4 shows the populations according to the 2010 US Census. The data illustrates the increase in population as one travels from Quabbin watershed eastward. It also demonstrates that there are several towns in the Wachusett and Ware watersheds, such as Hubbardston, Rutland, and Holden that are seeing continued growth as a suburban housing option for both Worcester and Boston.

Table 2-4: Watershed Town Populations 2000 and 2010

	Town	2000 Population	2010 Population	Change	% Change
Quabbin	Athol	11,299	11,584	285	2.5%
	Belchertown	12,968	14,649	1,681	13.0%
	Hardwick	2,622	2,990	368	14.0%
	New Salem	929	990	61	6.6%
	Orange	7,518	7,839	321	4.3%
	Pelham	1,403	1,321	-82	-5.8%
	Petersham	1,180	1,234	54	4.6%
	Phillipston	1,621	1,682	61	3.8%
	Shutesbury	1,810	1,771	-39	-2.2%
	Ware	9,707	9,872	165	1.7%
	Wendell	980	848	-132	-13.5%
Ware River	Barre	5,113	5,398	285	5.6%
	Hubbardston	3,909	4,382	473	12.1%
	Oakham	1,673	1,906	233	13.9%
	Rutland	6,353	7,973	1,620	25.5%
	Templeton	6,799	8,013	1,214	17.9%
	Phillipston	1,621	1,682	61	3.8%
	Westminster	6,907	7,277	370	5.4%
Wachusett	Boylston	4,008	4,355	347	8.7%
	Holden	15,621	17,346	1,725	11.0%
	Paxton	4,389	4,806	417	9.5%
	Princeton	3,353	3,413	60	1.8%
	Sterling	7,267	7,808	541	7.4%
	West Boylston	7,481	7,669	188	2.5%
Sudbury	Framingham	66,910	68,318	1,408	2.1%
	Marlborough	36,255	38,499	2,244	6.2%
	Northborough	14,013	14,155	142	1.0%
	Southborough	8,781	9,767	986	11.2%
	Westborough	17,997	18,272	275	1.5%

Source: (DWSP/GIS, 2013; US Census 2000)
Note: These figures are for entire municipality. Most towns are not fully within a given watershed. Several towns are split between two watersheds; they are placed in this table based on majority of area in a given watershed and/or administrative practice of DWSP.

2.3 Water Quality

DWSP conducts extensive water quality monitoring of the surface waters in the water supply watersheds. Routine water quality monitoring provides data that are used to assess current water quality conditions. Routine monitoring also allows staff to establish ranges of values for parameters considered normal or typical. Review of the routine data results allows screening for excursions from normal ranges, alerting staff to potential pollution events. Data collected in routine sampling over several years are used to assess watershed trends. Shorter term studies may be conducted to evaluate specific issues. Although it is often difficult to measure and/or link discrete water quality impacts to specific management actions, DWSP's goal is to base all management decisions on water quality impacts.

In addition to all the tributary and reservoir sampling, source water quality at the intake is monitored for compliance with drinking water regulations (310 CMR 22.00). DWSP works closely with MWRA to comply with regulatory requirements for source water. MWRA conducts thousands of additional tests on samples collected from the Carroll Water Treatment Plant, the Ware Disinfection Facility, and throughout the system to ensure compliance with standards for the distribution system. MWRA's comprehensive testing is summarized in their Annual Consumer Confidence Report, distributed by MWRA and available at www.mwra.com/water/html/awqr.htm. The DCR/MWRA water supply system consistently meets all regulatory standards established by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP).

2.3.1 Watershed and Reservoir Monitoring

Quabbin /Ware

Since 2005, the water quality monitoring program has included up to 14 sampling stations in the Quabbin Reservoir watershed, up to 10 sampling stations in the Ware River watershed, and three reservoir sampling stations. In 2011, 27 surface water monitoring stations were routinely monitored, including all major tributary inflows to Quabbin Reservoir, some minor tributaries flowing to the Quabbin Reservoir or Ware River, and selected locations within the Quabbin Reservoir. Of the 27 monitoring stations, 14 stations were located within the Quabbin Reservoir watershed, and 10 tributary stations were located in the Ware River watershed to characterize this supplemental source water supply. Each watershed is divided into sanitary districts, and water quality of each watershed is monitored with "core" sites and "Environmental Quality Assessment" (EQA) sites. Core sites are long-term monitoring stations, while EQA sites support ongoing evaluations of threats to water quality by sanitary district. The remaining three sampling stations are located within the reservoir and are monitored monthly during the months of April through December, weather-permitting, with samples collected from several depths at each location.

Each tributary station is sampled biweekly, with sampling runs alternating between the Quabbin Reservoir watershed and the Ware River watershed. Samples are collected by hand early in the work week (typically Tuesday) regardless of weather conditions. Tributary stream temperature, dissolved oxygen, pH, and specific conductance levels are determined in the field using a Eureka multiprobe meter. Samples from core sites are collected biweekly for turbidity, bacteria, and calcium analyses, while samples for nutrient analysis are collected quarterly. UV_{254} samples

from core sites are analyzed quarterly in the Quabbin watershed and biweekly in the Ware River watershed. Samples from EQA Sites are collected biweekly for alkalinity, turbidity, bacteria, nutrients, calcium, and UV_{254}. Bacteria include total coliform bacteria, fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria. Nutrients include nitrate, total Kjeldahl nitrogen, and total phosphorus. Calcium monitoring was begun in 2010 in response to the potential threat of zebra mussels in the reservoir. Calcium is a key indicator for the viability of this invasive species; levels remain well below the threshold for zebra mussel colonization.

Wachusett

An extensive monitoring system remains in place for tributary sampling in the Wachusett watershed. Sampling plans are evaluated and modified annually. Environmental Quality (EQ) staff collected routine water quality samples from: 54 stations on 30 tributaries during 2008, 34 stations on 22 tributaries in 2009 and 2010, 26 stations on 20 tributaries in 2011, and 23 stations on 19 tributaries in 2012.

After five years of an expanded sampling program that collected data from a large number of stations to be able to address issues identified in previous water quality summaries and EQA reports, sampling has gradually been reduced to include only direct tributaries to the reservoir and those stations deemed historically significant or potentially threatened. Additional stations are sampled as needed to support special studies or potential enforcement actions. Each tributary station is visited weekly, as long as there is adequate flow. Temperature and conductivity are measured, and samples collected for bacteria and turbidity. Bacteria samples are driven to the MWRA Southborough Laboratory and turbidity is measured at the DWSP Wachusett lab. Nutrient samples were historically collected on a somewhat irregular basis from selected tributaries but have been collected monthly at nine stations since January 2011.

Stormwater sampling has been done regularly to supplement routine water quality sampling at four locations beginning in August 2011. Standardized sampling methodologies have been developed with collection of flow-based composite samples of nutrients, total organic carbon, and total suspended solids during both the rising limb and falling limb of fifteen storms.

Sudbury

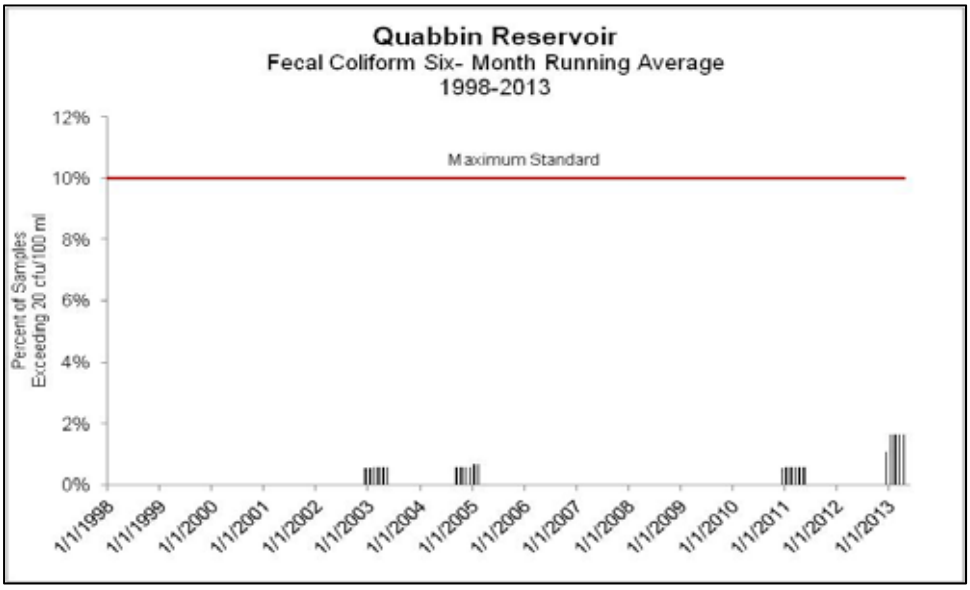
A reduced water quality sampling effort, with respect to the active watersheds, is conducted in the Sudbury watershed. Nutrient data from numerous monitoring efforts of Sudbury Reservoir (going back as far as 2002) consistently show elevated levels of nutrients as one would expect for this urbanized and highly productive water body. In addition to loading of phosphorus, nitrogen, and bacteria from the developed watershed, the data indicate that there are two additional major factors influencing water quality in this system: 1) the development of hypolimnetic anoxia that recurs each summer (leading to "internal" loading of nutrients); and 2) the periodic transfer of colder and higher quality water from Wachusett through the open channel into Sudbury. In 2009, DWSP documented that a transfer from Wachusett in September can destabilize the thermal stratification structure in Sudbury and hasten the occurrence of turnover thereby interrupting the influence of hypolimnetic anoxia.

2.3.2 Monitoring for Compliance with Federal and State Drinking Water Standards

The Federal Surface Water Treatment Rule (SWTR) requires that fecal coliform concentrations at the intake of an unfiltered surface water supply be no greater than 20 colonies per 100 ml in ninety percent of the samples in any six month period. Fecal coliform testing at the Wachusett Cosgrove Intake and the Quabbin Chicopee Valley Aqueduct (CVA) Intake began in 1991. Initial testing showed that Wachusett exceeded this standard at certain times of the year. Quabbin was able to meet the standard but also showed seasonal increases in fecal coliform concentrations. Staff investigations revealed that the source of the bacteria was seasonal bird populations. The development and implementation of bird harassment activities resulted in a dramatic drop in both roosting gull populations and fecal coliform concentrations. The standard has not been exceeded since the spring of 1999, as shown in Figure 2-5 and 2-5.

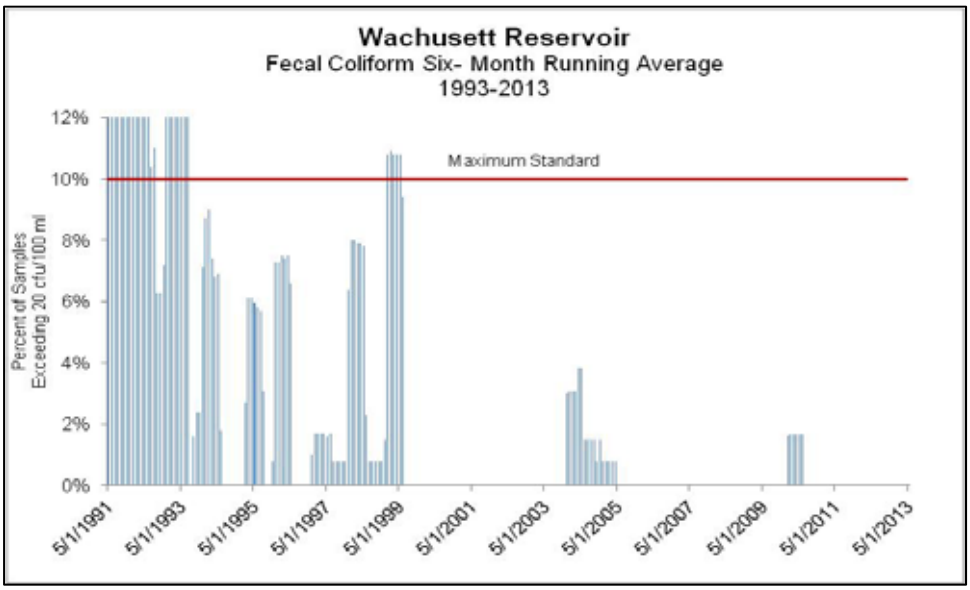
Quabbin Reservoir has consistently met federal fecal coliform bacteria standards for decades. Mass. DEP regulations, 310 CMR 22.20, state Quabbin Reservoir source water entering the distribution system must not exceed 20 cfu/100ml of fecal coliform bacteria in more than 10 percent of the samples collected in a six month period. Daily sampling results in 180 samples collected in a six month periods, and would allow 18 days with values greater than 20 cfu/100 ml. At no time has the reservoir water come close to approaching 18 days of fecal coliform levels over 20 cfu/100ml during a six month period. During the six month period, August 2012 thru January 2013, Quabbin Reservoir source water only exceeded the 20 cfu/100ml standard three times (Figure 2-7).

Figure 2-5: Quabbin Reservoir Fecal Coliform Bacteria Concentration 6 Month Averages, 1998-2013



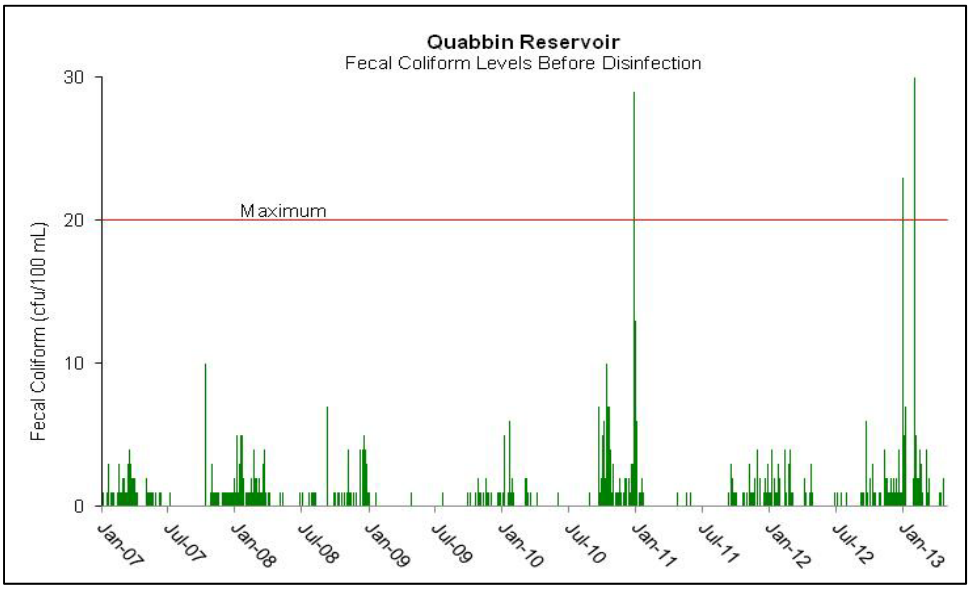
Source: MWRA

Figure 2-6: Wachusett Reservoir Fecal Coliform Bacteria Concentration 6 Month Averages, 1993-2013



Source: MWRA

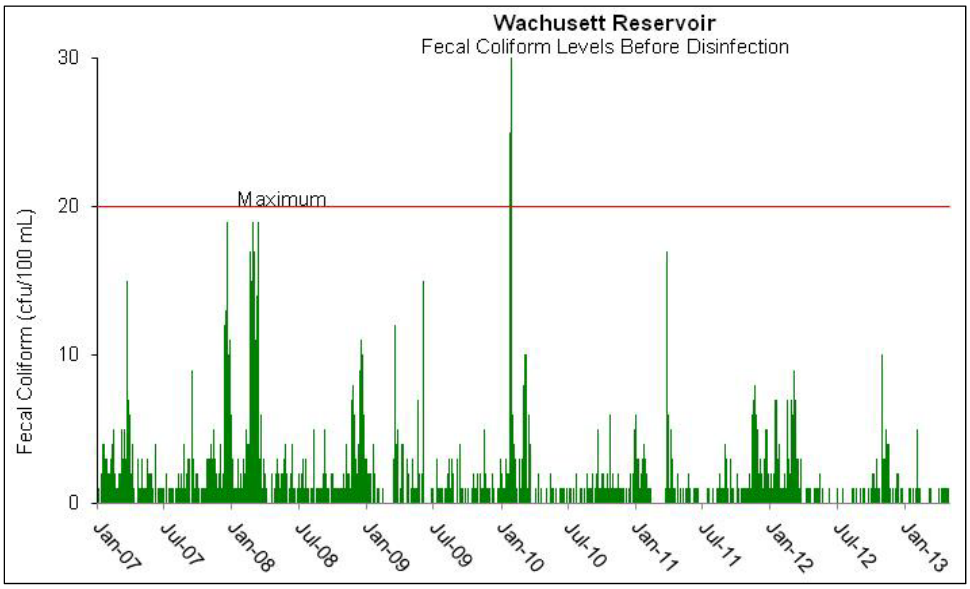
Figure 2-7: Quabbin Fecal Coliform Bacteria Concentrations 2007-2013



Source: MWRA

A sample above 20 cfu/100 ml is an unusual occurrence that is usually due to extreme weather conditions which may also prevent active gull harassment by DWSP crews. Similarly, there have been a few instances of single samples that exceed the standard at Wachusett Reservoir, as shown in Figure 2-8.

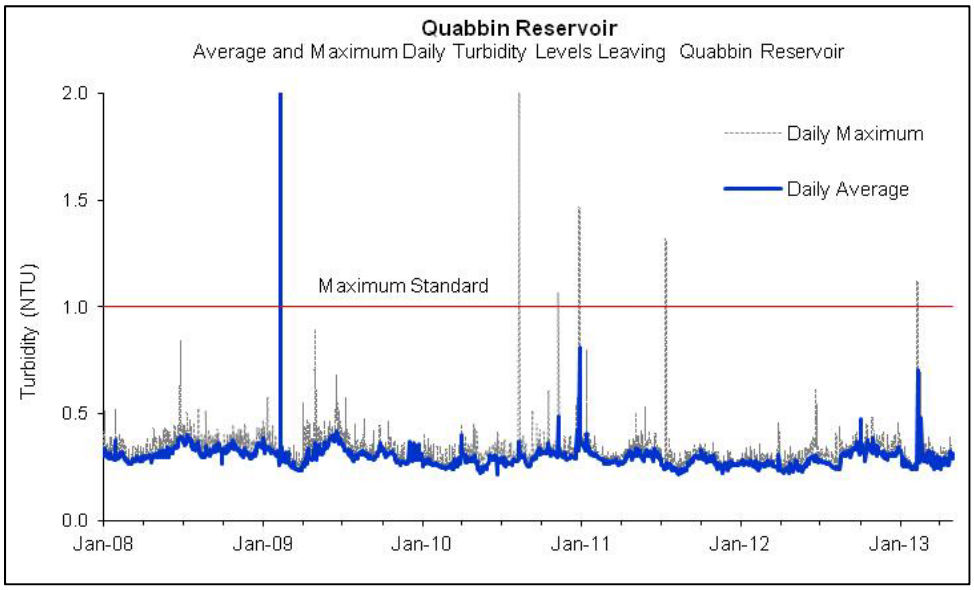
Figure 2-8: Wachusett Reservoir Fecal Coliform Concentrations 2007-2013



Source: MWRA

There are two standards for turbidity: all water must be below 5 NTU (Nephelometric Turbidity Units), and water only can be above 1 NTU if it does not interfere with effective disinfection. Figure 2-9 depicts daily maximum and average turbidity levels for 2008-2013 at Quabbin Reservoir. Turbidity levels averaged well below the 1.0 NTU standard, shown by a horizontal line on the graph. Large turbidity spikes are infrequent and short-term; they can be attributed to severe weather events or operational impacts. None of the turbidity spikes interfered with disinfection and no violations of drinking water standards occurred.

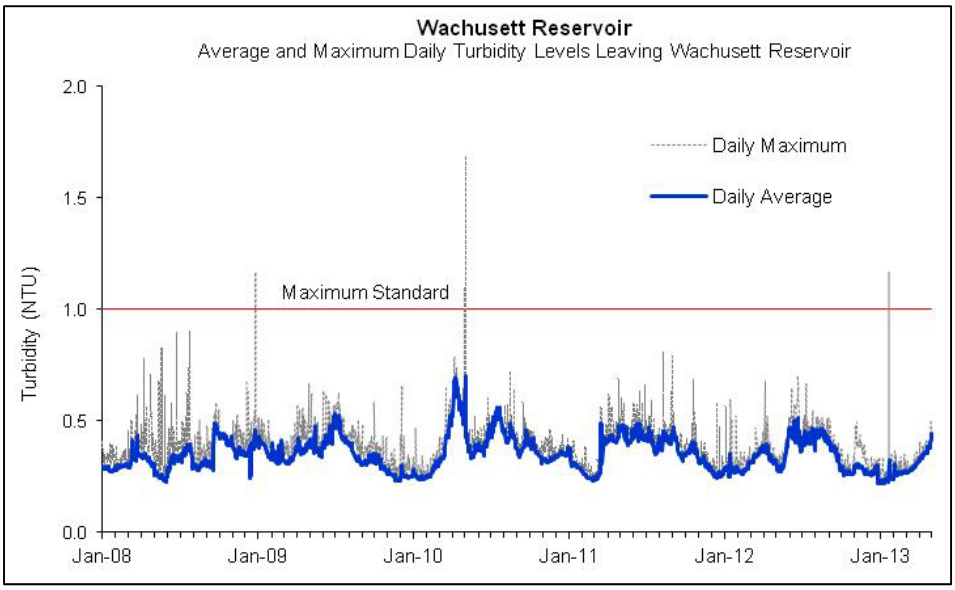
Figure 2-9: Quabbin Reservoir Source Water Turbidity 2008-2013



Source: MWRA

Wachusett reservoir turbidity, measured at the Carroll Treatment Plant, generally is around 0.5 NTU. Turbidity values for 2008 through 2013 are shown in Figure 2-10.

Figure 2-10: Wachusett Reservoir Source Water Turbidity 2008-2013



Source: MWRA

2.4 Hydrology

Quabbin

Quabbin Reservoir was created by damming portions of the Swift River (Figure 2-11). There are three discharge locations from the reservoir: the release to the Swift River, the discharge through the Chicopee Valley Aqueduct (CVA)to provide water to three western MA communities, and the discharge through the Quabbin Aqueduct to Wachusett Reservoir and, ultimately, the communities in metropolitan Boston. Quabbin reservoir is fed by streams in its watershed as well as transfers from the Ware River. The spillway discharges to the Swift River.

Ware

Waters from the Ware River can be diverted to the system (Figure 2-12). Water is collected at Ware River Intake and transported to Quabbin Reservoir via the Quabbin Aqueduct. Although water could also be diverted from Ware River to Wachusett Reservoir, it is DWSP and MWRA operating policy to divert only to Quabbin.

Wachusett

More than fifty percent of annual inflow into Wachusett Reservoir is from the Quabbin Reservoir; an additional thirty percent is provided by the Stillwater and Quinapoxet Rivers (Figure 2-13). Quabbin transfers, Quinapoxet River and Stillwater River all enter the reservoir through the Thomas Basin and pass through a constriction under the Route 12 Bridge. Water in the Wachusett Reservoir is assumed to have an approximate six month residence time, although during stratified conditions cold water transfers from the Quabbin Reservoir can pass through the reservoir in as little as three weeks. This phenomenon is called the Quabbin interflow and has

been extensively studied by DWSP and MWRA staff. The Wachusett spillway discharges to the Nashua River.

Sudbury

The major hydrologic inputs to the Sudbury and Foss reservoirs are the natural watershed drainage and the flow from the Wachusett Aqueduct and Open Channel (Figure 2-14). Water flows from the Sudbury to the Foss. Overflow from the Foss will enter into the Stearns Reservoir and eventually flow into the Sudbury River.

DWSP and MWRA cooperate with U.S. Geological Survey to maintain continuous, real time recording gages at a total of ten sites. Data from the sites are used to monitor hydrologic inputs and mandated releases. A summary of information about the gages is presented in Table 2-5. Continuous, real-time data for each station are available at the USGS web site, http://waterdata.usgs.gov/ma/nwis/current/?type=MWRA&group_key=basin_cd.

Table 2-5: USGS Stream Gages

Station #	Location	Utilization	Parameters
01170500	Connecticut River at Montague City	Required for decisions on Ware River Transfers	Stage-Discharge
01174500	East Branch Swift River near Hardwick	Streamflow monitoring	Stage-only
01174565	West Branch Swift River near Shutesbury	Streamflow monitoring	Stage-Discharge
01175500	Swift River at West Ware	Monitors Quabbin Reservoir release to Swift River and downstream conditions	Stage-Discharge
01173000	Ware River at Intake Works near Barre	Required for decisions on Ware River Transfer	Stage-Discharge, Temperature
01095220	Stillwater River at Sterling MA	Streamflow monitoring	Index-Velocity, Temperature, Conductivity, Precipitation
01095375	Quinapoxet River near Holden, MA	Streamflow monitoring	Stage-Discharge, Temperature, Conductivity, Precipitation
01095434	Gates Brook near West Boylston	Streamflow monitoring	Stage-Discharge, Temperature, Conductivity
01095503	Nashua River at Water Street at Clinton	Monitors Wachusett Reservoir release to Nashua River and downstream conditions	Stage-Discharge, Temperature
01098530	Sudbury River at Saxonville, MA	Monitors Sudbury Reservoir release to Sudbury River	Stage-Discharge

Figure 2-11: Quabbin Reservoir Watershed Hydrology

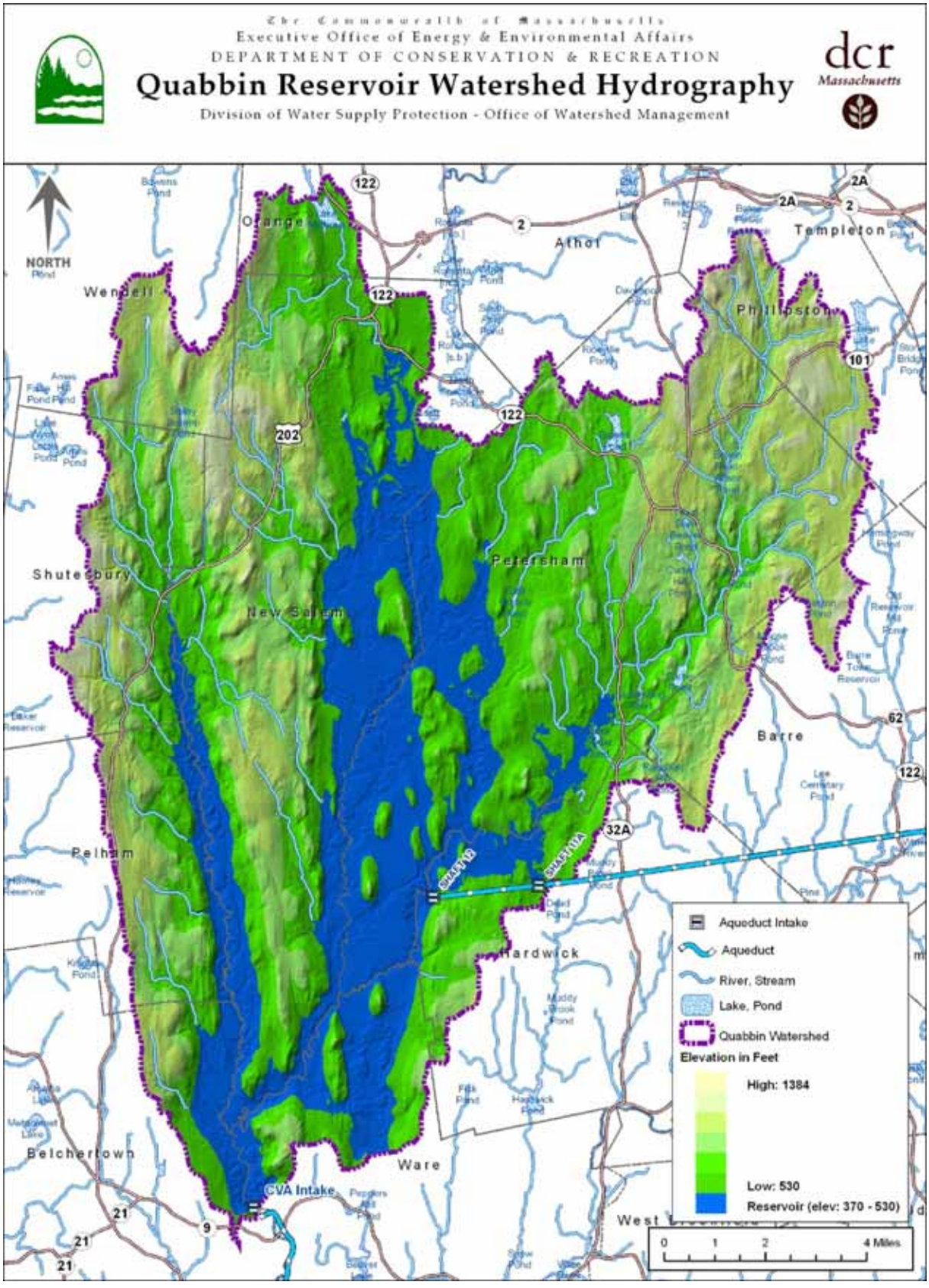


Figure 2-12: Ware River Watershed Hydrology

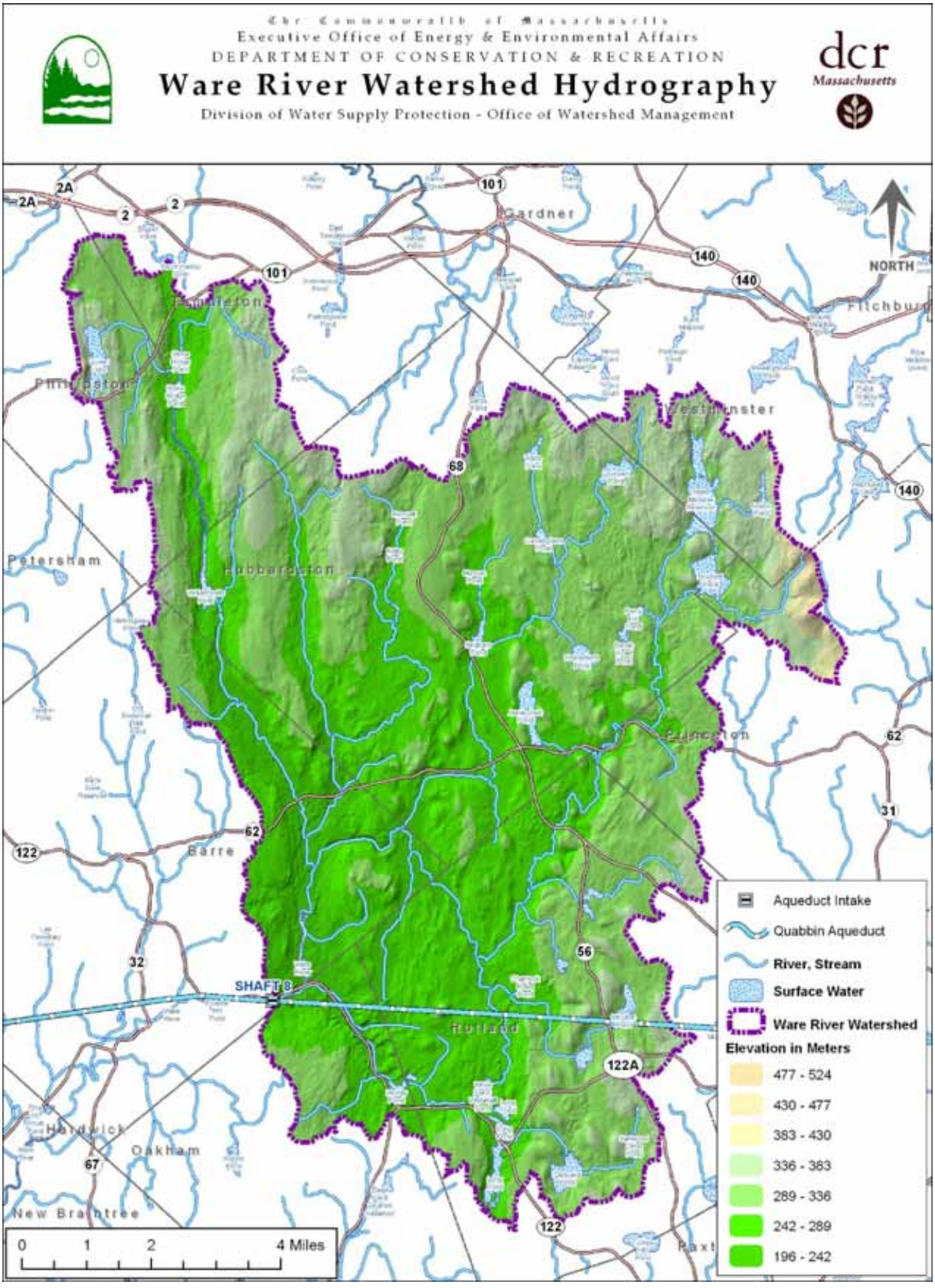


Figure 2-13: Wachusett Reservoir Watershed Hydrology

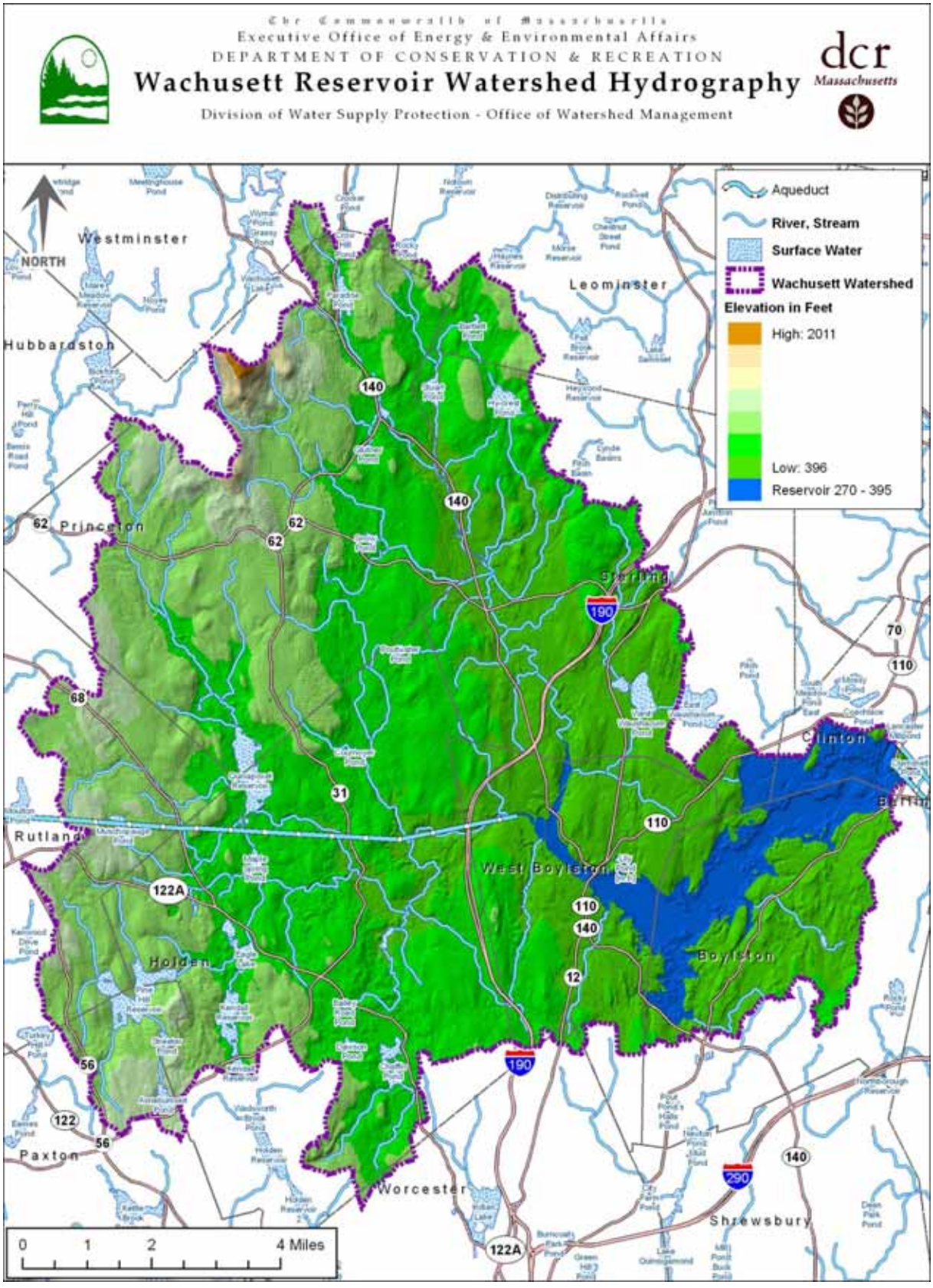
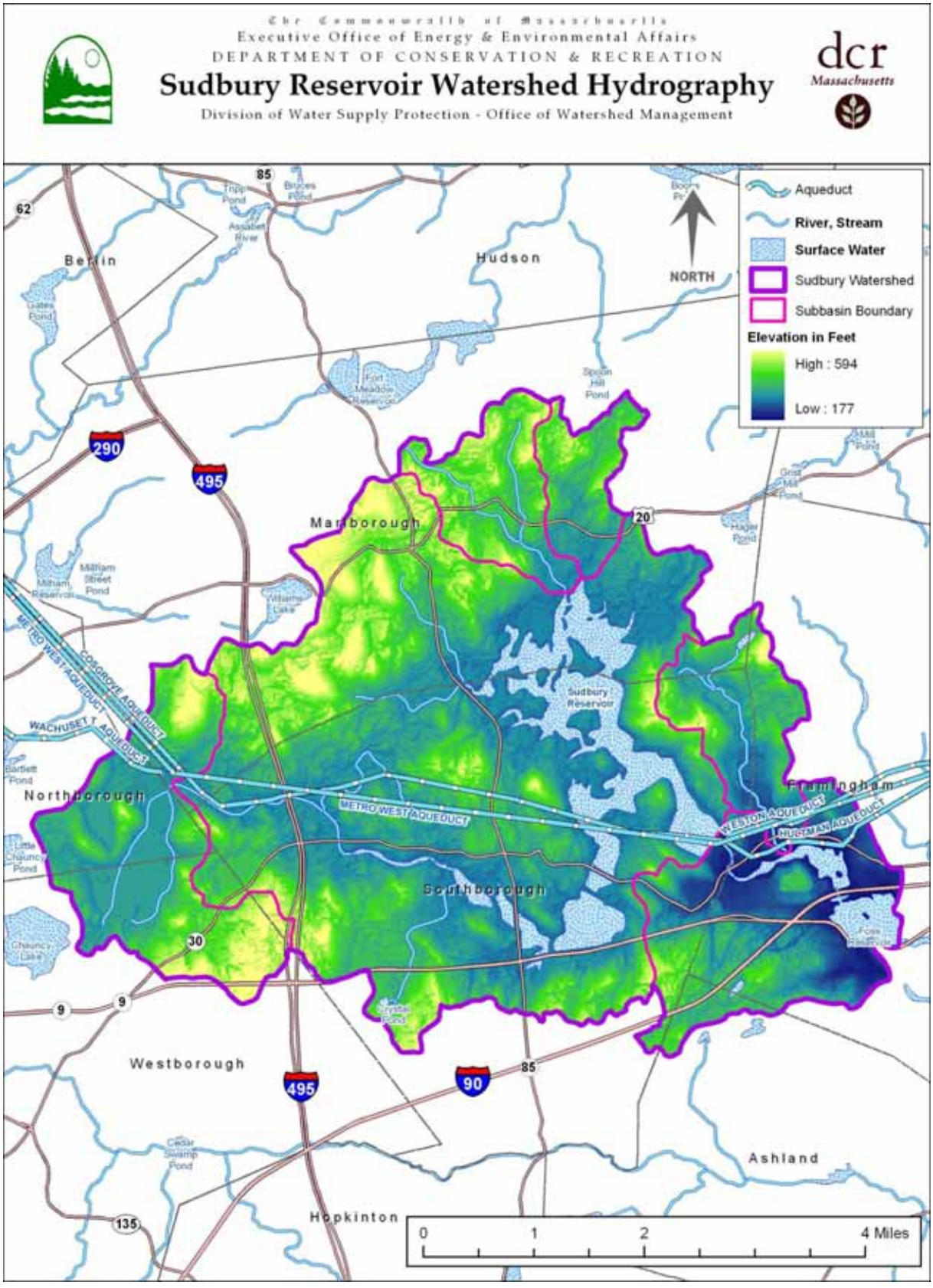


Figure 2-14: Sudbury Reservoir Watershed Hydrology



2.5 System Operation and Safe Yield

DWSP partners with the MWRA to deliver water to a total of 2.5 million people and 5,500 industrial users in 51 communities. There are two distribution systems supplied by the DWSP system. The Chicopee Valley Aqueduct is fed by the Quabbin Reservoir and supplies three communities in western Massachusetts. Quabbin water is also transferred east, through the Quabbin Aqueduct to Wachusett Reservoir, where it enters the Cosgrove Intake to travel to communities in the east. MWRA provides ozonation for primary disinfection, chloramination for residual disinfection, corrosion control, and fluoridation at the John J. Carroll Water Treatment Plant in Marlborough prior to delivery to municipalities in the Boston region. The safe yields from each source are summarized in Table 2-6.

Table 2-6: Safe Yield and Withdrawals from Supply Sources

	Source	Watershed Land Area (sq. mi.)	Watershed Yield (mgd)
Active System	Ware River	97	47
	Quabbin Reservoir	149	195
	Wachusett Reservoir	111	127
	Total	401	369
Emergency System	Sudbury Reservoir	21	N/A
	Foss Reservoir	5	N/A

Source: DWSP and MWRA

Due to the large storage volumes, 300 million gallons per day (mgd) can safely be supplied constantly by this system, even with release requirements and operational constraints. Withdrawals for water supply peaked in 1980 at 340 mgd, but have come down substantially due to MWRA's demand management programs. In 2012, the average system withdrawal was 194.7 mgd. Monthly water use data is available on the MWRA's website at www.mwra.com.

DWSP and MWRA staff coordinate to make systems operations decisions. Two interagency groups have been established to facilitate this work: the Reservoir Operations Group (Res Ops) and the Water Quality Sampling and Analysis Team (WQSWAT). Examples of the issues dealt with by these groups include establishing a normal range of reservoir elevations for Wachusett Reservoir, decision-making for initiating Quabbin transfers, developing reservoir treatment thresholds for taste and odor organisms, coordinating security and emergency-response capabilities, and developing watershed water quality sampling programs.

Emergency System

The Sudbury and Foss Reservoirs remain the only emergency drinking water source reservoirs for over 2 million residents of Eastern Massachusetts. There are three conditions under which these reservoirs would be used as an emergency source for the Boston area:

1. Wachusett Reservoir is declared non-potable.
2. The inability to convey water from the Wachusett Reservoir to the MWRA system.
3. Serious drought.

The combined resources of Sudbury and Foss Reservoirs could provide an estimated long-term safe yield of 18.0 mgd and could provide a rate of 200 mgd for a maximum of 30 days before virtual depletion of these sources. Water quality will be an issue should any of the emergency scenarios occur. In the event of a serious drought, low water levels in Sudbury would be anticipated to result in higher temperatures, greater algae blooms, and taste and odor problems.

The potential for the Sudbury system to be utilized will decrease once the overhaul of the Hultman Aqueduct (scheduled to be completed in 2014) and valve chambers to connect the aqueduct to the newer MetroWest Tunnel are completed. After completion of this project, MWRA will have the ability to divert water from the tunnel to the aqueduct should circumstances warrant. Wachusett Reservoir water flows to the Carroll Water Treatment Plant primarily via the Cosgrove Tunnel. The likelihood of aqueduct failure and vulnerability from Wachusett Reservoir contamination have been reduced because the upgraded Wachusett Aqueduct can also deliver water for treatment and distribution. If used, however, water would need to be treated at Wachusett Lower Gatehouse prior to entering the MetroWest tunnel or Hultman Aqueduct because the Wachusett Aqueduct elevation is below the Carroll Water Treatment Plant treatment tanks. MWRA is currently in the planning stages to construct a pump station that will bring Wachusett Aqueduct water up to the Carroll Water Treatment Plant.

3. Watershed Protection Program

DWSP and MWRA use a multi-barrier approach to protect the water supply system. The multi-barrier approach is defined as an integrated system of procedures, processes, and tools that collectively prevent or reduce the contamination of drinking water from source to tap in order to reduce risks to public health. The multi-barrier approach relies on integrated programs that prevent contamination of drinking water at all points in the system, from source to tap. Source protection is guided by the DWSP watershed protection program. Water treatment is provided at the John J. Carroll Water Treatment Plant at Walnut Hill in Marlborough and the Ware Water Treatment Facility in Ware. Distribution pipeline maintenance and improvement program ensures that high-quality is maintained to the tap.

As an unfiltered water supply, the DCR/MWRA system must comply with federal drinking water regulations. The Surface Water Treatment Rule (SWTR, June 1989) essentially requires filtration of all surface water supplies, but allows filtration waivers if specific criteria are met. One of the criteria required for unfiltered public water systems is an effective watershed control program that can preserve high quality source water through control of pollutants in the watershed.

DWSP and its predecessor agencies have understood the importance of watershed protection. Historically, watershed protection programs have been described and managed in a variety of programs and documents including Sanitary Surveys and Land Management Plans. Development of Watershed Protection Plans began in 1990 in response to requirements of the SWTR. The history of these plans is described in previous reports, listed in the Reference section. The organization of the plan has evolved over time, but the general approach remains similar and is described in this chapter.

The 2013 Watershed Protection Plan Update, like all previous Watershed Protection Plans (1991 Quabbin; 1991 Wachusett; 1998 Wachusett; 2000 Quabbin; 2003 Wachusett; and 2008 Watershed System) follows Massachusetts Department of Environmental Protection (DEP) guidance for developing an unfiltered water supply system's watershed protection plan. DCR's Watershed Protection Plans are reviewed and approved by DEP as part of its oversight of the DCR/MWRA water supply. Implementation of these Watershed Protection Programs is regularly reviewed by DEP as part of their annual inspection of the DCR/MWRA system. Two watershed inspections are conducted annually by DEP, one on the Quabbin Reservoir watershed, as it directly serves three towns via the Chicopee Valley Aqueduct, and the other on the Wachusett Reservoir watershed, as the terminal source reservoir for the metropolitan Boston drinking water supply.

DEP classifies Sudbury and Foss Reservoirs as Emergency Water Supply Sources. There is no current plan to re-activate the reservoirs as a permanent active source, nor are there regulatory requirements for a watershed protection plan for Emergency Water Supply Sources. Nevertheless, the Sudbury and Foss Reservoirs are valuable resources for which DWSP conducts several watershed management programs and helps enforce other pertinent environmental regulations concerning wetlands and wastewater. The level of protection, however, provided through these programs are lower than for the active water supply.

The *2013 DWSP Watershed Protection Plan Update* provides a systematic approach to evaluate potential water quality threats and to develop and implement programs that eliminate or minimize these threats. Priorities for watershed control programs change as water quality threats are contained and new issues emerge. The process used to develop Watershed Protection Plans provides a structured methodology to assess changes in watershed threats, develop programs to address the threats, and review staff assignments to ensure that staff priorities align with current watershed issues. This *2013 DWSP Watershed Protection Plan Update* outlines major goals and programs for Fiscal Year 2014 through 2018 (July 1, 2013 through June 30, 2018).

3.1 Pollution Sources and Assessment

DWSP staff identify activities or conditions that could degrade water quality and develop strategies to control these threats on a daily basis. The process undertaken in developing the *2013 DWSP Watershed Protection Plan Update* provides a longer term and systematic approach to evaluating threats and developing comprehensive, integrated programs to deal with the threats. The original threat assessment for watershed protection plan development was conducted in 1991, following guidelines developed by DEP. Assessments were repeated in 1998, 2003, and 2008 for Wachusett Reservoir and 2000 and 2008 for Quabbin Reservoir and Ware River. The process was reviewed and updated with each plan to better assess potential sources of contamination in the watersheds.

The basic assessment approach consists of three steps:

1. Compile a list of potential land uses that could degrade water quality. Identify pollutants or contaminants of concern that are associated with each activity. This pollutant list is not intended as a comprehensive inventory of water quality threats from activities or uses; rather it is developed as a tool to assist in conducting the evaluation.
2. Conduct a watershed-wide review to update the status of the activities identified as potential cause of concern in Step 1.
3. Conduct a screening level review to evaluate the threats. This is a qualitative evaluation that incorporates relevant water quality data collected since the last assessment and staff input of field observations made during the same period. Assign a ranking of Low, Medium or High.

It is very important to note that this is a tool used by DWSP and other watershed managers as part of a comprehensive planning process to develop control programs and prioritize efforts. It is a difficult process where staff strive to be vigilant for potential threats but not unnecessarily alarm users or regulators about conditions in the watershed. DWSP staff, with this iteration of the *Watershed Protection Plan Update*, have made the evaluation under a hypothetical scenario where the existing DWSP control programs do not exist. Because DWSP has an extensive watershed protection program in place, the rankings should not be interpreted as the actual risk to the DWSP system.

The source categories developed for use in this assessment are summarized in Table 3-1. As with the pollutant categories, this list was developed as a screening tool and is not intended as a definitive catalog. It was developed with the intention of encompassing all potential pollution sources in order to develop a comprehensive protection program.

Table 3-1: Potential Contaminant Source Categories

Activity	Concern
Wildlife	Threat to water quality from wildlife populations. *Examples: the direct threat of pollution from bird and aquatic mammal waste; indirect threats to water quality such as over browsing by herbivores and unstable beaver dams.*
Public Access/ Recreation	Threat to water quality from public access on publicly owned properties. *Examples: erosion from off road vehicles; waste from humans or animals; trash disposal and dumping.*
Timber Harvesting/ Forestry	Threat to water quality from timber harvesting activities. *Examples: harvesting within wetlands and riparian zones; road and landing construction and use; stream crossings; mechanical preparation for tree planting; spills from power equipment.*
Wastewater	Threat to water quality from wastewater treated in on-site systems or transported via sewers to (off-watershed) wastewater treatment plants. *Examples: leachate from failing or improperly sited on-site septic systems; release of untreated sewage from a sewer or pump station.*
Roadways, Railways and Rights-of-Way	Threat to water quality from roads and railways. *Examples: pollutants transported by stormwater runoff; releases of fuel or transported products caused by accidents; maintenance practices such as herbicide treatment of ROWs.*
Agriculture	Threat to water quality from growing and harvesting crops and keeping livestock. *Examples: horse stables; kennels.*
Construction	Threat to water quality from construction activities on a site. *Examples: earth moving with inadequate erosion and sediment controls; releases from construction equipment; introduction of invasive species through use of inappropriate erosion controls.*
Commercial, Industrial, and Governmental Sites	Threat to water quality from activities on sites in commercial, industrial, or governmental use. *Examples: runoff due to increased impervious surfaces; release of materials stored and used on site.*
Residential Sites	Threat to water quality from practices associated with land in residential use. *Examples: nutrient and pesticides from lawn care products; pet waste; pharmaceuticals and personal care products (PPCPs) from on-site wastewater disposal systems; use of non-native species in landscaping or aquaria.*
Future Growth	Threat to water quality from development of land that is currently undeveloped. *Examples: potential contaminants related to property development, which could be residential, agricultural, commercial, or industrial.*
Climate Change	Threat to water quality from impacts of climate change. *Examples: higher water temperatures; changes in the timing, intensity, and duration of precipitation.*
Security Threats	Threat to water quality from malicious attempts to contaminate water.

DWSP created five categories of pollutants that are most likely to be associated with these threats and share common properties for the purpose of this screening. These categories are based on conventional definitions which have been adapted to incorporate practical aspects in order to assess potential sources and develop protection programs. The five water quality pollutants categories are: Pathogens, Nutrients, Turbidity, Anthropogenic Compounds, and Invasive Species. This discussion is not definitive; it is developed as a tool to help conduct the threat assessment.

Pathogens

Pathogens are biological agents that can cause illness or disease. Indicator organisms are commonly examined, as pathogens are difficult and expensive to test in water. Such tests "indicate" possibility of presence of pathogenic compounds. Prevention of pathogen contamination is a high priority for water suppliers. Extensive watershed and reservoir testing using indicator organisms is conducted by DWSP and MWRA, and is summarized in Table 3-2.

Table 3-2: Bacteria Testing Summary

Sample Location	Agency	Test	Standard
Intake to Carroll Treatment Plant and Chicopee Valley Aqueduct	MWRA	Fecal Coliform	Federal Surface Water Treatment Rule (SWTR): Fecal coliform concentrations at a reservoir intake of an unfiltered system shall not exceed 20 colonies per 100 ml in 90 percent of the samples in any six month period.
Reservoir	DCR	Fecal Coliform	Massachusetts Water Quality Standards (314 CMR 4.00): Water supply intakes in unfiltered public water supplies requires either fecal coliform shall not exceed 20 fecal coliform organisms per 100 ml in all samples taken in any six month period, or total coliform shall not exceed 100 organisms per 100 ml in 90% of the samples taken in any six month period. If both fecal coliform and total coliform are measured, then only the fecal coliform criterion must be met.
Stream	DCR	*E. Coli*	Massachusetts Water Quality Standards (314 CMR 4.05c): The geometric mean of all *E. coli* samples taken within the most recent six months shall not exceed 126 colonies per 100 ml, typically based on a minimum of five samples, and no single sample shall exceed 235 colonies per 100 ml.

Nutrients

In discussions of water quality, DWSP uses the term nutrients as a category of chemical compounds that promote aquatic plant growth, primarily certain forms of phosphorus and nitrogen. Elevated levels of nutrients and the subsequent increase in aquatic plant growth can be deleterious to aquatic life and can impact drinking water quality. DWSP uses Total Phosphorus, Ammonia-nitrogen and Nitrate-nitrogen to evaluate the nutrient levels in the watershed streams and reservoirs. DWSP collects nutrient samples from the reservoir and its tributaries.

Turbidity

Turbidity is a measure of the clearness of a solution. Material suspended in water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt, and

sand), algae, plankton, microbes, and other substances. Turbidity samples are collected from watershed streams as part of routine sampling and in special studies to evaluate specific issues, such as monitoring the effectiveness of erosion controls at a construction site. Samples collected for turbidity are analyzed by DWSP staff using a turbidity meter.

Anthropogenic Compounds

There are many non-natural chemicals that pose potential threat to the drinking water supply. These compounds are often defined relative to the environmental laws that regulate the compounds. These materials are grouped in a category called Anthropogenic Compounds for the purpose of this assessment. The category includes hazardous materials, pesticides, and Pharmaceuticals and Personal Care Products (PPCPs) as pollutants. DWSP does not routinely monitor for any anthropogenic compounds in the reservoirs, however MWRA routinely monitors for many of these items in the finished water.

Aquatic Invasive Species

The US Department of Agriculture defines invasive species as a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., microbes). For water quality considerations, DWSP is primarily concerned with Aquatic Invasive Species (AIS). DWSP monitors extensively for AIS; MWRA has funded extensive AIS control efforts at Wachusett Reservoir since 2002 in addition to reservoir-wide surveys to detect new invasives.

The potential sources of water quality contaminants most likely to be associated with the activities identified are presented in Table 3-3.

Table 3-3: Potential Sources of Water Quality Contaminants

	Contaminant				
Source	**Pathogens**	**Nutrients**	**Turbidity**	**Anthropogenic Compounds**	**Aquatic Invasive Species**
Wildlife	●	●	●		●
Public Access/Recreation-	●	●	●	●	●
Timber Harvesting			●	●	
Roadways/Railways/ROWs			●	●	
Agriculture	●	●	●	●	
Construction			●	●	
Commercial, Industrial, and Governmental Sites	●		●	●	
Residential Sites	●	●		●	
Wastewater	●	●		●	
Future Growth	●	●	●	●	●
Climate Change	●	●	●		●
Security Threats	●			●	

DWSP staff conducted a review of each watershed to assess the potential threat from the pollution sources described above. The assessment process provided important information that was used to update the watershed control programs. The following is a brief summary of the detailed description developed for each watershed along with the ranking of the potential threat to water quality in each watershed. This assessment is summarized in Table 3-4.

3.1.1 Wildlife

Wildlife populations can directly threaten water quality through bacterial contamination from bird and mammal feces and unstable beaver dams and indirectly through herbivore over-browsing that impacts forest regeneration. Pollutants most likely to be created or spread by wildlife are pathogens, nutrients, turbidity, and invasive species. Burrowing mammals are a threat to infrastructure and also are considered in the threat assessment.

Quabbin

The types of wildlife most closely monitored at Quabbin are: 1) ring-billed gulls, herring gulls, great black-back gulls, Canada geese, and other waterfowl; 2) beaver and muskrat; and 3) white-tailed deer and moose. The threat of wildlife within the Quabbin Reservoir watershed is assessed through a wide range of monitoring activities and protection procedures to document their presence, type, and activity. General and systematic monitoring is conducted on a daily basis in the water quality monitoring program, on a weekly basis in the CVA Shoreline Weekly Survey (looking for nuisance animals), on a biweekly basis in the watershed monitoring program, and a monthly basis in the reservoir monitoring program. Targeted monitoring and protection activities are conducted through the Gull Harassment Program, the Canada Goose Population Control Program, Aquatic Pathogen-Free Control Zone Program, and the White-tailed Deer Management Program.

2013 Watershed Program System-wide Assessment of Importance for Planning: High.

Ware

Data on the wildlife resources and their impacts in the Ware River Watershed come from surveys (e.g., monitoring of moose sign, aquatic invasive surveys of ponds and rivers), staff reports (e.g., about beaver-plugged road culverts), observations made during Environmental Quality Assessments, and via water quality sampling results. Additional data comes from the New England Research Institute for Moose and Forest Dynamics at UMASS-Amherst and from the Division of Fisheries & Wildlife.

When water sampling data has elevated bacteria counts, staff conduct field investigations to determine the source. The elevated results are frequently attributed to beavers and their habitat; mitigation is performed as necessary.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Wachusett

Wachusett, similar to Quabbin, provides a daytime loafing area and nighttime roosting site for a large number of gulls, geese, ducks, and cormorants. Numbers generally begin to increase in late summer and early fall and reach a maximum of up to several thousand gulls during the winter months when other water bodies freeze. Nesting populations of resident geese utilize the reservoir shoreline and islands. Pathogens and nutrients from avian feces are a significant threat to water quality.

Beaver can cause localized damage to roads, culverts, and trees, and catastrophic beaver dam failure can lead to downstream flooding and elevated concentrations of nutrients, bacteria, and sediment. Burrowing by beaver, muskrat, and other mammals has the potential to damage dikes or dams.

Expanding deer populations may pose a concern within areas of the Wachusett Reservoir watershed, though it is doubtful that large-scale problems observed in the Quabbin watershed would occur at Wachusett. There have been no documented concerns regarding the amount or diversity of tree regeneration, although there are indications of localized severe browsing. No other animal species have been deemed potential problems in the watershed.

2013 Watershed Protection Program Assessment of Importance for Planning: High.

Sudbury

As a mostly urban/suburban watershed, the wildlife issues present in the Sudbury system are not as varied as those in the Quabbin Reservoir, Ware River, or Wachusett Reservoir watersheds. As an emergency water supply, there is less need to manage for water quality impacts from wildlife on the reservoir. In fact, DWSP holdings represent some of the largest blocks of contiguous, protected wildlife habitat in the area, contributing significant value for protecting biodiversity in this region.

The most serious threat to water quality that is actively managed by DWSP is the resident Canada goose population on the Sudbury Reservoir. Data collected by DWSP Natural Resources Staff indicates that the Sudbury and Foss Reservoirs are used by roosting gulls on a regular, but intermittent basis. In the event that this system was to go on-line as an emergency supply, particularly during the fall or winter months, it may be necessary to assess the extent of the roosting and/or, if conditions warranted, initiate a harassment program. Control of burrowing animals is important in the Sudbury system.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.2 Public Access/Recreation

Public access is the human presence and activities on DWSP owned lands and waters. The potential threat to water quality from public access and recreation comes both from allowed (e.g., hiking) and prohibited (e.g., swimming, dumping) activities. Pollutants most likely to be introduced to water resources due to public access and recreation are pathogens, nutrients, turbidity, and invasive species.

Quabbin

Recreation, both passive and active, by the general public is the most common public access activity on Quabbin lands and waters. Presently the most popular land based activities at Quabbin include driving for sight-seeing, hiking, and bird watching. Increasingly popular land activities appear to be bicycling and geocaching. Popular water-based activities include boat fishing and bird watching. Unauthorized activities on both DWSP lands and waters are considered a potential threat to water quality.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Ware

Public access and recreational activities are allowed on designated portions of DWSP's Ware River watershed lands, but is most popular in the areas closest to Route 122. Information on public access and recreation comes largely from staff observations, public interactions, and Watershed Rangers. Recreation is an activity of particular concern due to an increase in uncontrolled and/or unauthorized access or use, the expansion of snowmobiling and horseback riding, and the extension of a rail trail.

Substantial staff time is now spent dealing with recreational issues, including impact control, working with user groups, and resolving user conflicts. Unrestricted public access can result in dumping and vandalism problems on the watershed. Access to the more remote portions of the watershed is obtained when gates are open for legitimate DWSP activities. Partying, vandalism, and dumping has been an issue in recent years. Off-road vehicle (ORV) usage is occurring illegally in the watershed, resulting in soil erosion, direct water pollution from vehicles driving through streams, littering, and passage into areas not readily accessible to the public. All these impacts are potentially problematic.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

The *Wachusett Reservoir Watershed 2011 Public Access Plan Update* describes the current status of recreational activities on DWSP lands in the Wachusett watershed. The most popular activities on DWSP lands include hiking, fishing, geocaching, and biking. Many other activities, including hunting and trapping, boating, and horseback riding are not allowed, or allowed in limited areas. Enforcement of DWSP public access regulations and assessment of impacts from public access on DWSP land is done primarily by the Watershed Rangers. Watershed Rangers interact with the public to prevent or reduce inappropriate recreational uses.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury

The Sudbury land holdings are a popular area for the surrounding watershed communities, which are much more highly populated than any other part of the system. Wachusett/Sudbury Ranger staff regularly patrol to enforce DWSP public access requirements. Illegal swimming chronically occurs at certain spots around the two reservoirs, in particular the train trestle crossing the Foss Reservoir. Boating violations mostly occur from the launching of small craft at

nearby roadways or adjacent private lands. Shoreline fishing is currently allowed along most of the Sudbury Reservoir shoreline, with a fishing season that runs from the first Saturday in April until November 30 each year, provided no ice is present.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.3 Timber Harvesting

The maintenance and diversification of forest cover is an excellent strategy for supporting watershed protection efforts. Timber harvesting in Massachusetts is a highly regulated and controlled activity by the MA Forest Cutting Practices Act (FCPA; MGL Chapter 132, §§ 40-46 and 304 CMR 11.00). DWSP lands have several additional layers of water quality protection that are outlined in the Land Management Plans for each watershed. Active silviculture can have deleterious impacts on water quality when it involves harvesting in wetlands and riparian zones, road and landing construction and use, stream crossings, mechanical preparation for the planting of trees, and spills from power equipment. The pollutants most likely introduced to the watershed through timber harvesting are turbidity and anthropogenic compounds. However, due to the extensive regulation and review of timber harvesting on both DWSP and private lands, this activity is rated as a low potential risk to water quality in all four watersheds.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

3.1.4 Highways/Railways/ROW

The threats to water quality from roads, railways, and Rights-of-Way (ROWs) include pollutants transported by stormwater runoff, releases of fuel or transported products caused by accidents, and maintenance practices such as herbicide treatment of ROWs or sand and salt application for ice and snow treatment. The construction of new roadways or improvements to existing ones can lead to problems with erosion and sedimentation unless adequate management practices are utilized.

An emerging issue that has surfaced since development of the last plan is ethanol transport by tanker truck and rail lines. According to the Massachusetts Department of Fire Services, ethanol has become the fastest growing commodity in transportation which requires unusual firefighting equipment and causes unique environmental impacts. Ethanol is miscible in water and is soluble at any concentration, and will persist in the ground many years after a release or spill. The pollutants of concern related to Highways/Railways/ROW are turbidity, anthropogenic compounds, and invasive species.

Quabbin

In the Quabbin Reservoir watershed there are many locations where roads and streams intersect, and it is likely that a piped drainage outfall or paved chute empties directly into a tributary. Maintenance of these roads is the responsibility of Massachusetts Department of Transportation Highway Division (MassDOT), local communities, or DWSP; DWSP maintains over 200 miles of roads on its property. There are no functioning railways located in the Quabbin Reservoir

Watershed. Annual reviews of ROW maintenance plans are conducted for the three electrical utilities in the Quabbin Reservoir Watershed.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Ware

The issues of concern related to roadways, railways and other ROWs in the Ware River mainly relate to fuel or other hazardous material spills and the application of pesticides to control vegetation growth along those corridors. Despite the fact that the Ware River watershed is situated in a relatively rural part of Massachusetts, there are still a number of transportation and transmission corridors that pass through the watershed. These include six numbered state highways, many town roads, one active railway, and several electrical transmission lines. GIS data indicates that there are approximately 272 miles of roadways in the watershed, seven miles of active railroad lines, 12 miles of above-ground utility transmission lines and another 12 miles of underground cable line. These land uses represent linear access points into the heart of the watershed, many of which cross or run adjacent to streams, rivers, wetlands and other water bodies, that may also involve activities that are potentially harmful to water quality (e.g., vegetation control operations).

DWSP lands in the Ware River watershed have historically been much more open to vehicle access than its counterpart in either the Quabbin Reservoir or Wachusett Reservoir watersheds. This poses a particular challenge in regards to controlling illegal dumping, vandalism, and other access-related issues. Many of the town roads in the Ware River Watershed are dirt with country drainage, often draining directly to resource areas. Stormwater impacts along existing public ways, especially those adjacent to steep slopes, can be exacerbated under current statewide subdivision control laws which allow "Approval Not Required" house lots (MGL c. 41, §§81L and P), as there are no requirements for improved drainage with this common form of development.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

There are nearly 500 miles of primary and secondary roadway and almost thirty miles of railroad tracks in the Wachusett watershed. The transportation of hazardous materials has a high potential risk to water quality due to the proximity of a number of roadways and railroads to the reservoir. Construction of Best Management Practices (BMPs) and reconfiguration of drainage pathways has removed some direct discharges to the reservoir and consequently reduced the risk from an accidental release. Local fire departments have been provided access to emergency response materials by the DWSP to help prevent any hazardous materials spilled from reaching the reservoir.

2013 Watershed Protection Program Assessment of Importance for Planning: High.

Sudbury

There are over 265 miles of roads throughout the Sudbury and Foss basin. Two of Massachusetts's major thoroughfares bisect the watershed: the Massachusetts Turnpike, running east/west, and Interstate 495, running north/south. There are also four heavily traveled state numbered routes that pre-date the modern highways: Rte. 9, Rte. 20, and Rte. 30 running east/west, and Rte. 85, running north/south. Approximately 9 miles of rail line operated by CSX runs in a east/west direction across the watershed. The rail line and the Turnpike both travel across the southerly section of the Foss Reservoir. Rte. 9 runs along the southern border of the two reservoirs, and Rte. 85 crosses the Sudbury Reservoir at its western arm near its connection with the Open Channel.

Marlborough Airport, a small public airport located close to the Sudbury Reservoir adds to the threat of emergency situations in the watershed. It consists of one runway, averages 37 flights per day, and has approximately 40 aircraft based at its field. A flight instruction operation is also located on site.

DWSP depends on the local public works departments, MassDOT, and CSX to safely operate their respective road or rail line. The most significant risk from this myriad of transportation corridors is an accidental spill of hazardous materials. DWSP utilizes an Emergency Spill Management Plan and protocol developed in association with MWRA and local responders. These procedures were utilized successfully in 2004 to contain a spill of diesel fuel from a school bus parking yard that drained directly to Foss Reservoir.

2013 Watershed Protection Program Assessment of Importance for Planning: High.

3.1.5 Agriculture

Threats to water quality from agriculture are related both to the keeping of livestock and to the cultivation and harvest of crops. This category also includes hobby farms, backyard horses, and kennels. Pollutants of concern from agriculture are pathogens, nutrients, turbidity, and anthropogenic compounds. The percentage of land in agricultural use is very low in all watersheds, and most of the agricultural operations are very small. DCR and DEP regulations (see Section 3.2.11) provide setbacks and buffers that further protect water resources.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

3.1.6 Construction

Threats from construction activities include earth moving with inadequate erosion and sediment controls, releases from construction equipment, and invasive species growth in disturbed areas. The pollutants of concern are turbidity, anthropogenic compounds, and invasive species. Construction is a threat to water quality from activities such as land clearing and earth moving for the creation of new driveways, access routes, drainage basins, septic systems, and building lots. These activities can be the source of nutrients and sedimentation. In addition, unprotected work sites during construction activities, coupled with inadequate erosion and sedimentation controls, can also yield turbidity and nutrients into nearby water bodies.

Quabbin
Over seventy percent of the watershed is protected open space, where new construction is not allowed. Areas where construction is possible have significant protection from zoning. Existing construction activity is principally residential, and has experienced a significant drop since 2008.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Ware
A few towns in the Ware River watershed have experienced rapid growth in recent years, at times overwhelming the ability of local boards to monitor and control construction activity. Although activity has fallen off since the recession of 2008, parts of the Ware River watershed are in what is known as the "Sprawl Frontier" of Boston and Worcester, an exurban area likely to continue growing.

A significant portion of the new construction in the watershed is occurring on hillsides that are less stable and thus more prone to erosion and sedimentation during the construction phase. In some cases the hillsides developed or slated for development lie directly above water resource areas with little or no intervening level uplands to mitigate the effects of construction-induced runoff.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett
Construction is still relatively active in the watershed. Identification of construction activities is accomplished through regular communication with local boards and commissions, review of Watershed Protection Act applications, Massachusetts Environmental Policy Act filings, and sites regulated through EPA Municipal Separate Storm Sewer Systems (MS4) and Construction General Permits.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury
The Sudbury watershed is in a very active area for construction and redevelopment of currently developed sites. In addition, DWSP land holdings are small and development has occurred in close proximity to the reservoirs.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.7 Commercial/Industrial/Government

Threats to water quality from activities on commercial, industrial, or governmental sites include increased runoff from large amounts of impervious surfaces commonly associated with these uses, and the potential release of materials stored and used on-site. Discharges to the ground via shallow injection wells or infiltration devices can lead to groundwater contamination and long-term water quality problems. Pollutants of concern most likely to be generated from commercial, industrial, and governmental sites are anthropogenic compounds.

Quabbin

Facilities evaluated in this category at Quabbin include automotive repair shops, a junk yard, community Department of Public Works garages, DWSP facilities, a saw mill, and gravel pits. There are a very limited number of these sites, and they are generally well regulated by DEP and local officials.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Ware

There are no active solid waste facilities in the Ware River watershed at the present time. There is one active landfill just off the watershed downstream of the Shaft 8 Intake. Recent EQA assessments identified an old, overgrown landfill in Templeton that was not properly closed.

Most commercial and industrial establishments in the Ware River watershed are small retail establishments, primarily located in the towns of Hubbardston and Rutland. There are a variety of governmental offices and other facilities in the watershed, including schools, town halls, libraries, fire stations, DWSP facilities, and town garages. In addition, there is a MassDOT maintenance facility located on the shore of Long Pond in Rutland that could be of concern if a spill should occur onsite. Numerous gravel pits are scattered throughout the watershed, evidence of the glacial history of the area.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

There are many businesses and industries within the Wachusett Reservoir watershed, mostly concentrated in a few areas of Holden and West Boylston, especially along Routes 12 and 122A. Governmental sites such as state and municipal office complexes, schools, highway department facilities, DWSP facilities, and public safety buildings are scattered throughout watershed communities.

The most recent listing from DEP includes nearly 100 facilities that either store hazardous materials (including flammable solvents, methyl ethyl ketone, denatured alcohol, metals, acids, trichloroethylene, and flammable inks) or generate hazardous waste. A database of storage tanks in watershed towns has been compiled using on-line information from the Department of Fire Services as well as local fire department records. There are currently 50 Underground Storage Tanks (USTs) in the Wachusett watershed (550 – 30,000 gallons), with a total capacity of more than 600,000 gallons. A total of 182 tanks have been removed from service. There are also a small number of registered above ground storage tanks in Holden, Princeton, and West Boylston.

DWSP has generated a comprehensive database listing all reportable releases of oil and other hazardous materials in the watershed and their clean up status. A total of 28 releases in the past five years include many at commercial and industrial sites. None of the releases reached tributaries or the reservoir. Clean up activities continue at a number of sites still considered active where Response Action Outcomes (RAOs) under the Mass Contingency Plan for clean-ups have not been achieved. The DEP has a database that lists all active, inactive, and closed landfills in Massachusetts, including four within the Wachusett Reservoir watershed.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury
There are several nodes of commercial and industrial activities in the Sudbury and Foss Reservoirs watershed, mostly clustered around the major transportation arteries of the Mass Turnpike, I-495, and Rt. 9. While many of these sites are in the western edge of the watershed, the Framingham Technology Park is situated adjacent to Foss Reservoir. Commercial activity also spreads along the length of Rt. 9 as it borders the two reservoirs, and there is a strip of commercial sites along Rt. 85 to the northwest of Sudbury Reservoir.

According to a 2010 study completed by the MetroWest Regional Collaborative and the Metropolitan Area Planning Council, it is noted that the Route 9 corridor along Southborough, Framingham, Natick and Wellesley has the potential to expand commercial space by 88 percent under current zoning by-laws. In addition, traffic would also be expected to grow by 40 percent with this development. While towns are pushing to increase this economic development, "smart growth" design would decrease commercial space, according to the Collaborative.

There are three closed or inactive solid waste facilities in the Sudbury basin. Spills or releases of hazardous materials of certain concentrations are reportable to DEP under the Mass Contingency Plan (MCP). DWSP monitors submitted reports of cleanup efforts and relays concerns to DEP as conditions warrant for these sites.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.8 Residential Sites

The threats to water quality from practices associated with residential use include nutrients and pesticides from lawn care products, unmanaged pet waste, disposal of pharmaceuticals and personal care products, and use of non-native species in landscaping or aquaria. The major pollutants of concern for residential sites are pathogens, nutrients, anthropogenic compounds and invasive species.

Quabbin
Residential use is quite limited in the Quabbin watershed at less than two percent of total land use. Although there can be some impact from residential sites, they are considered a low potential threat to water quality at Quabbin.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Ware
There are no indications of significant issues related to residential sites in the Ware River watershed except for occasional septic system failures or other localized problems. Some residential sites have had releases of oil from heating oil storage tanks. Encroachments, however, are a concern as homeowners sometimes "extend" their property onto adjacent state land. Encroachment onto DWSP lands is a long-standing issue with impacts throughout the watershed. Encroachment can range from mild – cutting of foot paths or trails – to severe – storing of excavators, digging, vehicles abandoned on DWSP property. One possible future concern related to residential development is the conversion of summer cottages to year-round

residences; there is the potential for water quality impacts, at least localized, since this often occurs along lake shores.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

Population in the Wachusett watershed has increased by about ten percent in the past ten years, with a majority of the growth taking place in Rutland and Holden. An increase in population means increased residential use and a subsequent increase in potential problems. Household pets, especially dogs, have been identified as a possible major source of pathogens in the Wachusett Reservoir watershed. Lawn care and large household gardens are a potential source of nutrients, pesticides, and herbicides, and in extreme cases can result in erosion and sedimentation problems. Control of insect or rodent pests in and around residential development can lead to contamination of groundwater and surface water. Household use of hazardous materials leads to an increased risk of accidents or inappropriate disposal.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury

Almost one third of the Sudbury watershed is in residential development, with over 140,000 residents in the five towns encompassing this watershed. Stormwater runoff from residential sites poses a risk to the water supply. Dumping into storm drains, pet waste, improper disposal and storage of hazardous materials, automobile fluid leaks, fertilizer and pesticide use makes its way into the reservoir via storm drains and tributaries during rain events. For example, during the summer of 2011, DWSP investigated a toxic algae bloom at the Sudbury Reservoir that was suspected to be related to lawn care practices on abutting properties.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.9 Wastewater

Human wastewater may be treated with on-site systems or connected to a sewer for treatment at a municipal wastewater treatment plant. Properly functioning on-site treatment systems should not cause contamination of either groundwater or surface waters. Recent studies have indicated that some chemical compounds, including Pharmaceuticals and Personal Care Products (PPCPs), may not be removed in septic systems. Municipal sewerage systems in the watershed system transport sewage out of the watershed. Municipal sewers can cause water quality problems from events such as breaks in sewer lines and sewer pump failures. The primary pollutant of concern in this category is pathogens. In addition, human wastewater can contain nutrients and anthropogenic compounds.

Quabbin

There are no sewered areas in the Quabbin Reservoir watershed. All homes and facilities are served by on-site wastewater disposal. Wastewater is considered a low potential threat to water quality given the overall low population density in the watershed and the current state-wide and watershed specific regulations in place for installation, repair, and conversion of septic systems.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Ware

Most towns in the Ware River watershed rely on on-site septic systems. Current Title 5 regulations, technological advances in septic system design and installation, and increasing oversight by local boards of health have improved over the past several years. As failed systems are identified, they are repaired or replaced with better-functioning systems. On small lots where space limitations prevent conventional systems (e.g., around lakes or ponds), failed systems or cesspools are commonly replaced by tight tanks, an improvement over pre-existing conditions.

Sewer lines exist in only two relatively small parts of the Ware River watershed – in and around the center of Rutland and in a small portion of Templeton. In both cases, the wastewater collected in these systems is transported off-watershed. There has been discussion regarding sewer issues in Rutland, where rapid residential growth has pushed the limits and capacity of the existing sewer system. Several subdivisions dependent on sewer are planned for Rutland.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

A majority of homes, businesses, and industries in the Wachusett watershed utilize on-site wastewater disposal. Homes with on-site systems are monitored by DWSP staff to ensure that wastewater disposal issues do not become a water quality problem. DWSP staff investigate any reports of failing septic systems. Routine water quality monitoring of tributaries is used to detect any dramatic increases in fecal coliform concentrations that may be linked to problems with septic systems.

Major investments in constructing and maintaining sewers in key locations of the watershed have been made by DWSP, MWRA, and predecessor agencies, including the original 1930s era Rutland-Holden trunk line, the 1980s Rutland-Holden relief line, and the recently completed $83 million expansion in West Boylston and Holden. Many homes in the Wachusett watershed are now connected to these municipal sewer systems, which treat and discharge effluent off-watershed. All properties with available sewer connections in West Boylston were required to connect by July 2007, and most have done so, with more than seventy percent of the town now connected to the municipal sewer system. Individual homes and businesses in Holden are not required to connect to the sewer, but more than fifty-five percent in Holden are now connected. Additional properties in Rutland are currently unable to connect to the sewer because the town has exceeded its allowed flow allotment, although reductions in inflow and infiltration may help alleviate this problem and officials from Rutland, DWSP, and the DEP continue to work towards a reasonable solution.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury
The majority of the Sudbury watershed is sewered. The town of Framingham is serviced by the MWRA sewer system. The city of Marlborough and the town of Westborough have their own municipally operated sewer service, while the town of Northborough is partially sewered using Marlborough's facilities. Portions of Westborough and Northborough still utilize septic systems. The Town of Southborough relies solely on septic systems, with no plans to add sewers. The 2009 Town of Southborough Open Space Plan notes: "A vote to install sewers has always been rejected because of concerns over the increase in development density that sewers historically bring." None of the municipal wastewater treatment plant discharges are within the Sudbury watershed.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.10 Future Growth

The threat from future growth is best illustrated by the concept that all potential sources and contaminants are eventually possible unless land is under direct control of DWSP through outright ownership or Watershed Preservation Restriction. Partial control based on ownership by other environmental organizations or state agencies, conservation restrictions held by entities other than DWSP, or Chapter 61 protection substantially reduces, but does not completely eliminate, this risk. Changes in land use without careful planning can have long-term impacts on hydrology and water quality, as unregulated growth and development can introduce a variety of pollutants into tributaries and the reservoir. Potential contaminants are closely related to zoning and include pathogens, nutrients, turbidity, anthropogenic compounds, and invasive species.

Quabbin
Land ownership analyses and Watershed Protection Act maps are the primary tools used to assess future growth in the Quabbin watershed. Watershed town zoning maps and master plans can also help assess potential growth impact on individual towns. At the state level, Executive Office of Energy and Environmental Affairs (EOEEA) conducted a build-out analysis for all towns. Permanent land protection has increased in the watershed over the past decade, however growth is increasing all around the perimeter of the watershed. Staff are observing growth as remote parcels are liquidated and developed according to local zoning bylaws which specify a density of a new dwelling on every one or two acres.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

Ware
Future growth in the Ware River watershed can be affected by a variety of factors, including statewide and local decisions related to zoning and land use practices, economic conditions, and open space protection programs. For purposes of this assessment, data was obtained from MassGIS, including build out analyses conducted by EOEEA, as well as Town master plans, zoning maps, and census data. The EOEEA build out data towns suggests that almost 23,000 acres in the Ware River watershed are potentially available for future growth. While much of this land is located in the upper reaches of the watershed, significant acreages of developable land is also available in relatively close proximity to the major tributaries. Portions of the watershed with easy access to Rt. 2 in Templeton and Phillipston

are likely to experience significant growth in the future. The eastern portions of the watershed are within what has been described as the "Sprawl Frontier" of Boston and Worcester. Rapid exurban growth will likely continue apace, especially in those areas with significant amounts of developable privately-owned lands, barring significant economic disruption or increases in gasoline prices.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Wachusett

Population in the Wachusett watershed continues to increase, placing additional pressure on undeveloped lands. Not all communities are experiencing an equal amount of pressure, with only small increases in Princeton and West Boylston and moderate increase in Sterling, Boylston, Paxton, and Holden. Growth in Rutland (25.5%) over the last ten years was more than twice as rapid as any other watershed community and four times the rate overall in Worcester County. Total population of the seven primary watershed communities increased from 48,459 to 53,370 (10.1%) between 2000 and 2010.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

Sudbury

The Sudbury watershed is part of the MetroWest region, a focal point for growth in the greater Boston region. Its location and transportation infrastructure provide access to employment, services, and other amenities. There is little land available, however, for new development, so future growth will be more likely to result in redevelopment of properties already in residential, commercial, or industrial use.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

3.1.11 Climate Change

Threats to water quality from climate change include potentially higher water temperatures and changes in the timing, intensity, and duration of precipitation, with lengthy dry periods and infrequent but very heavy episodes of rainfall. Higher water temperatures reduce dissolved oxygen levels in water and can have an adverse effect on aquatic life. Increased frequency and intensity of rainfall may cause erosion and sedimentation problems, with stormwater carrying a variety of pollutants into streams and wetlands. Changing patterns and quantities of precipitation can lead to drought, less dilution of pollutants, and impacts to aquatic organisms. Variations in temperature and precipitation also can lead to changes in plant and animal populations, with new invasive species arriving or problematic resident species becoming more dominant. Pollutants of concern related to climate changes are pathogens, nutrients, turbidity, and invasive species.

Warming temperatures might also impact migratory behavior of wildlife, with greater numbers of waterfowl remaining in the area for an extended period of time. Higher temperatures could delay or prevent reservoir ice cover, allowing direct access by gulls, geese, and ducks throughout the winter and increasing the possibility of contamination by nutrients and pathogens.

Increased temperatures could result in a change of some or most of winter precipitation from snow to ice or rain. Even if annual precipitation amounts in the watershed remained the same, a decrease in snowfall would impact the timing and amounts of water storage in the reservoir and should be considered when planning for future safe yield.

2013 Watershed Protection Program Assessment of Importance for Planning: Medium.

3.1.12 Security Threats

Security threats have become more of an issue following the events of September 11, 2001. The probability of intentional contamination of a drinking water supply is relatively low, but the issue is taken seriously by all water utilities. Watershed Security Programs provide surveillance of the watershed and protect the water supply system from intentional malicious actions. DWSP, working with MWRA, have made many improvements to strengthen security measures that protect the watershed system.

2013 Watershed Protection Program Assessment of Importance for Planning: Low.

3.1.13 System-wide Assessment of Potential Threats

A summary of the relative potential water quality threats from land uses and activities, to be used for watershed protection program planning is presented in Table 3-4.

Table 3-4: DWSP Watershed System-wide Assessment of Importance of Potential Contaminant Sources for Watershed Protection Program Planning 2013

	Active			Emergency
Source	**Quabbin**	**Ware**	**Wachusett**	**Sudbury**
Wildlife	H	L	H	M
Public Access/ Recreation	M	M	M	M
Timber Harvesting	L	L	L	L
Highways/ Railways/ROW	M	M	H	H
Agriculture	L	L	L	L
Construction	L	M	M	M
Commercial/ Industrial/ Government Sites	L	M	M	M
Residential Sites	L	M	M	M
Wastewater	L	M	M	M
Future Growth	L	M	M	L
Climate Change	M	M	M	M
Security Threats	L	L	L	L

3.2 Watershed Protection Control Programs

The DCR DWSP Watershed Protection Program provides a drinking water source of exceptionally high quality. DWSP is committed to the goal of maintaining and enhancing this level of quality for future generations. In order to achieve this goal, DWSP has organized its efforts into programs that control water quality threats identified in ongoing assessments. This concept is used to manage staff, set priorities, and establish budgets. The programs are elastic, with the ability to shift in response to organizational changes as well as emerging issues as they are identified by DWSP.

DWSP protection efforts are organized into sixteen programs in this iteration of the *Watershed Protection Plan Update*. In comparison, the *2008 Watershed Protection Plan Update* organized the protection program in thirteen programs. This plan includes all the protection program components from the previous plan, reorganized to better reflect current internal organizational structure.

The overall goal of the control programs is to develop proactive strategies to prevent water quality problems wherever possible and to respond to detected problems quickly to limit their potential impact. The sixteen programs and their goals are shown in Table 3-5.

The Sudbury system is an Emergency Supply, and so the protection program conducted by DWSP is less aggressive than the program in the Active Supply watersheds. As shown in Table 3-5, a subset of the sixteen control programs is utilized in the Sudbury to provide an appropriate level of watershed protection.

Implementation of the DWSP Watershed Protection Plan is an iterative and ongoing process. It builds on an extensive body of work conducted by DWSP staff. Table 3-6 summarizes the relation between DWSP's Control Programs and the potential pollutant sources for which they are most effective. The purpose of this table is to illustrate that DWSP has developed multiple, overlapping control programs to protect from potential contamination threats and provide effective water supply protection.

The following sections provide a brief description of each program as it relates to the entire watershed system. Chapters 4, 5, 6 and 7 describes how these control programs are developed and implemented for Quabbin Watershed, Ware River Watershed, Wachusett Watershed, and Sudbury Watershed, respectively.

Table 3-5: DWSP Watershed Protection Control Programs

DWSP Programs	Goal	Quabbin, Ware, Wachusett	Sudbury
Land Procurement	Use money allocated for land acquisition in MWRA's capital budget for the purchase of critical lands by fee and Watershed Preservation Restriction (WPR).	✓	
Watershed Preservation Restrictions	Use Watershed Preservation Restrictions to increase control of watershed lands. Maintain good working relationships with land owners. Monitor for violations and resolve any that are found.	✓	
Land Management	Maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Manage all lands to minimize potential water quality impacts. Complete a comprehensive Land Management Plan for the watershed system.	✓	✓
Wildlife Management	Protect the water supply and infrastructure from adverse impacts caused directly or indirectly by wildlife. Continue bird harassment program, wildlife management in the reservoirs' Pathogen Control Zones, and implementation of the gull study recommendations. Protect common, rare, and significant wildlife species and their habitats.	✓	✓
Public Access Management	Manage public access to DWSP lands and waters in compliance with Public Access Plans to protect water quality. Utilize visitor contact to provide education and outreach on watershed issues.	✓	✓
Watershed Security	Maintain and improve watershed security programs to provide surveillance of the watersheds and protect the watershed system from potential threats.	✓	✓
Infrastructure Maintenance	Provide resources to maintain the integrity of all high hazard dams under DWSP control, to maintain and improve DWSP facilities long-term, and to maintain internal roadways to allow them to sufficiently support their use for the water supply protection program.	✓	✓
Watershed Protection Act	Enhance protection of the water supply through implementation of the Watershed Protection Act, which regulates land use in critical areas of the watershed.	✓	
Interpretive Services	Provide educational opportunities through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions to inform the public about watershed protection and drinking water issues.	✓	✓
Water Quality and Water Quantity Monitoring	Conduct tributary and reservoir sampling to identify short-term water quality problems and to maintain the historical record for long-term trend analyses. Collect hydrologic data to support water quality work and reservoir operations. Conduct analyses and assessments of data for use in management decisions.	✓	✓

DWSP Programs	Goal	Quabbin, Ware, Wachusett	Sudbury
Watershed Monitoring and Surveillance	Use site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations	✓	✓
Aquatic Invasive Species Management	Prevent introduction of Aquatic Invasive Species through monitoring, public education, exclusion, and decontamination measures at potential entry points.	✓	✓
Environmental Quality Assessments	Continue to conduct scheduled Environmental Quality Assessments and develop actions to correct identified problems.	✓	
Wastewater Management	Monitor installation of on-site wastewater disposal systems and operation of Rutland-Holden sewer to ensure proper treatment of waste.	✓	
Stormwater Management	Develop and implement actions to reduce stormwater loadings, including ongoing identification of stormwater inputs and continuation of stormwater BMP construction on DWSP land.	✓	
Emergency Response	Maintain and improve emergency response capabilities to assist local responders and protect the water supply.	✓	✓

Table 3-6: Potential Contaminant Sources and Watershed Control Programs

	DWSP Watershed Protection Program															
Potential Contaminant Sources	**Land Procurement**	**Watershed Preservation Restrictions**	**Land Management**	**Wildlife Management**	**Public Access Management**	**Watershed Security**	**Infrastructure**	**Watershed Protection Act**	**Interpretive Services**	**Water Quality/Quantity Monitoring**	**Watershed Monitoring**	**Aquatic Invasive Species**	**Environmental Quality Assessments**	**Wastewater Management**	**Stormwater Management**	**Emergency Response**
Wildlife			✓	✓						✓	✓	✓	✓		✓	
Public Access/ Recreation			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
Timber Harvesting/ Forestry			✓					✓	✓	✓	✓	✓	✓	✓	✓	✓
Wastewater	✓	✓						✓		✓	✓		✓	✓		
Roadways, Railways and Rights-of-Way										✓	✓	✓	✓	✓		✓
Agriculture	✓	✓						✓		✓	✓		✓	✓	✓	
Construction	✓	✓						✓		✓	✓		✓	✓	✓	
Commercial, Industrial, and Governmental Sites	✓	✓						✓		✓	✓	✓	✓	✓	✓	
Residential Sites	✓	✓								✓	✓	✓	✓	✓	✓	
Future Growth	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	
Climate Change	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Security Threats					✓	✓	✓			✓	✓		✓			✓

3.2.1 Land Procurement

Land procurement protects watershed land from development and allows DWSP to restore and/or maintain a stable vegetative cover. The purchase or control of new properties provides permanent protection and helps reduce the threat from additional urbanization. The Land Procurement Program uses money allocated for land acquisition in the MWRA's capital budget for the purchase of critical lands by fee or Watershed Preservation Restriction (see 3.2.2) to protect watershed land from development and to restore and maintain stable vegetative cover. Acquisition of Watershed Preservation Restrictions rather than fee interest is preferred due to lower costs to the program.

The Land Acquisition Panel (LAP) was formed by DWSP to help determine the most appropriate and efficacious way to prioritize land procurement options. The LAP developed a land acquisition model for the Wachusett watershed that incorporated various geographic, hydrologic, and regulatory parameters to develop weighted criteria to identify critical parcels. The model has guided LAP's land acquisition prioritization process for the past fifteen years.

Since 1985, $131 million has been spent on the acquisition of 22,000 acres in both fee and WPR.

3.2.2 Watershed Preservation Restrictions

A Watershed Preservation Restriction (WPR) is a legal agreement between DWSP and a private landowner where the landowner sells or donates the development rights of their property to DWSP while keeping ownership of the land. The WPR remains in effect in perpetuity and carries forward even if the landowner sells the property.

In recent years there has been a strong preference for acquisition of WPRs rather than acquiring land in fee. Lands protected through WPRs are less costly than outright acquisitions and do not involve annual payments in lieu of taxes to watershed towns. Because WPRs are still privately owned, DWSP has ongoing stewardship obligations to make sure that the landowner is abiding by a list of restrictions, including prohibitions on construction, dumping, mining, and certain agricultural practices. Important objectives of the Watershed Preservation Restrictions Program are documentation of baseline conditions on all WPR properties, routine monitoring to check compliance with restrictions, resolution of any violations, and maintenance of good working relationships with landowners.

DWSP's first WPRs were purchased during the 1990s, and several WPRs have been purchased each year. The proportion of WPRs to fee purchases has increased due to greater emphasis on trying to acquire a WPR on a piece of land before pursuing a fee option. There are 108 WPRs covering 5,427 acres. The addition of a WPR Coordinator in 2009 has allowed the program to meet its core stewardship obligations.

3.2.3 Land Management

The Land Management Program incorporates principles from the current scientific knowledge of watershed and natural resource management to develop and implement policies, goals, and methods for managing DWSP lands. The primary goal of the program is to continue to create and maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Forest cover provides the best protection for drinking water quality and maintaining a vigorously growing multi-aged, multi-species forest will provide the best resistance and resilience to a variety of known and unknown threats. The remaining non-forested lands should be managed in a manner to minimize potential water quality impacts. The Land Management Program takes guidance from periodic Land Management Plans that address Land Protection, Forest Management, Wildlife Management, Management and Protection of Biodiversity, and Cultural Resources Protection, as well as maintenance of forest roads under DWSP control. The presence of terrestrial invasives and potential approaches to deal with them are addressed in the land management plans, and are dealt with more detail in a *Terrestrial Invasive Plants Management Strategy* developed in 2011.

The Secretary of EOEEA temporarily placed a moratorium on new timber sales in April, 2010 and requested the existing Science and Technical Advisory Committee (STAC) conduct a review of the scientific principles that guide existing Land Management Plan objectives. The STAC was also asked to analyze DWSP proposed changes to implementation on issues such as opening sizes and retention standards. Resulting recommendations were reviewed by the existing public Advisory Committees. DWSP issued a report titled, *From Here Forward: Changes to the Department of Conservation and Recreation Division of Water Supply Protection's Watershed Forest Management Program* to address all STAC recommendations and public comments. All of the appropriate changes or clarifications to Land Management Plans and future watershed forestry projects that are proposed in *From Here Forward* will be implemented over this Watershed Protection Plan's five year schedule.

3.2.4 Wildlife Management

The watershed system supports an abundance of wildlife; a number of species are monitored by DWSP personnel or other agencies. The bird harassment program on both reservoirs and the Quabbin Controlled Deer Hunt are two ongoing initiatives that have proven to support water quality improvements. DWSP is required by state and a federal law to protect rare, uncommon, threatened, or endangered species, and consequently works to protect important wildlife and their habitats while minimizing or eliminating adverse wildlife impacts on other watershed resources.

3.2.5 Public Access Management

Human activity on or near water supply source waters can introduce disease-causing agents to the water supply and cause increases in nutrients, turbidity, and invasive species. Federal and state drinking water regulations require that public access on drinking water supply lands must be managed to minimize the risk of waterborne disease and to control other impacts such as erosion and sedimentation. The reservoirs and associated lands are valuable environmental resources of the Commonwealth that are open space attractions to watershed residents and the

general public alike; since public access has historically been allowed on portions of DWSP's water supply lands, it is not feasible or desirable to ban all access.

The Public Access Management Program guides and controls public access and use of DWSP lands in order to protect water quality, safety, and security. A Public Access Management Plan is in place for each watershed. Public access includes the ability to enter and use land for recreational activities, legal restrictions or prohibitions related to access or specific land or water-based recreational activities, sign placement, mapping, user education, and inter-governmental coordination and public safety. Public access is controlled by regulations (350 CMR 11.09) and public access policies.

Watershed Ranger staff has the primary responsibility for monitoring and enforcing appropriate public access, with the police as the official enforcement entity if needed. Watershed Rangers spend most of their time utilizing visitor contacts to explain watershed protection efforts and public access controls. Enforcement through education and outreach is a priority and has been highly successful. Signs, kiosks, and other printed information provide guidance on allowed activities and locations where specific recreational uses can be enjoyed.

3.2.6 Watershed Security

Watershed Security is a vital function in an unfiltered public water supply system. The terrorist attacks of September 11, 2001 forced all public water suppliers to re-focus their attention on the security of the water supply. DWSP and MWRA consider security of the water system to be of the highest importance. Security of the water system is comprehensive – source to tap – but is also flexible enough to adjust to a range of potential threat conditions. DWSP's policies are periodically reviewed in order to achieve the goal of providing a safe and secure water supply system.

3.2.7 Infrastructure Maintenance

The Infrastructure Program provides resources to maintain the integrity of dams, maintain and improve facilities, and construct and maintain the roads, culverts and bridges which are under DWSP control. The program also determines operating policies for the water supply system, including yield, public safety, and the generation of hydropower.

3.2.8 Watershed Protection Act

The Watershed Protection Act (WsPA, also known as the "Cohen Bill") is a 1992 state law implemented by DWSP that restricts certain land uses in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. There are two types of WsPA protective buffers: the "Primary Protection Zone" – the area within 400 feet of the reservoirs and 200 feet of tributaries and surface waters – where alteration is prohibited; the "Secondary Protection Zone" – the area between 200 and 400 feet of tributaries and surface waters, on land within flood plains, over some aquifers, and within bordering vegetated wetlands – where certain activities are not allowed, including storage, disposal or use of toxic, hazardous, and certain other materials,

alteration of bordering vegetated wetlands, and dense development. Over twelve percent of the three active source watersheds receive some level of protection through the WsPA, however there are a number of exemptions and grandfathering provisions that reduce the breadth of the associated regulations. The WsPA regulations, 350 CMR 11.01-11.08, do not prevent all development, rather they promote improved site designs, helping to control potentially harmful water quality impacts, particularly within 200 feet of tributaries and surface waters.

One potential difficulty in administering the WsPA is that neither the Act itself, nor the corresponding regulations, require landowners to contact the DWSP prior to conducting regulated activities on their land. As a result, DWSP depends upon having good relationships with town boards, building inspectors, realtors, consulting engineers, surveyors, and septic system designers, and others to inform landowners about the law and their obligations.

The WsPA legislation mandates that "a program of technical assistance" be provided to those watershed communities affected by the Act's regulations (Chapter 36 of the Acts of 1992, Section 15). Environmental Planning and Environmental Quality staff support initiatives that enhance local land use protection capabilities. Staff, upon municipal request, may assist local boards in their review of particular development proposals, development of bylaws and regulations, and provide clarifications of the various statutes which govern land use planning and regulation.

3.2.9 Interpretive Services

The Interpretive Services program provides public education for students, local residents, and visitors on the importance of watershed protection. Educational programs are an effective way to protect watershed resources over the long term by instilling a better understanding and appreciation of stewardship of natural resources. Many water suppliers incorporate interpretive services into their watershed protection programs to enhance their measure of water quality and resource protection. Interpretive services are delivered through school programs, programs on DWSP properties, and through Watershed Ranger interactions that inform the public about watershed protection and drinking water issues. An educated user population is one of the best ways to protect water quality in a drinking water supply watershed.

3.2.10 Water Quality and Water Quantity Monitoring

The DWSP has a comprehensive water quality and quantity monitoring program used to screen for potential pollutants, to measure the effectiveness of watershed management programs, to better understand the responses of the reservoirs to a variety of physical, chemical, and biological inputs, and to assess the ecological health of the reservoirs and the watershed system. DWSP continually reviews its sampling programs to meet changing priorities and public health concerns, as well as to incorporate newly developed analytical methods and updated regulatory requirements.

All monitoring programs are developed and executed in coordination with MWRA. DWSP monitoring is entirely for internal assessment purposes. All system monitoring for compliance with federal drinking water regulations is done by the MWRA.

3.2.11 Watershed Monitoring and Surveillance

Federal, state, and local environmental regulations provide a significant level of protection for the watershed. Regulations may prohibit activities or establish limits or controls on activities. Regulations may also establish protection zones which complement those established in the Watershed Protection Act (350 CMR 11.00). Notably section 22.20B of Massachusetts Drinking Water regulations (310 CMR 22.00) establishes protections zones for drinking water reservoir and their tributaries.

DWSP utilizes site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers to identify possible violations of state and federal regulations and potential water quality threats. Threats may be identified by unusual water quality sampling results, field observations by DWSP staff, review of public records, or notification from watershed residents. Suspected threats are investigated, identified, and then corrective actions are pursued utilizing the legal support of all applicable environmental laws. DWSP works with the appropriate local, state, and federal government agencies to enforce these laws.

3.2.12 Aquatic Invasive Species Management

Potential impacts from the spread of Aquatic Invasive Species (AIS) vary according to the characteristics of the invading organism. Many AIS cause local extinctions of native species through competition or predation. This loss of biodiversity causes changes in the trophic structure of the community because of disruptions of food web connections, productivity, energy flow, and nutrient cycling. Invasive aquatic macrophytes aggressively displace native plants and grow so densely that littoral zone habitats become choked with vegetation. Water quality is impaired by excessive macrophyte growth because macrophytes function as nutrient pumps, extracting nutrients from the sediment with their roots and releasing them to the surrounding water.

Managing the watershed system to prevent the introduction of AIS requires a comprehensive strategy that integrates public education and outreach, exclusion and decontamination measures at boat ramps and other potential entry points, and an expanded monitoring program. Public education focuses particularly on recreational anglers and boaters, but also includes those involved in the sale of bait, aquarium fish, water gardens, and exotic pets. Routine monitoring also expands beyond the reservoir and the tributaries to include lakes and ponds in the watershed system.

3.2.13 Environmental Quality Assessments

Environmental Quality Assessments (EQAs) provide a systematic method to locate and control all sources of pollution in each active watershed. EQAs are comprehensive inventories and evaluations of threats to water quality, including DWSP facilities. These reports are conducted on a recurring basis within distinct geographic areas called sanitary districts that are based on watershed hydrology. The EQAs incorporate field inspections, water quality data analysis, and records review, including compliance with environmental regulations for wastewater,

stormwater, agriculture, and hazardous materials and waste. EQAs develop recommendations for actions to improve watershed protection and water quality that are incorporated into the Annual Work Plans.

3.2.14 Wastewater Management

Improper disposal of wastewater is a serious threat to the water supply due to the potential for contamination by pathogens and nutrients, and any release of untreated wastewater must be considered of highest priority for action by DWSP staff. Staff monitors installation of onsite wastewater disposal systems and works with state and local regulators to ensure compliance with all applicable regulations to make sure wastewater is handled safely throughout the watershed. DWSP staff helps manage the Rutland-Holden Trunk sewer.

3.2.15 Stormwater Management

Stormwater carries pollutants from many different sources to watershed tributaries and reservoirs. It is currently considered the most significant threat to water quality in the Wachusett Reservoir watershed. The DWSP Stormwater Program develops and implements strategies to reduce pollutant loads from stormwater, such as quantifying stormwater inputs and assisting private individuals, businesses, and local municipalities in their efforts to reduce pollutant loading. DWSP has worked closely with the MassDOT to design and construct stormwater BMPs in key locations on state highways around Wachusett Reservoir.

3.2.16 Emergency Response

Emergency response is a crucial part of watershed protection programs, especially where water supply reservoirs or watersheds are readily accessible to potential contamination sources, such as transportation corridors passing closely to the reservoir or tributaries. DWSP maintains and improves emergency response capabilities to assist local emergency responders should a release occur. A prompt response that recognizes the importance of the tributaries and reservoirs can help minimize any impact to the water supply. DWSP staff, along with MWRA and consultants, provide expertise regarding the hydrologic characteristics of the reservoir and its tributaries, on-water spill control, and specialized equipment for reservoir response. Components of this program include Incident Command training, first responder training, the purchase and staging of equipment, and mathematical modeling of potential spill scenarios.

4. Quabbin Reservoir Watershed Control Programs

4.1 Land Procurement

Goal: Use money allocated for land acquisition in MWRA's capital budget for the purchase of critical lands by fee and Watershed Preservation Restriction (WPR).

Land protection priorities in the Quabbin Reservoir watershed are primarily driven by water quality considerations such as proximity to tributaries and intakes. The watershed has been divided into three land acquisition priority sectors: primary is the West Branch of the Swift River and Hop Brook, secondary is the Middle Branch of the Swift River along with Fever Brook, and tertiary is the East Branch of the Swift River. Other considerations include boundary consolidation, management or access enhancement such as in-holdings, and mitigation of water quality degradation threats.

Accomplishments

Approximately $2.5 million was spent on land acquisition in the Quabbin Reservoir watershed from FY08 to the first half of FY13, procuring over 1,300 acres (Table 4-1). Several projects were acquired in cooperation with other organizations. Work is in progress on the 3,200 acre "Quabbin to Wachusett" Forest Legacy project.

Table 4-1: DWSP Protected Land with the Quabbin Reservoir Watershed 1985-2013

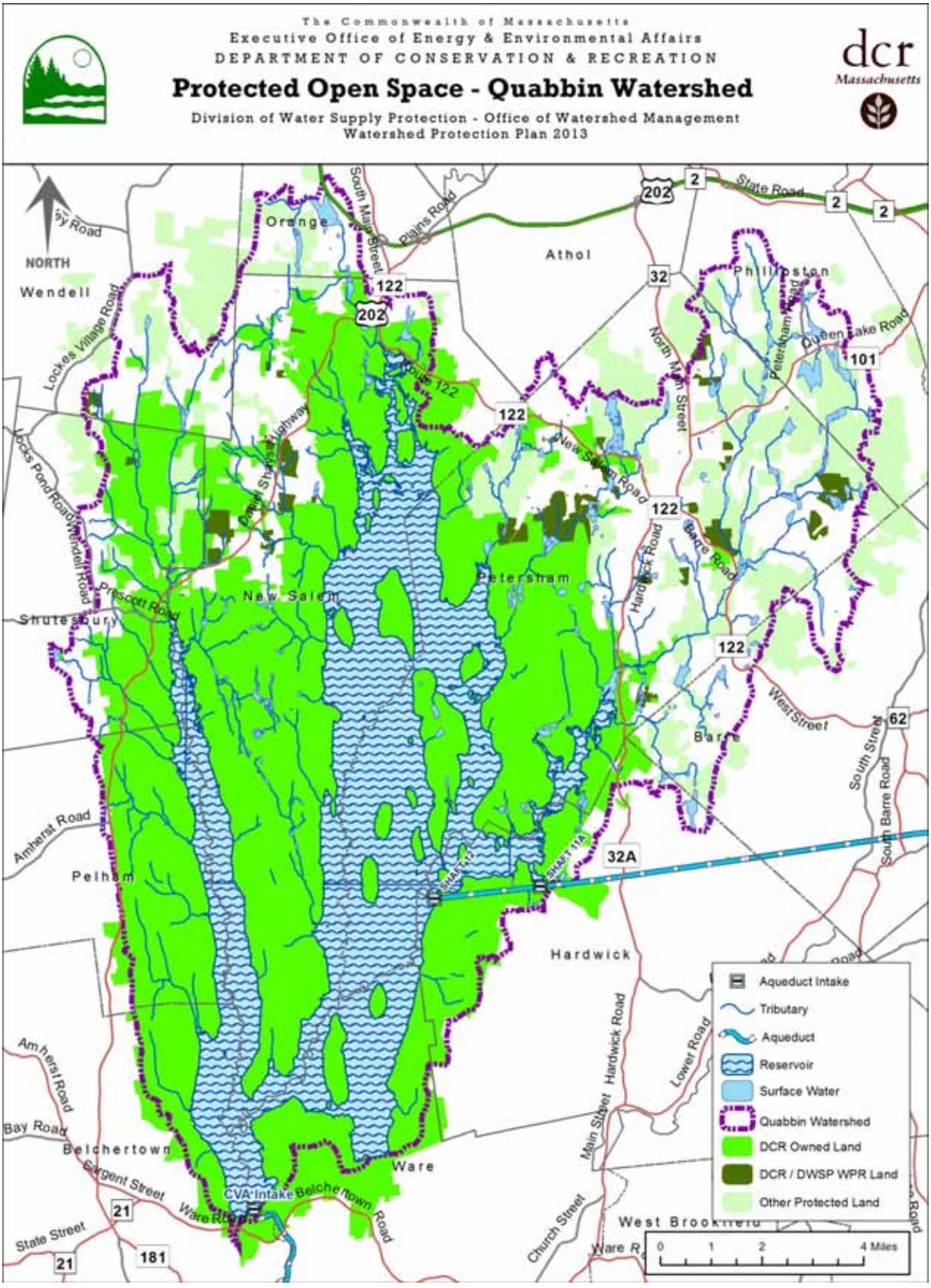
1985		2008		2013	
Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
51,792	54.3%	54,050	56.6%	55,355	58.0%

Source: GIS, 2013 and Watershed Preservation Restrictions deed descriptions.
Acres includes WPRs.

Five Year Objectives

- Identify opportunities in the field for land procurement and forward information to the Land Acquisition Panel.
- Collaborate with Land Trusts and other land protection groups (e.g., Forest Legacy Program) to acquire lands through gifts and other means.
- Reduce the amount of time it takes to complete land acquisition projects.

Figure 4-1: Quabbin Reservoir Watershed Protected Open Space



4.2 Watershed Preservation Restrictions

Goal: Use Watershed Preservation Restrictions to increase control of watershed lands. Maintain good working relationships with land owners. Monitor for violations and resolve any that are found.

A Watershed Preservation Restriction (WPR) is a legal agreement between DWSP and a private landowner where the landowner sells or donates the development rights of their property to DWSP while keeping ownership of the land. The WPR remains in effect in perpetuity and carries forward even if the landowner sells the property. Because WPRs are still privately owned, DWSP has ongoing stewardship obligations to make sure that the landowner is abiding by a list of restrictions, including prohibitions on construction, dumping, mining, and certain agricultural practices. Important objectives of the Watershed Preservation Restriction Program are documentation of baseline conditions on all WPR properties, routine monitoring to check compliance with restrictions, resolution of any violations, and maintenance of good working relationships with landowners.

DWSP's first WPRs were purchased during the 1990s, and several WPRs have been purchased each year. The proportion of WPRs to fee purchases has increased due to greater emphasis on trying to acquire a WPR on a piece of land before pursuing a fee option.

Accomplishments

There are currently 40 WPRs in the Quabbin Reservoir watershed, an increase of almost 25% since 2008, covering 2,077 acres (Figure 4-1). The WPR monitoring program was faced with an increasing number of properties that needed initial baselines and continued monitoring as DWSP acquired a greater number of WPRs from 2005-2008. The WPR program was able to meet core stewardship obligations with the addition of a new staff member in 2009.

Baseline documentation reports have been completed for all overdue WPRs, and they are now completed prior to acquisition. All WPRs have been monitored, with high-priority properties having been monitored two or three times. DWSP staff is now more informed about the WPR program, as the WPR Coordinator meets regularly with other staff and distributes up-to-date GIS information. All paper data has been scanned into digital form and organized in databases.

Five Year Objectives

- Monitor each WPR at least once every two years; annually monitor high-priority WPRs.
- Maintain good working relationships with landowners and resolve WPR violations.
- Use WPRs to increase control of watershed lands in an economical manner.
- Complete baseline documentation reports prior to WPR acquisition.
- Maintain good records and distribute them to other staff as necessary.

4.3 Land Management

Goal: Maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Manage all lands to minimize potential water quality impacts. Complete a comprehensive Land Management Plan for the watershed system.

The Land Management Program at Quabbin takes guidance from the *Quabbin Reservoir Land Management Plan 2007-2017* and the 2012 Science and Technical Advisory Committee recommendations. *The Land Management Plan* addresses Land Protection, Forest Management, Wildlife Management, Management and Protection of Biodiversity, and Cultural Resources Protection, as well as maintenance of forest roads under DWSP control. Specific details of land management activities can be found in the *Land Management Plan* and are not reproduced here.

The Land Management Program incorporates principles from the current scientific knowledge of watershed and natural resource management to develop and implement policies, goals, and methods for managing DWSP lands. Forest cover provides the best protection for drinking water quality. Maintaining a vigorously growing forest composed of diverse species, ages and tree sizes will provide the best resistance to and resilience following a variety of known and unknown threats. The remaining non-forested lands should also be managed in a manner to minimize potential water quality impacts.

Long-Term Forest Monitoring and Research
Monitoring the effects of implemented practices on natural and cultural resources has occurred regularly over the past six decades of land management at Quabbin Reservoir. This monitoring has included establishment of permanent Continuous Forestry Inventory (CFI) plots and their measurement consistently every 5 or 10 years. In addition, regeneration and the effects of browsing by deer have been monitored annually since 1989, and a variety of techniques are being tested for monitoring moose populations.

Climate Change Monitoring
DWSP has a long history of data collection on its watersheds in terms of detecting and documenting the indicators of climate change. These include physical, chemical, and biological parameter measurements made as part of the water quality monitoring program as well as indices of forest health that are gathered during decadal Continuous Forest Inventory measurements. The National Ecological Observatory Network (NEON), funded by the National Science Foundation, is a continental-scale research platform for discovering and understanding the impacts of climate change, land-use change, and invasive species on ecology. The NEON network is comprised of sites centered in 20 eco-climatic domains representing distinct regions of vegetation, landforms, climate, and ecosystem performance. The Northeast domain site is located at the Harvard Forest, with some sampling areas located on the Quabbin watershed

Accomplishments
DWSP staff completed a CFI in the Quabbin Watershed in 2010. In addition, regeneration surveys are conducted annually by staff. In 2011, the first *Terrestrial Invasive Species Strategy* was completed. Significant efforts have been occurring to resolve encroachments, including completion of 89 miles of boundary marking in the Quabbin and Ware watersheds. Staff

provided supervision on all previously existing active lots and finalized six timber harvesting projects (halted in 2010 with moratorium) lots in Quabbin.

In 2012 DWSP staff met with NEON representatives who sought input that would improve the applicability of the data collected by NEON to the issues of highest concern to DWSP. Staff worked with STAC. DWSP staff started water quality monitoring on one forest lot in Pelham, MA.

The Secretary of EOEEA temporarily placed a moratorium on new timber sales in April, 2010 and requested the existing Science and Technical Advisory Committee (STAC) conduct a review of the scientific principles that guide existing Land Management Plan objectives. The STAC was also asked to analyze DWSP proposed changes to implementation on issues such as opening sizes and retention standards. Resulting recommendations were reviewed by the existing public Advisory Committees. DWSP issued a report titled, *From Here Forward: Changes to the Department of Conservation and Recreation Division of Water Supply Protection's Watershed Forest Management Program* to address all STAC recommendations and public comments. All of the appropriate changes or clarifications to Land Management Plans and future watershed forestry projects that are proposed in *From Here Forward* will be implemented over this Watershed Protection Plan's five year schedule.

Five Year Objectives

- Write the Quabbin chapter of the comprehensive Land Management Plan.
- Design and begin to implement research and monitoring to verify the effectiveness of the existing statewide and DWSP forestry BMPs/Conservation Management Practices (CMPs) in protecting the water supply.
- Continue regeneration monitoring.
- Continue forestry operations and follow all documented management techniques including oversight of active logging.
- Coordinate monitoring and analysis efforts with NEON regarding Climate Change.

4.4 Wildlife Management

Goal: Protect the water supply and infrastructure from adverse impacts caused directly or indirectly by wildlife. Continue bird harassment program, wildlife management in the reservoirs' Pathogen Control Zones, and implementation of the gull study recommendations. Protect common, rare, and significant wildlife species and their habitats.

The Quabbin watershed supports an impressive variety and abundance of wildlife, and a number of species are monitored by DWSP personnel or other agencies. DWSP is required by state and a federal law to protect rare, uncommon, threatened, or endangered species. In general, DWSP works to protect important wildlife and their habitats while minimizing or eliminating adverse wildlife impacts on other watershed resources. In certain circumstances, where applicable, active management to enhance wildlife habitat may occur.

Gull Harassment Program

The Gull Harassment Program operates year round, usually with an active harassment phase between mid-October and mid-April, with mid-winter breaks when and if the west arm of the reservoir freezes over. During the active harassment phase, a three-mile "Gull Free Zone" is patrolled daily, weather permitting, by boat crews utilizing pyrotechnics and herding techniques to move the gulls outside of the sensitive water supply protection area. When weather or ice conditions on the reservoir prevent the launching of boats, harassment is conducted from shore. Results from daily bacteriological testing of water entering the CVA Intake indicate that fecal coliform levels have consistently remained well below the SWTR source water quality standard since the inception of the harassment program. Harassment efforts coupled with food source reduction efforts have succeeded in maintaining Quabbin Reservoir's filtration waiver status. The primary goal of the Gull Harassment Program over the next five years is to ensure compliance with source water fecal coliform criteria through a safe and effective program.

Accomplishments

The Quabbin Gull Harassment program successfully added another five years to the ongoing full compliance with fecal coliform standards. During the program's active period, beginning in 2011, EQ staff produced weekly reports for MWRA; annual reports have also been written over the past five years. Harassment safety protocols were improved for program staff. New harassment techniques have been investigated; for example, lasers have proven effective in trials.

Twenty-four ring-billed gulls and two herring gulls were tested for *Giardia* and *Cryptosporidium*. No gull samples were positive for *Giardia*; only one ring-billed gull sample was positive for *Cryptosporidium*. Hundreds of gulls have been tagged and thousands of observations reported to help document movement. Subsequently, a study was initiated of feeding behavior at wastewater treatment plants and parking lots as well as a public education program. Area landfills were monitored, problem landfills were identified, and harassment was increased to ensure DEP compliance. Gull numbers were limited at most regional landfills. The United States Department of Agriculture (USDA) is now responsible for this task.

Canada Goose Population Control

Canada geese can expel *Giardia* cysts into the environment and be a carrier of *Cryptosporidium spp*. The Canada Goose Population Control Program was begun in 1996 because they are year-round residents at Quabbin Reservoir. Original efforts were to locate all active nests in selected portions of Quabbin Reservoir. The program was expanded in 2006 to try to include all islands within the Quabbin Reservoir. Once nests are discovered, eggs are counted and treated to prevent hatching. In addition, efforts are made to prevent geese with goslings from accessing the lawn of the main administration building, the Area 1 Boat Launch Area, and the auxiliary spillway. Efforts will continue to focus on eliminating breeding and excluding birds. Barrier fencing will be monitored, and active harassment will be implemented to discourage geese access onto lawns.

Accomplishments

DWSP staff completed a pilot goose harassment program in Winsor Basin. Staff installed and maintained goose fencing in critical locations. Reservoir islands were surveyed and eggs were treated to prevent hatching. New harassment techniques were explored, including the installation of a coyote effigy. Annual Reports highlight the program's efforts.

Aquatic Wildlife Pathogen Control Zone Program

The Aquatic Wildlife Pathogen Control Zone program is designed to control the occurrence of *Giardia spp*. and *Cryptosporidium spp*. in the Quabbin Reservoir by preventing populations of aquatic mammals, specifically beaver and muskrat, near intake structures. The program is conducted in a delineated zone (Figure 4-2) where regular monitoring for selected aquatic wildlife species occurs. When identified in this area, efforts to remove the populations will occur with priority given to populations closest to the intake. In addition, fecal samples from all removed animals are tested for the presence of *Giardia* and *Cryptosporidium*.

Accomplishments

Staff conducted annual surveys of the aquatic wildlife pathogen control zone and removed all beavers attempting to build dams and lodges within this zone. All aquatic mammals removed from Pathogen Control Zone were analyzed (as well as fecal samples from gulls and geese when possible) for the presence of *Giardia and Cryptosporidium* by Cornell University using fecal samples.

White-tailed Deer Impact Management Program

DWSP has implemented the White-tailed Deer Impact Management Program since 1991. The general goals of the program are to reduce deer population densities on DWSP lands and to maintain those densities at levels that allow the growth and regeneration of forest tree species. Quabbin deer populations have decreased substantially through the annual managed hunts and the forest has responded tremendously. Regeneration surveys indicate that on disturbed plots the number of young tree stems greater than 4.5 ft. and less than 1" diameter at breast height has increased from 240 per acre in 1989 to 3,841 per acre in 2011. Tree species diversity also continues to increase, and although white pine and black birch dominate the understory, more maple, oak, and hemlock trees are now present.

Accomplishments

DWSP staff made preparations for and conducted the Controlled Deer hunt successfully for the past five years on Quabbin Reservation lands, with approximately 1,000 hunters participating annually. Over the 5 year period, more than 550 deer were harvested. Annual Reports are published by DWSP.

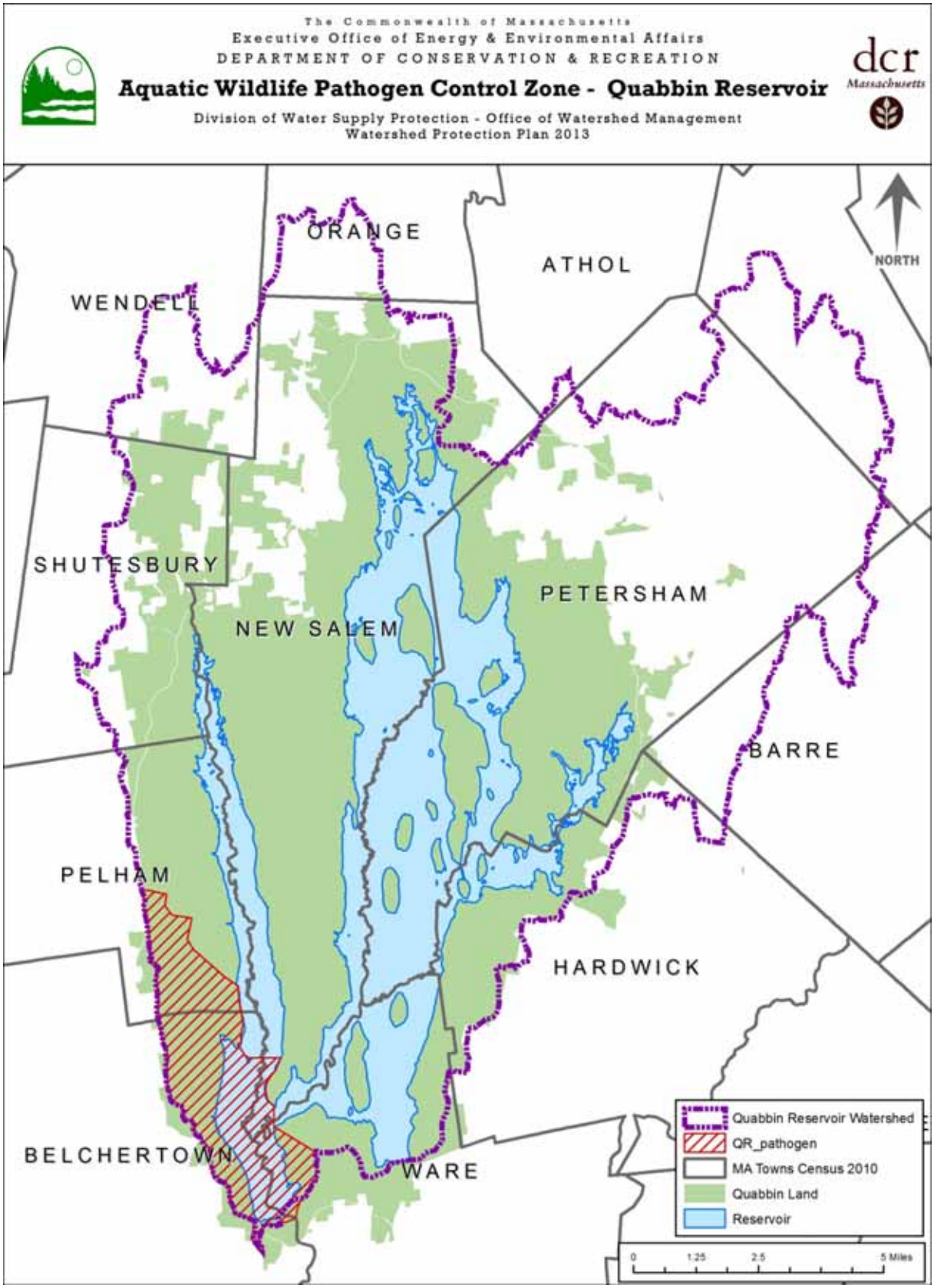
Problem Animal Response

This program addresses various wildlife problems that arise throughout the watershed and are not covered by other programs, such as woodchucks, moles, and voles digging and causing damage to the integrity of earthen dams, dikes, and other watershed structures. Lethal methods are used to remove these problem animals under the direction of the DWSP Wildlife Biologist. DWSP is working to develop long-term management techniques to discourage reoccupation.

Accomplishments

Staff responded to a variable number of beaver related flooding issues in several locations on DWSP lands in the Quabbin watershed each year. Routine surveys were conducted of Winsor Dam and Goodnough Dike; when necessary, burrows were treated annually at each location.

Figure 4-2: Aquatic Wildlife Pathogen Control Zone – Quabbin Reservoir



Five Year Objectives

- Control aquatic mammals that threaten water quality or infrastructure.
- Reduce the amount of food available to gulls in central MA by controlling public feeding and identifying and controlling alternative food sources.
- Monitor moose populations and their impact on forest dynamics through browsing surveys, annual moose sign surveys, and exclosure studies.
- Continue year-round bird observation on the reservoir; continue to control the resident Canada goose population.
- Manage habitat for rare species, such as bald eagles and loons; monitor populations of select species.
- Continue to test mammal and bird fecal samples for the presence of *Giardia* and *Cryptosporidium.*
- Administer the White-tailed Deer Management Program, including the application, permit, biological data collection, and orientation components of the program.
- Assess deer management options in Quabbin Park.
- Manage burrowing animals to prevent damage to infrastructure.
- Protect wildlife and their habitats while minimizing or eliminating adverse impacts caused directly or indirectly by wildlife.

4.5 Public Access Management

Goal: Manage public access to DWSP lands and waters in compliance with Public Access Plans to protect water quality. Utilize visitor contact to provide education and outreach on watershed issues.

The 2006 *Public Access Management Plan Update: Quabbin Reservoir Watershed System* describes DWSP's Public Access Management Program in detail (Table 4-2; Figure 4-3). Stakeholders have been involved in public access policy development, review, and modification since the first Public Access Plan was developed for Quabbin in 1988. The general public (local residents, land abutters, visitors, and environmental organizations) have been generally supportive of DWSP's policies to protect the public water supply while allowing controlled access. Public access management has become a high priority in DWSP's watershed protection efforts, especially following the events of September 11, 2001.

The intensity and location of legal recreational public access is both increasing and changing, as measured by the number of people visiting and frequency in which they visit DWSP lands and waters. This trend of increased intensity of use is best quantified by boat launch area attendance, Watershed Ranger encounters, and the number and size of Interpretive Services visitor programs. This increased intensity, for the most part, has been concentrated within Quabbin Park, which appears to becoming more of a visitor destination. Quabbin Park lies primarily outside of the Reservoir's watershed. Informal public access to DWSP lands and waters is increasing as residential development continues in the watershed.

Table 4-2: Quabbin Reservoir Watershed Public Access Rules

Activity	Quabbin Park	Quabbin Reservation	Off-Reservation	Quabbin Reservoir	Regulating Ponds	Off-Watershed Ponds[23]
VEHICLE ACCESS						
Driving for Sightseeing	□[1]	Ò	Ò	Ò	Ò	Ò
Snowmobiling	Ò	Ò	□[2]	Ò	Ò	Ò
ATV Riding	Ò	Ò	Ò	Ò	Ò	Ò
Bicycling -Designated roads	□[3]	□[4]	□[5]	Ò	Ò	Ò
Off-road Bicycling	Ò	Ò	Ò	Ò	Ò	Ò
Sledding	□[6]	□	□	Ò	Ò	□
FOOT ACCESS						
Walking/Hiking/ Snowshoeing	□[7]	□[7]	□	Ò	Ò	□
Cross-country skiing	Ò	Ò	□	Ò	Ò	Ò
Hunting/Trapping	Ò[8]	Ò[8]	□	Ò	Ò	Ò
Ice Fishing/Ice Skating	Ò	Ò	□	Ò	Ò	□[9]
Shore Fishing	Ò[10]	□[11]	□[12]	□[11]	□[11]	□[12]
WATER ACCESS						
Boat Fishing	Ò	Ò	□[13]	□[14]	□[14]	□[13]
Canoeing/Kayaking/Boating	Ò	Ò	Ò	Ò	□[14]	□[15]
Wading (fishing, launching)	Ò[16]	□[17]	□[17]	[18]	□[18]	□[16]
Swimming	Ò	Ò	Ò	Ò	Ò	Ò
OTHER ACCESS						
Group Activities (e.g., weddings)	□[19]	□[19]	□[19]	Ò	Ò	Ò
Geocaching/Questing	□[20]	□[20]	□[20]	Ò	Ò	Ò
Wildlife/Bird Watching	□[7]	□[7]	□[7]	□[7]	□[7]	□[7]
Night Access	Ò[21]	□[22]	□[22]	Ò	Ò	□[21]
Organized Sports	Ò[24]	Ò[24]	Ò[24]	Ò	Ò	Ò
Dogs/Other Animals	Ò	Ò	Ò	Ò	Ò	Ò
Horseback Riding	Ò	Ò	Ò	Ò	Ò	Ò
Collecting/Metal Detecting	Ò	Ò	Ò	Ò	Ò	Ò
Camping	Ò	Ò	Ò	Ò	Ò	Ò
Fishing Derbies	Ò	Ò	Ò	Ò	Ò	Ò
Target Shooting	Ò	Ò	Ò	Ò	Ò	Ò
Advertising	Ò	Ò	Ò	Ò	Ò	Ò
Marking – Trail/Roads (unauthorized)	Ò	Ò	Ò	Ò	Ò	Ò
Alcohol (possession of)	Ò	Ò	Ò	Ò	Ò	Ò
Other	**Please call the Quabbin Visitor Center 413-323-7221 or Watershed Ranger Station 413-323-0192**					

LEGEND
Prohibited: Ò **Allowed - general restrictions:** □ **Specific Conditions:** □ #

Table 4-2: Quabbin Reservoir Watershed Access Rules (continued)

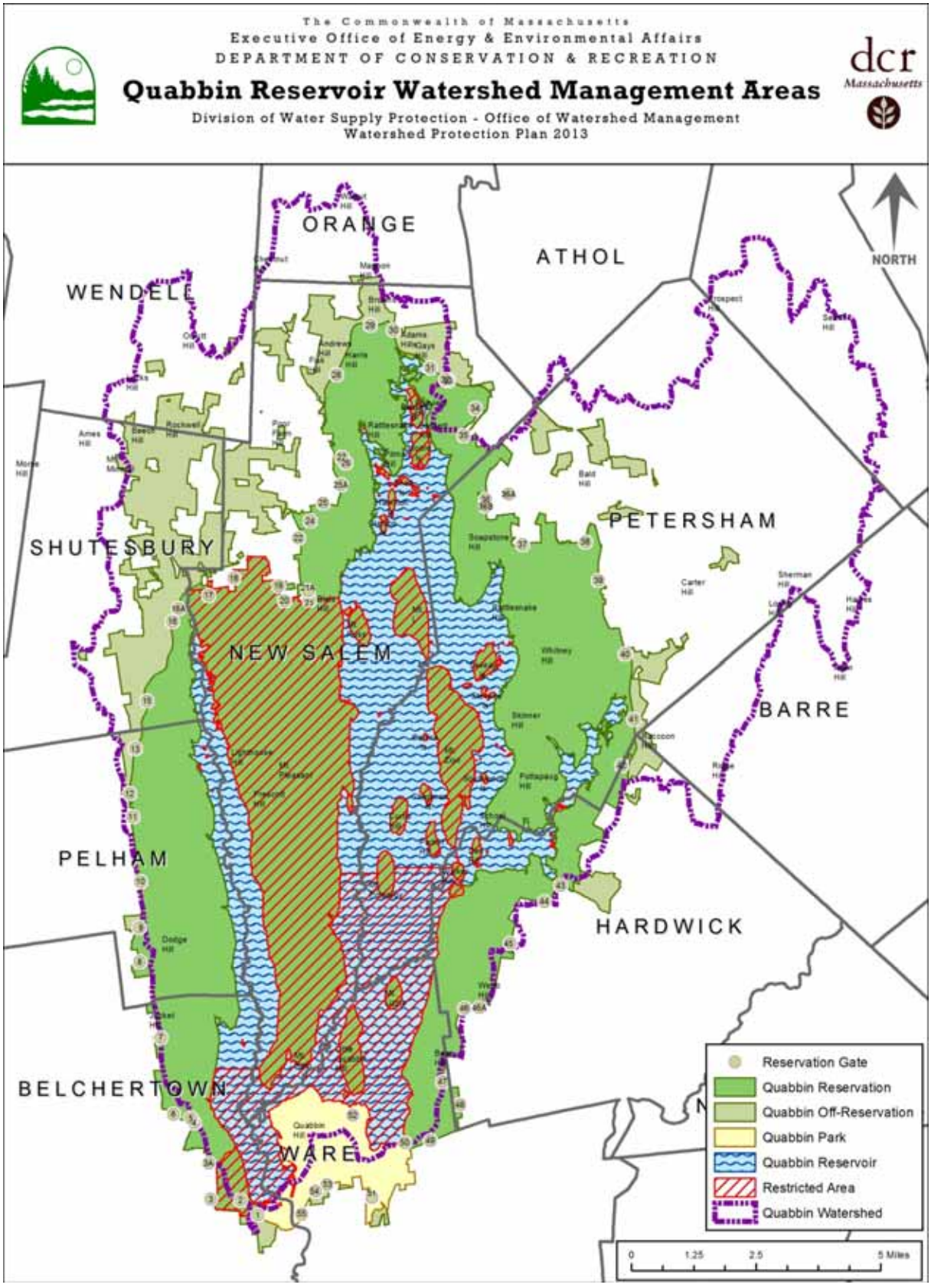
General Restrictions

□ General public access within the Quabbin Reservoir Watershed System is restricted to one hour before sunrise and one hour after sunset through gates or designated (posted) areas only. Any activity which injures or defaces the property of the Commonwealth is strictly prohibited. This chart is based on the Watershed Protection Regulations 350 CMR 11.00, copies of which are available at the Quabbin Visitor Center. Littering is strictly prohibited. Carry in/Carry out. Don't feed wildlife.

Specific Restrictions

[1] The Winsor Dam and Goodnough Dike have restricted vehicle access for security reasons.
[2] Snowmobiling is allowed only on DCR designated trail located on Off-Reservation land. 304 CMR 12.29 applies.
[3] Bicycling is only allowed on designated roads in Quabbin Park. See DCR Bicycling maps. Helmets and protective gear are required by MA law for children under 16 years of age and recommended for others
[4] Bicycling is allowed only on designated roads through DCR gates 29, 30, 31, 35, 40, 43A & B, and 44. Bicycling is only allowed on designated roads through Gate 8 during fishing season. See DCR Bicycling map for designated roads.
[5] Bicycling is allowed on main forest roads only within Off-Reservation lands with seasonal restrictions (e.g., mud season).
[6] Sledding or any other kind of sliding activity is prohibited on the reservoir, the dams and other structures.
[7] Walking, hiking, or snowshoeing access is allowed within the Quabbin Reservoir Watershed system, except in restricted areas (e.g., Prescott Peninsula, posted Administration Areas, Reservoir islands and along the baffle dams-November 15 – June 15).
[8] Hunting and Trapping are prohibited except by special permit during the Quabbin Controlled Deer Hunt and associated Paraplegic Hunt. Contact the Quabbin Visitor Center for more information.
[9] Ice fishing, ice skating, and carry-in boat access allowed on three Off-watershed ponds: South Spectacle, Bassett and Peppers Mill Ponds only. Please call Watershed Rangers, if accessing, as a courtesy at 413-323-0192.
[10] No fishing in Quabbin Park except catch-and-release fly fishing (allowed all year) below the Winsor Dam in the Swift River, unless posted.
[11] Shore fishing along the Reservoir and along streams is permitted between Gates 8-West Branch Swift River, and 22-44 (except on baffledams), by foot, during the designated Quabbin Fishing Season only. See the current Quabbin Fishing Guide and Map available at the Quabbin Visitor Center.
[12] Shore fishing within off-reservation lands and along off-watershed ponds is allowed year round according to State Fishing regulations.
[13] Carry-in boat access is allowed on off-watershed ponds. See Night Access Policy, if applicable.
[14] Boat access on designated areas of reservoir or regulating ponds requires valid MA Fishing License and size/motor restrictions. Wearing boots is mandatory if wading while launching or removing boats at designated areas from the Reservoir. Fishing access using canoes, kayaks, or jon boats is allowed only through Gate 31 above regulating dam and through Gate 43 on Pottapaug Pond with restrictions. Contact the Quabbin Visitor Center at 413-323-7221 for more information regarding current Fishing Guide.
[15] Allowed subject to MA Boating regulations. Please call Watershed Rangers, if accessing, as a courtesy at 413-323-0192
[16] Wading is allowed Off-watershed below the Winsor Dam Power Station on the Swift River
[17] Wading with boots is allowed between Gate 8-West Branch Swift River, and Gate 22-44, except in restricted areas, and in Off-Reservation tributaries.
[18] Wading is prohibited except while launching or removing boats while wearing boots, at designated boat launch areas.
[19] Allowed without a permit for groups of less than 25 individuals and/or less than 10 cars and/or 10 motorcycles. Permit required for group of 25 through 100 individuals and/or 10-40 cars/motorcycles or 1 bus. Permit and Ranger required for larger groups or other combinations.
[20] Special permit from Visitor Center required for any cache placement.
[21] Night access within Quabbin Park is prohibited with two exceptions. It is allowed without a permit on Swift River below Y pool, if access is from Route 9, and on Peppers Mill Pond.
[22] Night access within Quabbin Reservation is allowed by permit for pedestrians only through Gates 16, 31, 35, 41, and 43 only during the designated Quabbin Fishing season. Night access directly from 122 is allowed without a permit on South Spectacle Pond (off-watershed). Night access is allowed on Off-Reservation lands with special permit. Contact Quabbin Visitor Center for permit information.
[23] South Spectacle, Bassett, and Peppers Mill Ponds.
[24] Prohibited except with written permission from the Commissioner.

Figure 4-3: Quabbin Reservoir Watershed Management Areas



Visitor Education regarding access rules is formally conducted by Interpretative Services and informally by the Watershed Rangers and Boat Launch Area staff. The Quabbin Visitors Center, located in Quabbin Park, remains busiest on weekends and some holidays, with current visitation numbers returning to pre-9/11 levels. Use of the Boat Launch Areas has fluctuated over time; there are currently fewer people fishing than historic numbers.

Access Rules and Regulations – Monitoring and Compliance
The Watershed Rangers rely on rules education rather than enforcement to seek compliance in the Access Rules and Regulations Compliance Program. Watershed Rangers do not have law enforcement powers. When situations occur that require law enforcement personnel, Watershed Rangers communicate these to the State Police and other enforcement agencies. In addition, the MA Environmental Police Officers (EPOs) provide rules enforcement for complementary state-wide environmental regulations. Watershed Rangers are in radio contact with both the EPOs and State Police, and regularly meet with both groups. These relationships are critical to the enforcement of DWSP regulations.

Access Permit Issuance, Monitoring, and Enforcement
Access permits are issued by DWSP to individuals requesting access to areas under the control of DWSP. The category of access permits depends on the purpose of access. Currently there are three main categories of access permits issued by DWSP: access for research, access for forestry operations, and access for visitor/educational needs. Each permit category is issued by a separate section: Administration, Forestry, and Interpretive Services, respectively. However, all permits are monitored by the Watershed Ranger staff. Enforcement of permit conditions is conducted by the section issuing the permit in coordination with the findings of the Watershed Ranger staff. Access permits allow monitoring, tracking, and evaluation.

Research Proposal Review and Permitting
DWSP has supported a wide variety of watershed research by providing access to its properties, directed management activities, and/or limited direct funding. Research proposal submission requires an extensive application that is reviewed by DWSP senior staff. Research proposals are reviewed against specific criteria related to supporting or improving watershed protection activities. If granted, researchers receive conditional permits and annual project review. All researchers are required to notify the Watershed Rangers prior to accessing research areas at all times. All research findings, databases, and papers are shared with DWSP. This program is being tracked in a database to ensure security integrity and to help avoid user conflicts with other research, forestry operations, and other land use activities managed by DWSP.

Public Access Information
DWSP recognizes the role of public education in the protection of public drinking water supplies and associated resources. The Interpretive Services staff disseminates information about DWSP's access policies and recreational use on DWSP lands and waters. Educational programs are operated at the Quabbin Reservoir where staff, exhibits, and materials help visitors interpret the DWSP/MWRA water system, the history of the reservoirs, and the natural and cultural features of the watershed. By raising the public's awareness and appreciation for these precious resources, DWSP is helping to fulfill its mandate to "protect, conserve and enhance the resources of the Commonwealth and to assure the availability of pure water for future generations."

Signage
The Signage Program has been in operation since the 1940s, when gates and signs were first created and installed around the Quabbin Reservation to keep people out of the watershed lands and off the waters. Modern sign-making equipment, coupled with long-standing signage tools, allow DWSP staff to operate the signage program. DWSP has the ability to quickly produce professional signs to communicate any message: describing a specific activity, demarcating ownership, emphasizing rules, and giving directions. Signage types range from single use historical signs to special event signage. Updated, accurate, and legible signage is an invaluable, yet ever changing component, of the watershed protection field tools.

Boat Launch Areas
DWSP currently operates three Boat Launch Areas (BLA) in order to protect water quality and control impacts of use. Motor boat fishing at Quabbin Reservoir is a legacy of political decisions made in the 1950s that were implemented against the recommendations of Quabbin Reservoir's managers. Staff focus on preventing human contact with the water, monitoring equipment use near and on the water, and preventing the introduction of aquatic invasive species. The BLAs operate off the grid on solar power and wood heat. Public education and rules enforcement is performed by staff at the boat launch areas, Watershed Rangers, EPOs, and State Police. Every boat requires a fishing license to launch and is inspected by DWSP personnel prior to being put into the water. Public rest areas are provided at the launch areas and, for day-long boat users, at mapped locations on shore in more remote areas with specific mooring times. Boat motor size is limited by the Watershed Protection regulations (350 CMR 11.00); times and locations of access are also limited by DWSP policies.

Quabbin Park
DWSP's first comprehensive plan for the management and maintenance of the Quabbin Park area will be implemented starting in FY2014. Components of the Plan include Security, Infrastructure, Vegetation Management, Cemetery Management, Cultural Resources, and Visitor Management. Specific guidance is provided for planning and prioritizing management activities in the Park that address the significant public usage that it receives while also assuring long-term water quality protection.

Special Event Oversight
DWSP watershed lands, specifically the Quabbin Park, are popular destination sites for many private and public events, ranging from weddings to fundraising to movie making. Due to the increased frequency of these public event requests and the numbers of people involved, a special event oversight program has been initiated to control access to popular areas, protect vulnerable areas, prevent conflicts, and protect public safety. These events typically require access permits issued by the Interpretative Services staff that are subsequently monitored or staffed by the Watershed Rangers.

Field Education
Watershed Rangers are DWSP's "good will ambassadors," not only showing a positive presence but also speaking on behalf of the agency and DWSP about proper watershed stewardship and drinking water protection to community or other organization gatherings, children, school groups, service organizations, senior groups, etc. Through their positive interaction with visitors,

the Watershed Rangers protect these open spaces and encourage all people to do the same by obeying all watershed rules and regulations for specific DWSP reservoirs and the system as a whole.

Accomplishments

Quabbin staff developed, implemented and improved the Quabbin Boat Seal Program at three Boat Launch Areas. Staff operate the Boat and Shore Fishing Program for 185 days per year; over the past five years there have been 200,000 users and $1.2 million collected to partially off-set the cost of the program. Staff converted Quabbin Sanitation Program and all portable toilets to Americans with Disability Act (ADA) compliant facilities. Staff completed an annual evaluation and update of the *Quabbin Public Access Plan* in 2011. Maps, regulations and other assistance were provided to police and public to enhance emergency response in the watershed. New signage and expanded kiosks were distributed throughout the watershed. The DCR website is increasingly utilized to share and obtain public access information. Quabbin personnel logged over 100,000 contacts with the public; approximately 1,250 minor violations were reported. More than 1,600 short-term access permits were issued and monitored at Quabbin.

Five Year Objectives

- Implement, evaluate, modify, and update *Quabbin Public Access Management Plan* by 2016.
- Continue to provide educational opportunities through school programs, interpretive programs and through Watershed Ranger interaction.
- Maintain working relationships with State, Environmental, and local police.
- Continue to address illegal access to DWSP lands and water.
- Expand use of electronic media to collect and disseminate information.
- Begin implementation of Quabbin Park plan and incorporate into the operations of the Watershed Maintenance crews.

4.6 Watershed Security

Goal: Maintain and improve watershed security programs to provide surveillance of the watersheds and protect the watershed system from potential threats.

Security of the water system must be comprehensive – source to tap – but flexible enough to adjust to a range of potential threat conditions. The terrorist attacks of September 11, 2001 forced all public water suppliers to focus their attention on the security of the water supply. DWSP's policies are periodically reviewed in order to achieve the goal of providing a safe and secure water supply system.

Watershed Ranger Patrol

The primary function of DWSP's Watershed Ranger Patrol Program is to protect drinking water resources by conducting regularly scheduled patrols and surveillance of DWSP-owned lands. The patrol is focused on both popular recreational access locations and vulnerable security areas around the Quabbin Reservoir watershed. Patrols are conducted by motor vehicle, boat, bicycle, snowmobile, foot, and All-Terrain Vehicles (ATV). Watershed Rangers provide security for

DWSP facilities and other designated buildings and regularly monitor potential trouble spots on the watershed. Special use and group permits may be checked by Watershed Rangers to ensure that permittees are in compliance with their permit. Watershed Rangers keep a daily log of their patrolling activities. In addition, Watershed Rangers are trained as emergency first responders and have undertaken ice rescue training.

Physical Barriers

The Physical Barriers Program has grown in complexity since September 11, 2001. Previously, the program focused on the installation and maintenance of locked metal gates and wooden barways at roadway intersections. The program presently, in conjunction with the MWRA, focuses on preventing unauthorized vehicular access to resource areas using concrete barriers, metal security fencing, and boulders/felled trees. These structures are regularly installed, monitored, and replaced when necessary.

Technology Opportunities/Utilizing Technology to Enhance Security

Rapid advancements in technology have contributed to improved communication within DWSP and from outside of DWSP. DWSP staff regularly receive inquires via email, often accompanied with photos, from the visiting public regarding questions or concerns. This mode of communication can be responded to in real time, greatly enhancing watershed security. DWSP will explore additional technology opportunities to enhance security through improved communication. In addition, DWSP and MWRA will continue to explore remote sensing options through its continuous investigations to improve security at Quabbin with greater monitoring capabilities.

Accomplishments

Many security improvements have been made by both MWRA and DWSP over the past years. Due to security concerns, these improvements will not be listed here.

Ranger staff led efforts to coordinate with MWRA. Three new security gates were installed at Winsor Dam and Goodnough Dike with MWRA. Quabbin Watershed Rangers conducted daily patrols of gates/barways, dam, dike, CVA, and Shaft 8; no security incidents were reported over the past five years.

DWSP worked with other agencies as needed regarding security, including conversations with FEMA on Shaft 8 and Quabbin Tower improvements. Training was provided for IS 700, ICS 100 g, ICS 200, and ICS 300. Work began on the Quabbin/Ware Emergency Response Manual. Annual drills were held to acquaint the workforce with how to react to an ongoing emergency.

DWSP has developed an informal network of recreational users of the watershed that use email, digital photos, and cell phones to report violations of regulations or suspicious activities in real time. The Quabbin Boat Seal Program, initiated to prevent aquatic invasive species, has also added a level of security by insuring all private boats brought onto Quabbin are identified by owner registration and are sealed or inspected since its last use on the reservoir.

Five Year Objectives

- Continue to use, improve, and integrate Incident Command System (ICS) to respond to emergency situations.
- Coordinate with MWRA in order to maintain comprehensive system-wide approach on all security issues.
- Finalize Quabbin/Ware River Emergency Response Manual.
- Continue Watershed Ranger patrols of High Vulnerability Sites.
- Improve signage to clarify legal issues on trespassing.

4.7 Infrastructure

Goal: Provide resources to maintain the integrity of all high hazard dams under DWSP control, to maintain and improve DWSP facilities long-term, and to maintain internal roadways to allow them to sufficiently support their use for the water supply protection program.

The Quabbin Infrastructure Program focuses on maintenance and improved efficiency in support of watershed protection programs. These activities are conducted by both professional engineering staff and skilled laborers. Program components include: Reservoir Operations, Dams and Dike, Facilities Management, Boat Launch Areas 1-3, Quabbin Park, Quabbin Cemetery, Internal DWSP Roads and Culvert Maintenance, Bridge Inspections, Surveying and Drafting, Construction Planning and Supervision, Fleet Procurement and Maintenance, and Snowplowing. Opportunities to improve energy efficiency and sustainability are sought and implemented in all of these programs; for example, an energy audit was performed on the Quabbin Administration Building in Belchertown and a biomass heating system that was installed in 2008 has greatly improved the building's energy efficiency.

Reservoir Operations

Reservoir Operations are coordinated between MWRA, DWSP, the Army Corps of Engineers (ACOE), MA Fish & Wildlife (DFW), and MA DEP. Quarterly meetings of the Reservoir Operations group coordinates operations and provides an opportunity to address emerging issues relating to water quality, flood control, and major infrastructure improvements.

Dams and Dike

Quabbin Reservoir is impounded by two large, earthen dam structures: Winsor Dam and Goodnough Dike. The two major, high hazard dams and their ancillary structures are inspected and maintained jointly by MWRA and DWSP. DWSP works with MWRA to optimize the delivery of high quality water for drinking water supply while ensuring adequate volume in storage to respond to fluctuations in precipitation and demand, meet downstream minimum flow release requirements, and prevent violation of minimum pool reservoir stage limitations. DWSP maximizes rainfall capture while minimizing spillage and controlling downstream flooding. In addition, electricity is generated by using the head provided by water stored in Quabbin Reservoir.

DWSP also owns and serves as caretaker for a number of smaller jurisdictional dams located throughout the watershed system. DWSP maintains and manages a total of 15 small dams

located throughout the Quabbin Reservoir and Ware River watersheds. All dams must be maintained, inspected, and monitored in accordance with Massachusetts Dam Safety Regulations.

Facilities Management
DWSP Quabbin/Ware Region manages and maintains 26 separate facilities ranging in size from small photovoltaic power sheds to the 40,000 square foot Administrative Complex facility. Ancillary structures and utilities associated with these facilities include water supply systems, septic systems, IT equipment, fueling islands, and heating systems that include the 60 horsepower, wood fired boiler system that heats the Administrative Complex. Civil Engineering staffs provide primary oversight to these operations while maintenance staff provide support with skilled labor and maintenance. Ongoing maintenance and repairs to these facilities provides compliance with public health, safety, and environmental standards, while opportunities are realized to improve energy efficiency, universal access, and the long term sustainability of each facility.

Boat Launch Areas 1, 2 & 3
DWSP currently operates three Boat Launch Areas (BLA) in order to protect water quality (see Chapter 4.5).

Quabbin Park/Quabbin Cemetery
DWSP's first comprehensive plan for the management and maintenance of the Quabbin Park area will be implemented starting in FY2014. Components of the Plan include Security, Infrastructure, Vegetation Management, Cemetery Management, Cultural Resources, and Visitor Management (see Chapter 4.5).

Internal DWSP Roadways/Culverts/Bridges
The DWSP Quabbin/Ware Region manages and maintains a network of more than 300 miles of roads. Occasional road washouts are a source of water contamination. The stream crossings on many of these roads are spanned with simple culvert pipe or box structures. However, a smaller number of bridge crossings exist that service woods roads, logging traffic, and recreational trails throughout the watersheds. The primary care and control of many of the major bridge structures were transferred in 2010 to the MassDOT. The DWSP Quabbin/Ware Region was left with primary care and control of five major bridge spans, most notable of these include the Spillway Bridge Crossing at Winsor Dam and Horseshoe Dam bridge crossing at BLA III. Bridge decks at the three other major crossings have been removed due to safety concerns.

Gravel Pits
DWSP owns approximately 20 acres of gravel pits (e.g., off Route 202). Watershed towns, for instance Petersham, also own and/or operate gravel pits. In some cases, there are privately owned gravel pits in the watershed. The investigation and documentation of ownership and use gravel pits will be conducted through the annual Environmental Quality Assessment process throughout the watershed (see Chapter 4.13).

Construction Planning and Supervision
DWSP staff provides a wide array of construction support services ranging from project planning, contract writing, survey, design, permitting, and construction oversight. In-house projects have ranged from the installation of salt sheds, replacement boat ramps, septic systems, and stormwater treatment BMPs. In addition to serving as design and construction engineer on a number of in-house projects, Civil Engineering staff also work closely with private contractors on the development of facility improvement plans and on oversight of construction. Examples of recently completed projects include storm drain improvements at the Hangar facility overlooking the reservoir, new ADA compliant restroom facilities at BLA III, and an ADA accessible boat ramp and pier structure at BLA I.

Procurement
Procurement, which includes supplies, vehicles, contracts, and equipment, affects all operations in DWSP. Better coordination within the Region, Watershed Division and the Division of Administration and Finance will help attain operational goals.

Snow Program
The snow program at Quabbin has four components: 1) 24/7 access to the Administration Building and the Dam. 2) Plowing of work areas for employee access prior to and including business hours. 3) Making Quabbin Park and Cemetery accessible to the public in a reasonable amount of time once a storm has ended. 4) Plowing roads throughout the watershed based on priority access and ongoing activities. The procedural details are described in DWSP's Emergency Operation Document.

Accomplishments
Quarterly Reservoir Operations meetings were coordinated with MWRA, ACOE, DFW, and downstream communities. Significant effort has been invested in Quabbin Dam and Dike monitoring and maintenance, including monthly inspections and reporting. Facilities were treated annually for burrowing animals. Several major projects were completed, including: Boat Launch Area I Ramp Reconstruction and Shore Improvements; Quabbin Tower Restroom Renovation and Universal Access; construction of Universally Accessible Restroom at Boat Launch Area III; Blue Meadow Conference Center renovations; Phase II Study and Dam Rehabilitation Design for Brigham Pond Dam; conversion of the Administration Building Above-ground Storage Tank; and improvements to the Hangar's storm drain.

Five Year Objectives
- Continue maintenance and rehabilitation of DWSP facilities and roads, including evaluation of Quabbin Administration Building drinking water system.
- Operate Quabbin Reservoir to maximize water quality, minimize flood risk, and meet operational needs.
- Develop a Long Range Capital Project Improvement Plan to target maintenance repairs and to budget for future capital funding needs.
- Assess infrastructure needs and explore alternative mechanisms for funding to make much needed repairs (e.g., small dams, small bridges, etc.).
- Operate DWSP fuel storage facilities in proper working order and in compliance with all applicable codes and regulations. Continue to investigate feasibility of upgrading or converting underground storage tanks to above ground structures.

- Improve procurement coordination within the Region, DWSP, and DCR Administration & Finance.
- Continue to reduce energy use through energy efficiency practices.
- Complete individual Gravel Management Plans for all gravel pits (active/closed) on DWSP lands in the Quabbin Reservoir Watershed; update plans annually. Monitor and report extraction quarterly. Review, monitor, and revise gravel extraction MOUs with local towns annually.
- Continue to incorporate changing regulations, ADA requirements, and updated Codes into project planning and all major construction activities.
- Maintain 24-hour access to Administration Facility, State Police, and MWRA laboratory. Maintain facility access for staff; access to Quabbin Park for public, and access for others (e.g., researchers, BLA) as needed.

4.8 Watershed Protection Act

Goal: Enhance protection of the water supply through implementation of the Watershed Protection Act, which regulates land use in critical areas of the watershed.

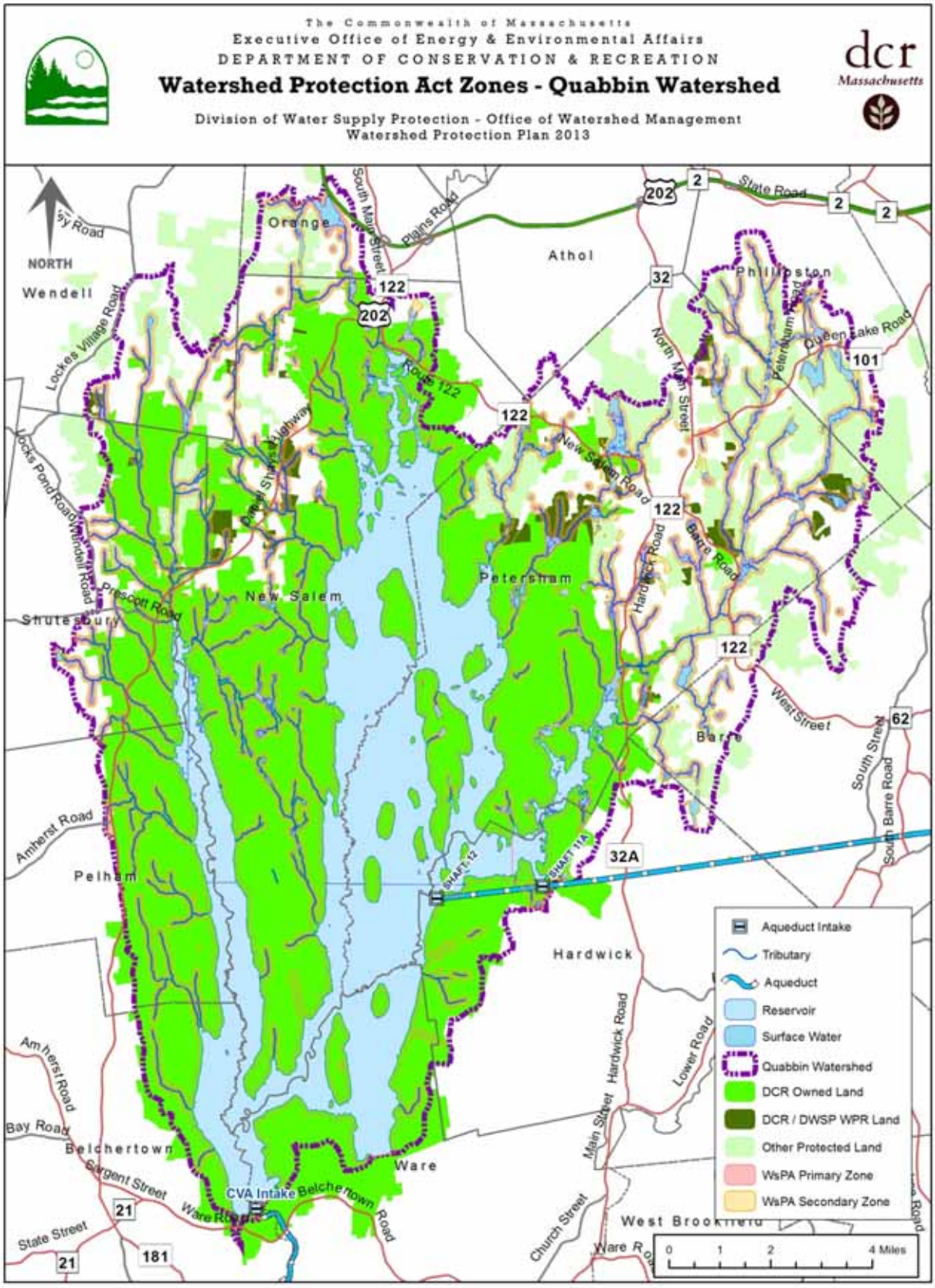
The Watershed Protection regulations, 350 CMR 11.00 – 11.08, applies to these towns in the Quabbin Reservoir watershed: Athol, Barre, Belchertown, Hardwick, New Salem, Orange, Pelham, Petersham, Phillipston, Shutesbury, Ware, and Wendell (Figure 4-4). Staff based at Quabbin also administers the WsPA in the Ware River watershed and a small portion of the Wachusett Reservoir watershed that is in the Town of Rutland.

Accomplishments

The WsPA has been effectively implemented, maintaining both inter- and intra-agency coordination for the past five years. More than 60 WsPA applications were completed over the past five years in the Quabbin Reservoir watershed and resolved several violations during this time. Judicial rulings by the Division of Administrative Law Appeals, the MA Superior Court, and the MA Supreme Judicial Court have supported DWSP's rulings and enforcement of the WsPA.

Quabbin staff has worked with several watershed towns on planning, zoning, and subdivision projects involving assistance in master planning, drafting of zoning bylaws, and updating subdivision regulations. A series of environmental protection measures have been added to local subdivision regulations as well as a model open space design methodology for zoning bylaws. Zoning, wetland, and soil testing manuals have been distributed to each watershed community's planning and zoning boards, building inspectors, conservation commissions, and boards of health.

Figure 4-4: Watershed Protection Act Zones – Quabbin Reservoir Watershed



Five Year Objectives

- Continue to implement the Watershed Protection Act.
- Maintain good relations with building inspectors and other town permitting staff and boards to enhance the notification of potentially affected parties of WsPA requirements.
- Provide direct professional support on land use planning or other associated topics, to watershed communities upon request and within staff time and capabilities.
- Generate interest in the EOEEA/DWSP model Natural Resource Protection Zoning in the watershed towns and assist in the adoption of these zoning bylaws.
- Support regional or statewide initiatives, such as statewide zoning reform, that will improve local land use, environmental, or public health decision making.
- Continue to review WsPA applications for stormwater applicability, including National Pollutant Discharge Elimination System (NPDES) construction general permit, MA Stormwater Performance Standards, and/or town stormwater bylaws.

4.9 Interpretive Services

Goal: Provide educational opportunities through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions to inform the public about watershed protection and drinking water issues.

The Quabbin Interpretive Services program operates the Quabbin Visitor Center, which offers education programs, teacher workshops, and general information about DWSP resources. Three full time staff members are available to assist with visitor information and services. An automated telephone system provides 24-hour access to current information on fishing, hunting, programs, rules and regulations, and public access. Current information and updates are also available on the DCR website.

Visitor Center

The Quabbin Visitor Center is located on the first floor of the DWSP Quabbin Administration Building in Belchertown and is open seven days a week on a year-round basis from 9 a.m. to 4:30 p.m. The Center is closed on Thanksgiving, Christmas, New Year's Day, and the weekend between Christmas and New Year's Day. The Center features exhibits, brochures, books, and videos about Quabbin management and history. Maps, books, trail guides and related materials are available for purchase from the Friends of Quabbin (FoQ) at the Visitor Center. Vital records for the disincorporated towns of Dana, Enfield, Greenwich, and Prescott are available on microfiche for genealogical research.

Visitor Education

Groups visiting Quabbin Reservoir are welcome to stop at the Visitor Center for an introduction to Quabbin by DWSP staff, including a history of the Quabbin area, a summary of reservoir construction, an overview of the DWSP/MWRA water system, DWSP watershed management activities, and information about the wildlife and other natural resources found at Quabbin. More extensive programs on Quabbin history and the bald eagle restoration program are also available. The Center also offers an on-going series of guest speakers on a variety of topics ranging from wildlife and local history to art and photography. Group size is limited and program reservations must be made well in advance of the anticipated date. A variety of self-

guided educational opportunities exist for groups visiting Quabbin, including eagle watching at Enfield Lookout and 22 miles of hiking trails with a descriptive trail guide (available for purchase at the Visitor Center). Educational staff are also available to consult with teachers planning Quabbin Reservoir or water related programs in their school, or for those interested in a group visit to the reservoir. Interpretive staff maintain up-to-date and accurate information kiosks at selected sites in the Quabbin Reservoir watershed.

School Programs/Community Based Education
Educational programs are offered for school groups at the Quabbin Visitor Center on a variety of topics, from Quabbin history to the bald eagle restoration program. Group size is limited to 60, and programs are offered on a first come-first serve basis. Prior arrangements are required for group programs, which are made through the Visitor Center. Groups interested in just visiting the Visitor Center are encouraged to notify the Center prior to their visit. All groups larger than 25 persons are required to secure a permit from the Center. There is no charge for the permit, but the application should be submitted at least three weeks before the visit date. Classroom programs and field trips are also offered to schools and groups in the watershed area and to communities which receive water from Quabbin. Topics range from water quality, water awareness, watersheds, natural history, and Quabbin area history. The Quabbin Interpretive staff offers teacher workshops on Water Quality Testing, Watersheds, Project WET, Project WILD, Project Learning Tree, Quabbin History, and other topics. Interpretive staff also have a long history, which will continue, of involvement in the MA Envirothon.

Visitor Permitting
The Interpretive staff currently works as the liaison for review of and issuance of group, special, and night permits. Staff provides educational programs to groups interested in visiting parts of the watershed within the constraints of the rules and regulations.

Records Research and Management
Upon dissolution of the Swift River Valley towns prior to construction of the Quabbin Reservoir, the Quabbin Superintendent became Town Clerk for Dana, Greenwich, Prescott, and Enfield. Each Superintendent (now Regional Director) has held this office and has been responsible for maintaining and managing the Vital Records of previous inhabitants of the valley towns. Copies of these records are stored at the Quabbin Administration Building and are available to the public for research purposes. Similarly, the original survey "Taking Sheets," photographs, and records of each property purchased by the Commonwealth prior to the actual reservoir construction are archived in the Quabbin Engineering Office. Interpretive Services staff frequently draw upon in-house collections of artifacts, as well as the extensive records of reservoir construction and the early management of the watershed lands, for educational outreach purposes.

Collaboration with Quabbin Cemetery
Information about the cemetery, its history, the layout of lots, and the process of accessing Vital Records and burials at the Quabbin Park Cemetery is currently disseminated through the Visitor Center through direct visitor contact, phone inquiries, and by electronic and written correspondences. Recent efforts to formalize the management of the Quabbin Park Cemetery have launched the development of a Cemetery Management Plan. As part of this effort, this

array of information will be made more accessible through a kiosk that will be developed for visitors near the Cemetery Administration Building.

Outreach and Public Relations
Future efforts of the Interpretive staff will focus on visitor outreach and education regarding the role of the Quabbin Reservoir as a public drinking water supply resource. Activities related to public involvement, either on-site or off-site, for many of the plan reviews, updates, and development are typically coordinated through the Interpretive Services program. A bi-annual newsletter, *Downstream*, is produced in-house with input from all sections of DWSP (www.mass.gov/eea/agencies/dcr/water-res-protection/watershed-mgmt/fact-sheets-and-reports.html).

Accomplishments
Over the past five years, ITS staff has implemented the Interpretive Services Plan for Quabbin Reservoir. The Visitor Center staff operates on average 360 days/year with 125,000 visitors for this period. Staff conducted over 400 public education programs. In addition, staff coordinated with FoQ, Swift River Historical Society, MA Envirothon, and Wachusett Greenways. Staff has developed extensive paper and electronic educational resources such as handouts, posters, displays. Ten issues of *Downstream* were published, and DWSP's website is maintained with current information.

Five Year Objectives
- Maintain and/or initiate information sites (e.g., kiosks) and programs in watersheds.
- Operate Quabbin Visitor Center.
- Implement and amend Interpretive Services Plan as needed.
- Conduct and monitor established program of public education; expand educational outreach efforts on aquatic invasive species and climate change.
- Continue to participate in environmental programs with other environmental groups (e.g., conduct environmental education teacher training, support Mass Envirothon, etc.).
- Develop interactive electronic interpretation for visitors.

4.10 Water Quality and Quantity Monitoring

Goal: Conduct tributary and reservoir sampling to identify short-term water quality problems and to maintain the historical record for long-term trend analyses. Collect hydrologic data to support water quality work and reservoir operations. Conduct analyses and assessments of data for use in management decisions.

Water quality data provide information on a variety of physical, chemical, and biological parameters. Water quantity (flow) data are necessary to develop and compare watershed loadings. These data are used to identify water quality problems, better understand reservoir responses to physical, chemical, and biological inputs, assess the ecological health of the reservoir and watershed, measure the effectiveness of watershed management programs, and ensure protection of the water supply sources.

Environmental Quality staff develops and implements water quality monitoring programs. In some cases, water quality impacts may not be apparent due to limitations in methodology or due to extended time periods for impacts to become discernible. DWSP continually reviews its sampling programs to meet changing priorities and public health concerns, as well as to incorporate newly developed analytical methods and updated regulatory requirements.

All monitoring programs are developed and executed in coordination with MWRA. To further this cooperation, DWSP and MWRA staff holds quarterly or as needed Water Quality Sampling and Analysis Team (WQSAT) meetings. EQ staff conducts follow-up sampling when elevated levels are observed. DWSP monitoring is entirely for internal assessment purposes. All system monitoring for compliance with federal drinking water regulations is done by the MWRA.

Water Quality

Chicopee Valley Aqueduct (CVA) Monitoring – daily

DWSP conducts daily site and data monitoring and weekly inspections by foot, vehicle, or boat to identify any potential man-made or natural contamination. Further investigations are conducted as needed. Regular and systematic gull and beaver monitoring is also performed in the area surrounding the CVA Intake. Daily sampling and analysis from the intake is conducted by MWRA laboratory staff. Measurements including fecal coliform, *Giardia* or *Cryptosporidium*, or high Total Coliform found to exceed pre-determined thresholds trigger DWSP staff notification for additional investigation. CVA data is monitored on-line.

Reservoir Monitoring - bimonthly

Water quality data are collected monthly at three established sample sites on Quabbin Reservoir, except during periods of adverse weather and ice conditions in the winter (Figure 4-5). Temperature, dissolved oxygen, pH, and conductivity profiles were measured at each site in the reservoir in conjunction with routine plankton monitoring. Bacteria sampling is conducted for analysis at the Quabbin Laboratory. Quarterly water quality monitoring of the reservoir in 2012 consists of Ammonia, Nitrate, Total Kjeldahl Nitrogen, Total Phosphorus, Silica, Ultraviolet Absorbance at wavelength 254 nm (UV_{254}), and Calcium (mid-depth only).

Tributary Monitoring - biweekly

Surface water monitoring stations (non-reservoir) are routinely monitored, including all major tributary inflows to Quabbin Reservoir. The number of stations varies annually. Each tributary station is sampled biweekly, with sampling runs alternating between the Quabbin Reservoir watershed (Figure 4-5) and the Ware River watershed. Samples are collected by hand early in the work week, typically Tuesday, regardless of weather conditions. Tributary samples are analyzed for Bacteria (Total Coliform and Fecal Coliform) and Physiochemical parameters (Temperature, Dissolved Oxygen, Specific Conductance, Turbidity, and Alkalinity). This data is analyzed and reported annually and every 10 years.

Aquatic Invasive Species - biweekly, monthly, and seasonally

Non-native aquatic invasive species within the Reservoir are monitored and managed through several focused efforts. DWSP has managed Macrophyte Surveys of the Quabbin Reservoir since 1998. This annual effort characterizes macrophyte flora using visual observation and

mapping techniques in areas with the greatest potential for introduction of alien species. In addition, macrophyte flora observations are conducted during the EQA cycles, with a focus on presence or absence of invasive aquatics as well as change over time. Geosyntec Consultants conducted an intensive and wide-ranging macrophyte survey of Quabbin Reservoir, and a more limited survey on the Ware River, in 2006 under a contract with MWRA. In 2011, ESS Group completed macrophyte survey of the MWRA Reservoir System. A third survey is planned for 2013. These surveys provide the most comprehensive database currently available on aquatic macrophytes in the Quabbin Reservoir and Ware River Intake.

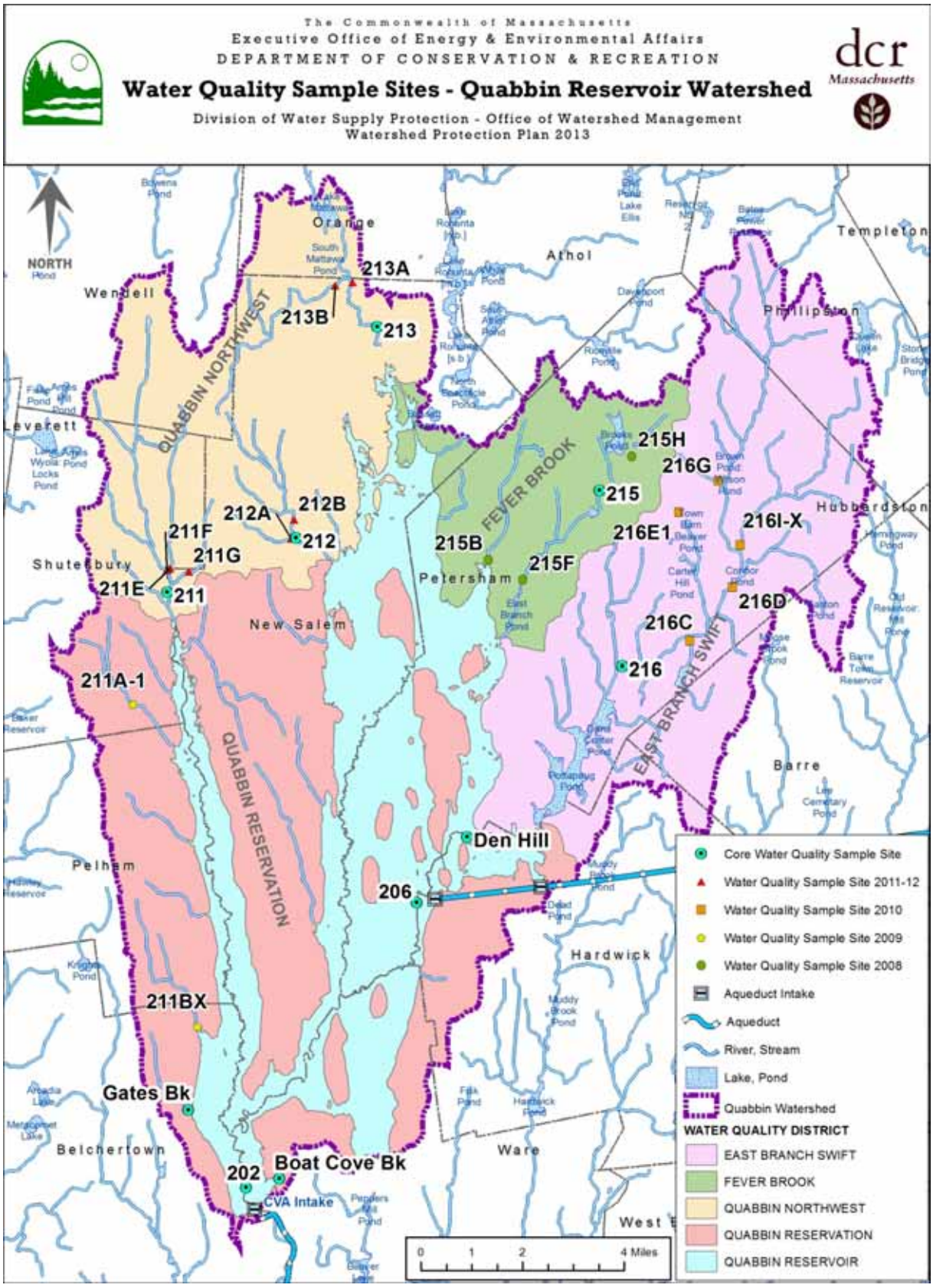
DWSP conducts routine monitoring for invasive macrophytes throughout the watershed near tributary sample sites and other locations including ponds with ramps in both watershed. Priority is given to water bodies with ramps suitable for launching trailered boats or other related risk factors. Monitoring of aquatic invasive macrophytes and invertebrates has been underway since 2006. A third-party Aquatic Invasive survey, financed by MWRA, is conducted every three years of both the Quabbin Reservoir and the Ware River intake area; one was completed in 2010 and another is pending for 2013.

The Quabbin Boat Seal program was established in 2009 due to of the potential for aquatic invasive species to be introduced by private boats through the Boat Launch Areas. The program now runs year long to accommodate boat quarantines, boat washing, and sealing. All private boats are now inspected and must be sealed before entering the boat ramps to launch on the reservoir. A comprehensive database tracks boats; during the 2012 fishing season, 8,526 boat launches occurred on Quabbin Reservoir.

Forestry – Short-term during harvest operations
Sampling for turbidity at active logging operations occurs regularly during both dry and wet weather above the site and below the site during forestry operations. In addition, samples are collected above and below all stream crossings. Forestry BMPs are regularly monitored, inspected; sampling is conducted, if appropriate. Sampling is initiated prior to any disturbance in order to establish baseline conditions, and continues until all activity has been completed

Water Quantity
Meteorological Monitoring
Advancing technologies combined with the need to integrate long-standing historic weather data collection are the basis for the Environmental Quality and Civil Engineering Sections' work, in collaboration with MWRA, to maintain and enhance DWSP's meteorological monitoring program. Collaboration with DEP's Air Quality Monitoring Site will continue and expand to better characterize the influence of atmospheric deposition on reservoir water quality. Daily precipitation has been recorded at the Belchertown monitoring station for 73 years. This data, along with information collected from USGS Stream Gages, has multi-faceted uses for DWSP, including regulatory reporting, assessing pollutant loads, measuring water flow, and informing water transfer protocols between Quabbin and Wachusett Reservoirs.

Figure 4-5: Water Quality Sample Sites – Quabbin Reservoir Watershed



USGS Stream Gages
DWSP and MWRA cooperate with U.S. Geological Survey (USGS), Water Resources Division, to maintain continuous, real time recording gages at two sites in the Quabbin Reservoir: on the East Branch Swift River in Hardwick and the West Branch Swift River in Shutesbury (Table 4-3). Real time data are available from these stations at the USGS website listed at http://waterdata.usgs.gov/ma/nwis/current.

Table 4-3: USGS Gages in the Quabbin Reservoir Watershed

USGS Gage Location	Purpose	Parameters
East Branch Swift River in Hardwick	Stream flow monitoring	Index-Velocity, Temp, Cond
West Branch Swift River in Shutesbury	Stream flow monitoring	Stage-Q, Temp, Cond, Precip

Climate Change Monitoring
In terms of detecting and documenting the indicators of climate change, DWSP has a long history of data collection on its watersheds. These include physical, chemical, and biological parameter measurements made as part of the water quality monitoring program as well as indices of forest health that are gathered during decadal Continuous Forest Inventory measurements.

Accomplishments
An extensive water quality monitoring system is in place for tributary and reservoir sampling in the Quabbin Reservoir Watershed. DWSP staff collect tributary and reservoir water quality samples and physiochemical measurements in the field using a Eureka Manta Multiprobe. All bacteriological, chemical analyses are performed by MWRA at the Quabbin or Deer Island Laboratories. EQ staff at Quabbin interact weekly with the MWRA lab to assure efficient operations of lab. Annual Water Quality reports document findings; a ten year review (2000-2010) of water quality data was also published.

Aquatic Invasive Species (AIS) monitoring and sampling was added to the water quality program during this period. Zebra mussel and calcium concentration rock studies were conducted for Quabbin Reservoir. Quabbin developed watershed specific plans for monitoring, protection, and emergency response to invasive species. A reservoir wide assessment for AIS was conducted every two years. AIS assessment for watershed lakes and ponds are conducted annually.

Coordination and communication occurs within DWSP and outside agencies to monitor for potential water quality threats. DWSP and MWRA tested for PPCPs and did not detect contamination. Quabbin advocated for continued funding of USGS sites at two main tributaries of the Swift River and an additional site on the Middle Branch of the Swift River.

A Logging Monitoring Plan was developed for active sites. A short term environmental quality forestry operations monitoring program was developed to keep any possible threats to water quality generated by the implementation phase of forestry operations to a minimum. This was accomplished by a coordinated system of planning, implementation, feedback and review, and

monitoring. Environmental Quality staff performed site inspection, collected turbidity samples and developed a pilot biomonitoring program.

Quabbin staff monitors the water wells utilized at DWSP's facilities; all records are maintained in permanent bound books and in a digital format. A scientific review was conducted by EQ for the elevated Total Coliform levels measured by MWRA in the CVA raw water intake

Five Year Objectives

- Continue routine tributary and reservoir sampling program to identify short term water quality problems and to maintain the historical record for long term trend analysis, with annual adjustments to the sampling plan to adapt to changing conditions.
- Conduct a short-term forestry water quality monitoring program by developing and implementing a coordinated system of planning, implementation, feedback/review, and monitoring of forestry operations.
- Assure that water entering the CVA meets DEP standards for microbial and chemical parameters.
- Continue to operate and improve the Quabbin Gull Harassment Program.
- Implement a team approach with Natural Resources staff to develop a long term water quality monitoring program for forestry operations.
- Engage researchers to investigate climate change questions related to algae blooms and invasive species in the reservoir.

4.11 Watershed Monitoring and Surveillance

Goal: Use site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations

Threats may be identified by unusual water quality sampling results, field observations by DWSP staff, review of public records, or notification from watershed residents. Suspected threats are investigated, identified, and then corrective actions are pursued utilizing the legal support of all applicable environmental laws. DWSP relies on its own specific watershed protection regulations (350 CMR 11.00) as well as a wide array of federal and state regulations to promote private land owners' responsibility for environmental and public health protection. DWSP works with the appropriate local, state, and federal government agencies to enforce these laws.

Accomplishments

DWSP staff has worked with the US EPA, the Massachusetts DEP, and local boards and commissions to correct situations where pollution has entered watershed tributaries. Results have included both environmental remediation and fines. Hundreds of sites have been inspected for a variety of possible water quality threats and corrective actions taken when necessary. Highlights include major utility rights-of-way infrastructure projects by National Grid (2005-present).

Five Year Objectives

- Continue to use fieldwork, local contacts, and EQAs to find violations of environmental regulations.
- Continue to enforce all environmental regulations and coordinate with other agencies when necessary.

4.12 Aquatic Invasive Species Management

Goal: Prevent introduction of Aquatic Invasive Species through monitoring, public education, exclusion, and decontamination measures at potential entry points.

Quabbin Reservoir has, to date, remained free of Aquatic Invasive Species (AIS). Reservoir-wide surveys that have been conducted for a number of years have confirmed this relatively AIS free status. Over 40,000 anglers and boaters visit Quabbin each year bringing the potential of AIS to the reservoir. The 2009 appearance of Zebra Mussels in the state lead to development and adoption of the Quabbin Boat Seal program, the hiring of an Aquatic Biologist, and the prioritization of AIS controls as a major program.

AIS management activities in the Quabbin Reservoir watershed include: reservoir monitoring; surveys of ponds and rivers; and the identification, collection, and analysis of plants and zooplankton. Some water bodies are surveyed annually, and others are done in conjunction with EQAs. Macrophyte surveys are done during the growing season and have been completed on a regular basis since 2006. See Chapter 4.10 for additional water quality monitoring information.

Accomplishments

Quabbin hired an Aquatic Biologist to monitor the Reservoir and outside water bodies for emerging contaminants. Monitoring and sampling of numerous water bodies in the watershed found several invasive species of plants but no invasive microorganisms. DWSP has instituted numerous public education and outreach efforts, including signage, brochures, and presentations.

The Quabbin Boat Seal Program was developed and implemented after the appearance of Zebra Mussels in Berkshire County. It now reaches over 10,000 boats that seasonally use the Quabbin Reservoir. The program includes a Boat Decontamination Program that utilizes a privately run car wash as well as a Cold Weather Quarantine Program. A kayak/canoe rental program was started at two Boat Launch Areas to keep private boats out of these water bodies.

DWSP routinely monitors the reservoir, tributaries, and ponds for AIS through reservoir scouting, watershed scouting, net sampling, and *Didymo* monitoring. A special research study on Zebra Mussels, supported by MWRA, was performed in collaboration with Rensselaer Polytechnic Institute. An AIS Assessment and Management Plan was developed in 2010, and AIS is also now a consideration in the Emergency Action Plan.

Five Year Objectives

- Continue to implement the *2010 AIS Management Plan*; update as needed.
- Continue to operate and improve the Quabbin Boat Seal Program.
- Continue efforts to survey, monitor, and prevent the spread of aquatic invasive macrophytes in the reservoir and throughout water bodies in the watershed.

4.13 Environmental Quality Assessments

Goal: Continue to conduct scheduled Environmental Quality Assessments and develop actions to correct identified problems.

An Environmental Quality Assessment (EQA) is a systematic, geographic-based review of potential contamination sources within the Sanitary District of each watershed (Figure 4-6). This contrasts with regular Environmental Quality activities that are typically prompted by 1) elevated results from water quality monitoring, 2) WsPA requests, 3) local boards' technical assistance requests, and 4) citizen complaints. The EQA reports contain the cumulative research, monitoring, assessment, and recommendations regarding existing and potential water quality threats specific to the district. The Quabbin Reservoir watershed has historically been divided into four main Sanitary Districts for assessment purposes: 1) Quabbin Northwest Sanitary District; 2) Fever Brook Sanitary District; 3) East Branch Swift River Sanitary District; and 4) Quabbin Reservation Sanitary District. Each Sanitary District is further divided into sub-districts (Table 4-4).

A watershed-based monitoring and assessment process to identify and correct both existing and potential water quality threats has been in place since the 1940s. This program has been refined and tailored throughout the years in order to provide a greater level of detail for water quality threat assessment, prevention, and mitigation efforts. Within the past five years, the EQ staff has further modified the program, conducted on a five year cycle, to improve the link between land based monitoring and water quality sampling and analysis. EQAs will be completed according to the schedule in Table 4-5. The goal is to complete an EQA for each sanitary district every five years.

In the next period the EQ section will implement a mitigation program with immediate (24 hours), moderate (7 days), and long-term elements for threats identified in the EQA process. An annual report will be developed that focuses on watershed wide problems identified through the EQA, mitigation techniques applied, and status steps. Databases related to tracking and coordination will be further developed and improved.

Accomplishments

A revised EQA team approach was instituted for Quabbin/Ware watersheds. During this period, Quabbin/Ware EQAs incorporated EQA sampling site monitoring. Four of five Quabbin EQAs were completed, and the fifth is in preparation. Mitigation recommendations were reviewed and addressed annually. Quabbin EQ piloted database based on the Wachusett model.

Figure 4-6: Environmental Quality Sanitary Districts – Quabbin Reservoir Watershed

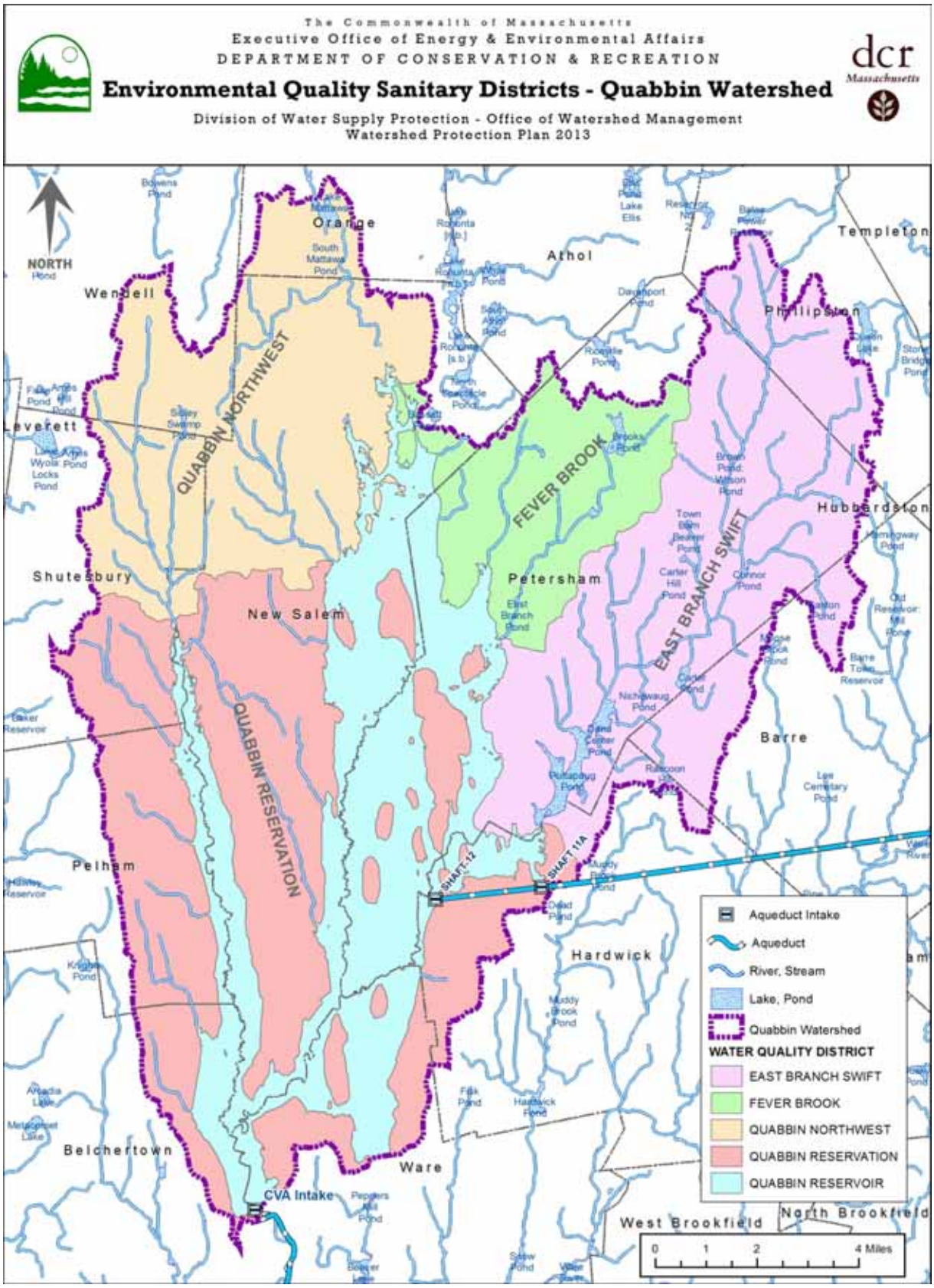


Table 4-4: Sanitary District and Sub-district Attributes

Sanitary District/ Sanitary Sub-district	Drainage Area (sq. miles)	% DWSP Land Ownership	USGS Stream (miles)
Quabbin Northwest Sanitary District			
West Swift River Sanitary Sub-district	14.1	47.6%	24.5
Middle Swift River Sanitary Sub-district	12.25	37.7%	25.3
Hop Brook Sanitary Sub-district	9.67	48%	19.8
Fever Brook Sanitary District			
West Fever Brook Sanitary Sub-district	8.17	59.07%	6.1
East Fever Brook Sanitary Sub-district	8.71	37.9%	8.0
East Branch Swift River Sanitary District			
East Swift River Upper Sanitary Sub-district	10.42	<1%	18.7
East Swift River Lower Sanitary Sub-district	12.97	17.6%	21.1
Pottapaug Pond Sanitary Sub-district	11.65	77.12%	7.1
East Petersham Sanitary Sub-district	11.13	0%	13.1
Quabbin Reservation Sanitary District			
Winsor Dam Sanitary Sub-district	10.50	99%	12.3
Shaft 12 (includes islands) Sanitary Sub-district	20.79	98.6%	26.9
West Arm (Quabbin Reservoir) Sanitary Sub-district	19.67	90%	45.5

Source: EQ, 1998

Table 4-5: Quabbin Reservoir Watershed Environmental Quality Assessment Schedule

Sanitary District	Completed Plans	Future Schedule
Quabbin Northwest Sanitary District	2000, 2006, 2007, 2013	2017
Fever Brook Sanitary District	2003, 2008	2014
East Branch Swift River Sanitary District	2003, 2008, 2012	2016
Quabbin Reservation Sanitary District	2003, 2005, 2007, 2011	2015

Source: EQ, 2013

Five Year Objectives

- Continue to conduct Environmental Quality Assessments as scheduled (adding stormwater treatment and gravel pits). Incorporate specific recommendations from EQAs into annual work plans. Present and share findings and mitigation measures annually.
- Continue to maintain database of agricultural operations, Aboveground Storage Tanks (ASTs), hazardous waste generators, spills, and hazardous materials use through field inspections and record review.

4.14 Wastewater Management

Goal: Monitor installation of on-site wastewater disposal systems and operation of Rutland-Holden sewer to ensure proper treatment of waste.

Improper disposal of wastewater is a serious threat to the water supply due to the potential for contamination by pathogens and nutrients, and any release of untreated wastewater must be considered of highest priority for action by DWSP staff. Staff monitors installation of onsite wastewater disposal systems and works with state and local regulators to ensure compliance with all applicable regulations to make sure wastewater is handled safely throughout the watershed.

On-site septic systems and, to a lesser extent, "tight tanks" are the methods of wastewater treatment or collection/disposal within the Quabbin Reservoir watershed. Septic systems throughout Massachusetts are regulated by Title 5 regulations. Massachusetts' Title 5 regulations, last modified in 1995, are now fully implemented by local Boards of Health across the watershed. Board of Health records vary considerably within Quabbin watershed towns. Activities related to system installations, repairs, and replacements on private lands in the watershed, but outside of the regulated areas are difficult to monitor.

DWSP's Watershed Protection regulations provide an additional level of protection to review new system siting within regulated areas, as well as an avenue to review repairs/conversions. System conversions from septic to tight tanks are common for lake houses on very small lots where a conventional system cannot be sited (e.g., Lake Mattawa). Installations of new septic systems, septic repairs, and septic conversions occur regularly within the watershed. DWSP facilities in the watershed are all serviced by septic systems, which are maintained by DWSP staff.

Accomplishments

A majority of DWSP systems were upgraded beginning in 1998 as part of the Clean State Initiative. To date, 13 DWSP-Quabbin septic systems have been replaced; two systems have been abandoned/closed (Quabbin Cemetery and Antennae site); and one system has been converted from a septic system to tight tank (BLA 3).

Five Year Objectives

- Review water quality data and other pertinent information to identify potential problem sites from onsite wastewater management.
- Continue to monitor and enforce the provisions of Title 5, working with local Boards of Health and DEP.
- Provide technical assistance, upon request, to towns regarding onsite wastewater management issues.

4.15 Stormwater Management

Goal: Develop and implement actions to reduce stormwater loadings, including ongoing identification of stormwater inputs and continuation of stormwater BMP construction on DWSP land.

Stormwater management within the Quabbin Reservoir watershed is primarily focused on road drainage systems. The total impervious surface within the watershed is less than one percent. Historically, a hydraulically efficient storm drain system is one that collects and conveys stormwater from the road surface and surrounding area to the nearest receiving watercourse as efficiently and as quickly as possible, which is typically not the best approach for water quality protection. Road redevelopment projects occurring within the watershed present an opportunity to correct or make improvements to better safeguard receiving watercourses against the effects of stormwater pollution. These projects include work immediately adjacent to Quabbin Reservoir as well as road systems in the wider watershed.

Other discharges of concern are flows to tributaries from the State roadways that surround the reservoir, namely Highway Routes 202, 122, 32A, and 9. Staff strives to work cooperatively with MassDOT and local officials on highway and local road reconstruction projects to more effectively influence stormwater management design aspects and redevelopment improvements. DWSP efforts begin with the review of project designs and continue through the construction phases of the project to completion.

A significant portion of the watershed roads are rural roads incorporating "country drainage" systems (i.e., no piped collection and conveyance of stormwater), and "dirt" roads are not uncommon. DWSP is the largest owner of gravel roads within the watershed, with more than 250 miles under its direct care and control. DWSP's gravel roads provide access for water supply protection purposes, fire protection, forest management and visitor access. To ensure a reliable road system the system is maintained using best management practices to limit road washouts, ensure road safety, and to satisfy environmental standards.

Accomplishments

Staff reviewed, commented and monitored MassDOT work on Route 122 and bridge near Connor Pond in Petersham and on Route 2 in Orange. Major projects that were completed by DWSP include the 2012 Administration Building Complex – Hangar Storm Drain Improvement Project and the 2009 Boat Cove – Roadway Improvement Project. WsPA case submittals undergo a stormwater compliance review with respect to recently updated programs such as the NPDES stormwater compliance standards (under the Construction General Permit) and MA River and Stream Crossing Standards.

Five Year Objectives

- Strive for early input into state and local road reconstruction projects to more effectively influence stormwater management design aspects of projects.
- Integrate, maintain, and monitor structural stormwater Best Management Practices (BMPs) needed and/or constructed on DWSP property.

4.16 Emergency Response

Goal: Maintain and improve emergency response capabilities to assist local responders and protect the water supply.

Emergency response is a crucial part of watershed protection programs, especially where water supply reservoirs or watersheds are readily accessible to potential contamination sources, such as transportation corridors passing closely to the reservoir or tributaries. Accordingly, an emergency response program has been put in place for the Quabbin Reservoir watershed in an attempt to minimize the risk of accidental or intentional contamination of the water supply. This program, focused on spill response, has several components, including planning, staff training, and equipment acquisition and maintenance.

The role of DWSP is to maintain and improve emergency response capabilities and to assist local emergency responders should a release occur. A prompt response that recognizes the importance of the tributaries and reservoirs can help minimize any impact to the water supply. DWSP provides expertise regarding the hydrologic characteristics of the reservoir and its tributaries, on-water spill control, and specialized equipment for reservoir response. Components of this program include Incident Command training, first responder training, the purchase and staging of equipment, and mathematical modeling of potential spill scenarios.

Planning
An Emergency Response Handbook for the watershed is maintained and periodically updated. It includes contact information for DWSP and MWRA staff, as well as local emergency management agencies, contact procedures, information on the DWSP radio system, and roles/responsibilities for staff and local emergency personnel. It also includes information on Incident Command procedures, maps, and other pertinent information that might be needed during emergency situations. The handbook is primarily meant to address hazardous material spills; the next update will also include sections on other emergency situations that could directly or indirectly affect water quality, including accidents, disease outbreaks, weather emergencies, aircraft incidents, and waterworks or administrative infrastructure emergencies. Emergency procedures have also been developed for loggers working on the watershed, including emergency contact cards that instruct loggers who to call in the event of a spill or other emergency situation. Another planning activity is the ongoing development of a culvert location and information database.

Training
Annual training, in conjunction with MWRA, is provided on containment boom deployment and terrestrial spill response to DWSP staff, appropriate local emergency officials, and more recently, to loggers operating on DWSP property. The Watershed Rangers are key participants in these trainings, and also receive additional emergency response training.

Equipment
Emergency response equipment is stored and maintained in several locations in the watershed. There are three spill response trailers: one holds boom supplies, another contains terrestrial spill response equipment and supplies, and the third stores supplies mainly pertaining to on-water spill situations. These trailers are sited in appropriate locations for quick access in the event of an

emergency situation. A boom deployment shed is stocked and maintained on the bank of the West Branch Swift River (due to the proximity of Route 202),. In addition, additional boom supplies are stored in particularly sensitive locations around the reservoir where rapid deployment may be necessary. Spill response supplies are also positioned near active logging operations or ROW construction work when the site is located close to the reservoir or certain tributaries or sensitive areas. Spill response equipment is periodically checked, tested, and maintained; new or replacement equipment is added on a regular basis.

Accomplishments

Three response trailers – land based, water based, and boom – were maintained and used for training annually. Staff worked with local emergency personnel to coordinate services and training. Select staff completed annual training through a MWRA-led contract. All staff completed either IS 700 or ICS 100 training. In addition, some staff completed ICS 200, ICS 300, and OPA90. Annual mock drills – tabletop and field exercises – have been held with agency staff.

The Quabbin Hangar project has constructed an emergency shut-off valve to the storm drain piping that discharges to the rip rap beside the reservoir. In the event of a spill on the Hangar apron, contaminated water can now be held inside the network of catch basins and drain piping to be later removed by a vacuum truck.

Booms have been installed by the horseshoe dams at BLA 2, BLA 3 and Shaft 8. A hazardous material shed has been located on bank of West Branch Swift River. Work has begun on Quabbin/Ware Emergency Spill Response/Prevention Plans.

Five Year Objectives

- Continue to provide emergency response support services. Maintain response supplies and up-to-date contact lists. Participate in mock hazardous release exercise for training purposes.
- Coordinate with MWRA and local emergency officials to provide ICS, emergency response training and annual tabletop or field exercises.
- Construct additional structural controls to reduce likelihood of spills reaching the reservoir.
- Evaluate, monitor, and oversee spills that threaten water quality or DWSP property and work with appropriate federal, state, and local agencies to contain and remediate.

5. Ware River Watershed Control Programs

5.1 Land Procurement

Goal: Use money allocated for land acquisition in MWRA's capital budget for the purchase of critical lands by fee and Watershed Preservation Restriction (WPR).

Parcel acquisitions for the Ware River watershed, both in fee and Watershed Preservation Restriction, must pass a finer filter than the two active reservoir watershed given the rarity of water diversions from this basin. The Land Acquisition Panel recommends Ware River acquisitions only under "extraordinary" circumstances – notably when gifts, bargain sales, collaborative projects, and important in-holdings are made available.

Accomplishments

DWSP increased its land holdings from 1985 through 2007 in the Ware River watershed from approximately 19,300 acres to more than 24,000 acres, a 25% increase of about 4,900 acres (Table 5-1). There have been no new acquisitions over the past five years. (Figures 5-1 and 5-2)

Table 5-1: DWSP Protected Land within the Ware River Watershed, 1985-2012

1985		2008		2013	
Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
19,300	31.3%	24,137	39.1%	24,232	39.3%

Source: GIS, 2013 and Watershed Preservation Restrictions deed descriptions. Acres includes WPRs. Increase from 2008 to 2013 is due to improvement in data accuracy taken from WPR deeds.

Five Year Objectives

- Identify opportunities in the field for land procurement and forward information to LAP.
- Collaborate with Land Trusts and other land protection groups, such as the Forest Legacy Program, to acquire lands through gifts and other means.

5.2 Watershed Preservation Restrictions

Goal: Use Watershed Preservation Restrictions to increase control of watershed lands. Maintain good working relationships with land owners. Monitor for violations and resolve any that are found.

Future land protection efforts in the Ware River watershed will likely rely mainly on low- or no-cost options such as gifts, protection through other funding sources (e.g., the Forest Legacy Program), and other creative means. As is the case with the DWSP Land Acquisition program in recent years, acquisitions of development rights via Watershed Preservation Restrictions are generally favored over outright fee acquisitions, which carry the additional long-term costs of payments in lieu of taxes (PILOT).

There are currently 12 Watershed Preservation Restriction properties, covering 919 acres in the Ware River watershed, which is no increase since 2008 (Figure 5-2).

Accomplishments
Landowner issues were addressed through collaborative working group discussions. All WPRs in the watershed were monitored at least once since 2008.

Five Year Objectives
- Monitor each WPR at least once every two years; annually monitor high-priority WPRs.
- Maintain good working relationships with landowners and resolve WPR violations.

5.3 Land Management

Goal: Maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Manage all lands to minimize potential water quality impacts. Complete a comprehensive Land Management Plan for the watershed system.

Substantial research, staff discussion, and effort go into the development of the Land Management Plans for the DWSP watershed reservations, and as a result, they represent well-reasoned and rational approaches to managing watershed forests. *The Ware River Watershed Land Management Plan* will continue to guide DWSP forest management activities on the Ware River watershed during the next planning period, with the continued goal of establishing a diverse and resilient watershed protection forest.

Timber harvesting on DWSP lands is a carefully monitored and regulated activity designed to enhance the ability of the watershed to protect water quality. All forest management activities are conducted under the supervision of a Watershed Forester. Timber harvesting activities abide by the current Massachusetts Forest Cutting Practices Act regulations and additional guidelines and restrictions outlined in the current DWSP's Ware River Watershed Land Management Plan.

Long-term land monitoring activities include browse surveys and CFI plots. Terrestrial invasives are monitored as part of CFI plots.

Accomplishments
Most logging operations were suspended in 2010 pending review of Land Management Plan principles and practices by STAC. From FY 2009-2013, 285 acres were logged in the Ware River. A subwatershed analysis was completed in FY2010. CFI data was collected and analyzed in 2009. The *Terrestrial Invasive Species Management Strategy* was finalized in 2011.

Five Year Objectives
- Write the Ware River chapter of the comprehensive Land Management Plan.
- Assess and monitor status of encroachments onto DWSP property, and take appropriate follow-up actions.

5.4 Wildlife Management

Goal: Protect the water supply and infrastructure from adverse impacts caused directly or indirectly by wildlife. Continue bird harassment program, wildlife management in the reservoirs' Pathogen Control Zones, and implementation of the gull study recommendations. Protect common, rare, and significant wildlife species and their habitats.

Wildlife management in the Ware River watershed primarily consists of research, dealing with problem animals and making accommodations for hunters. Research is conducted by DWSP staff and other agencies on gulls, moose, and bats. Problem animals, typically beaver that block culverts, are dealt with on a case-by-case basis. Accommodations for hunters (of whitetail deer and game birds) are made by controlling gate access during applicable seasons. Additionally, seasonal trout stocking occurs on the Ware River. Water quality threats from wildlife is considered a low risk in the watershed so less emphasis is placed on monitoring and managing wildlife that can impact water quality.

When water sampling data has elevated bacteria counts, EQ staff conduct field investigations to determine the source. The elevated results are frequently attributed to beavers and their habitat; mitigation is performed as necessary.

Accomplishments

Beaver flooding problems were evaluated and appropriate control measures implemented as needed. Annual moose sign surveys were conducted, and staff participated in other moose research activities. Vernal pools were visited and assessed for obligate species. A habitat reclamation project, using federal funds, restored 20 acres of apple orchard and field. A complete survey of existing DWSP fields was completed.

Five Year Objectives

- Control aquatic mammals that threaten water quality or infrastructure.
- Reduce the amount of food available to gulls in central MA by controlling public feeding and identifying and controlling alternative food sources.
- Monitor moose populations and their impact on forest dynamics through browsing surveys, annual moose sign surveys, and exclosure studies.
- Develop management plans for existing DWSP fields.

5.5 Public Access Management

Goal: Manage public access to DWSP lands and waters in compliance with Public Access Plans to protect water quality. Utilize visitor contact to provide education and outreach on watershed issues.

The Ware River watershed is widely accessible to the public for much of the year, and public access issues occupy substantial staff time. Public access and recreation on the watershed is presently governed by the 2010 *Ware River Watershed Public Access Management Plan Update* and the *Evaluation of the Ware River Watershed Public Access Management Plan - 2011*.

Recreation in the Ware River watershed is an activity of particular concern, mainly related to an increase in uncontrolled and/or unauthorized access or use, the expansion of snowmobiling and horseback riding, and the extension of the rail trail. Substantial staff time is now spent dealing with recreational issues, including impact control, working with user groups, and resolving user conflicts. Staff monitor environmental problems that stem from illegal ORV use.

The 2010 Public Access Plan outlines a number of policies and guidelines for recreational activities and other public access on the watershed reservation (Table 5-2 and Figure 5-1). It also includes a Master Policy Statement regarding public access on the watershed, which strives for a balance between appropriate recreational activities and the need to protect water quality and the natural, cultural, and historical values of the watershed lands.

Information regarding rules and regulations on public access are available online, through the Quabbin Visitor's Center, and displayed on kiosks in several locations in the watershed. Even with information widely available, the average user is not aware of the watershed function of the land; most consider it a park. Much confusion exists regarding allowed or permitted activities.

Watershed Rangers conduct patrols and surveillance of DWSP lands in Ware River. The US Army Corp of Engineers (ACOE) also has a Ranger Section that provides additional security to the land they control within the watershed. However, situations occasionally occur that require law enforcement. During these times, the Environmental Police, the Massachusetts State Police or local police are contacted for enforcement. Within the past few years, the Environmental Police have led the investigation and clean-up of a large dumping site and have pursued enforcement against illegal trail construction through DWSP lands.

Continued population growth in Ware River watershed communities, plus continued expansion of interest in outdoor pursuits, such as horseback riding, snowmobiling, and mountain biking, will likely lead to increased recreational pressure. Permits are currently required for groups over 25 (15 for horseback riding) and are routinely obtained by a few user groups. Watershed Rangers are often involved with user groups (e.g., snowmobile clubs). However, enforcement of some permit requirements is based on peer pressure by permit holders. The Ware River Advisory Committee provides substantial input and review from user groups and individuals requesting access.

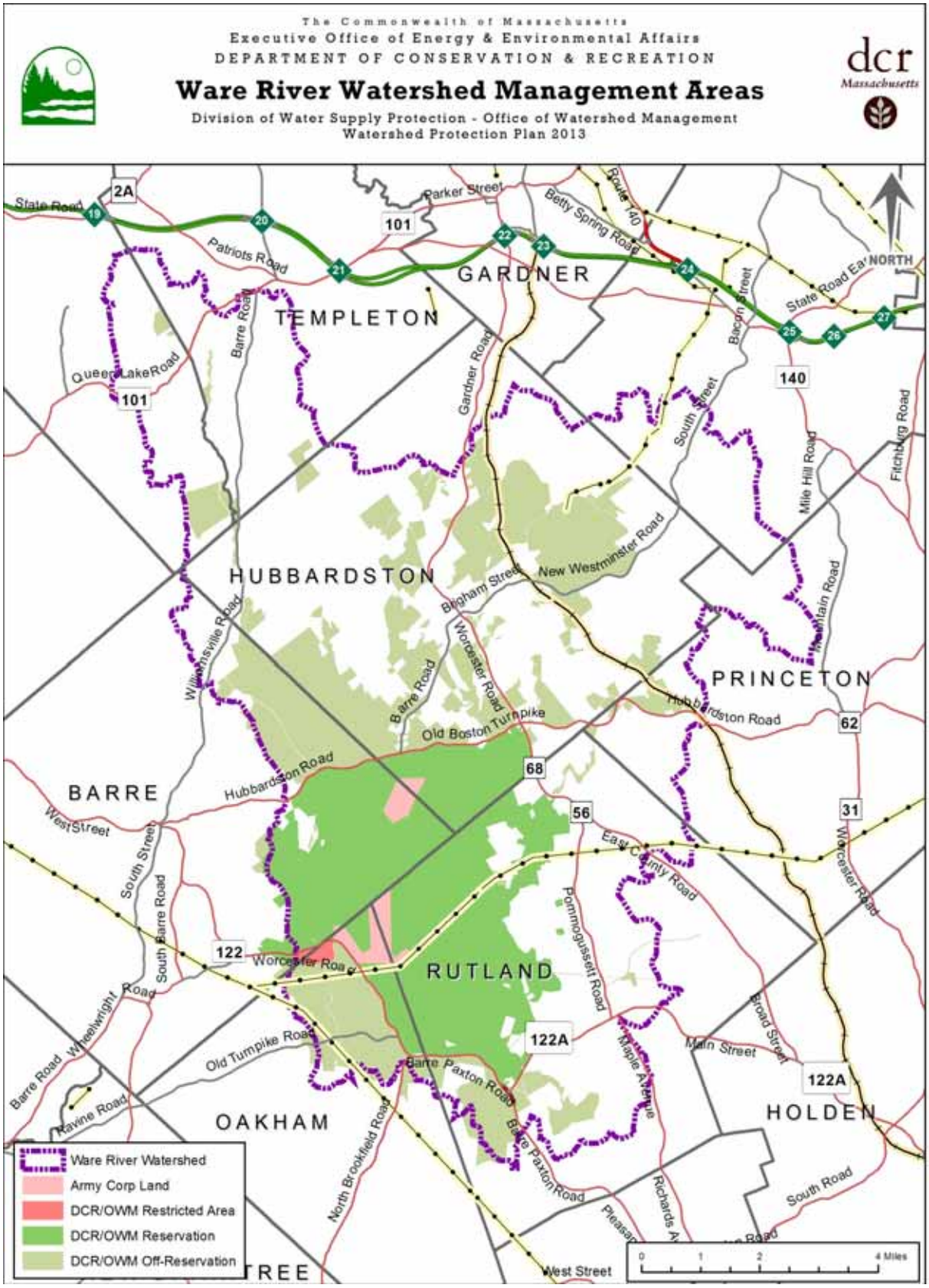
Table 5-2: Ware River Watershed Public Access Rules

Activity	Ware River Reservation	Ware River Off-Reservation	Ware River Intake Zone (Restricted Area)
VEHICLE ACCESS			
Motorized			
Driving – vehicles registered for public roadways	☐1	☐1	⃠
Snowmobiling – designated area only	☐2	☐	⃠
Operating ORVs – ATVs, dirt bikes, etc.	⃠3	⃠3	⃠3
Non-Motorized			
Bicycling – DCR roads only	☐4	☐4	⃠
FOOT ACCESS			
Wildlife Viewing/Nature Study	☐15	☐15	⃠
Hiking/Walking/Snowshoeing/ Cross-country Skiing	☐15	☐15	⃠
Hunting and Trapping	☐5	☐5	⃠
Ice Fishing and Ice Skating	☐6	☐6	⃠
Shore Fishing	☐6	☐6	⃠
Fires and Cooking – includes gas grills	⃠	⃠	⃠
Dogs and Domestic Animals – includes hunting with dogs	☐7	☐7	⃠
Horseback Riding – designated routes	☐8	☐8	⃠
WATER ACCESS			
Boating (motorized)	⃠9	☐10	⃠
Boating (non-motorized) – canoes and kayaks	☐11	☐11	⃠
Swimming/Wading	☐12	☐12	⃠
Operating Personal Water Crafts – jet skis	⃠	⃠	⃠
OTHER ACTIVITIES			
Night Access	☐	☐	⃠
Overnight Camping	⃠	☐13	⃠
Organized Sports	☐14	☐14	⃠
Programs/Assemblies	☐15	☐15	⃠
Fishing Derbies	☐14	☐11	⃠
Geocaching	☐16	☐16	⃠
Trail Clearing/Trail Marking/Advertising	⃠	⃠	⃠
Possessing Alcoholic Beverages	⃠	⃠	⃠
Collecting/Metal Detecting	⃠	⃠	⃠
Target Shooting	⃠	⃠	⃠
Other	**CHECK WITH DCR VISITOR CENTER**		
Legend: ⃠ Prohibited; ☐ Allowed with general restrictions (below); ☐# Allowed with specific restrictions			

☐ General public access on DCR lands is allowed through gates and bar-ways in designated areas only. Any activity which injures or defaces the property of the Commonwealth is strictly prohibited. Night access is allowed on DCR lands in the Ware River Watershed. These policies are based on Watershed Protection regulations, 350 CMR 11.00.
Ware River Reservation: all DCR-controlled lands and waters within Rts. 122, 122A, 56, 68, and 62.
Ware River Off-Reservation: DCR-owned lands within the Ware River Watershed located outside of Rts. 122, 122A, 56, 68, and 62.

Specific Restrictions for Public Access on DCR Lands in the Ware River Watershed	
☐1	Registered motorized vehicles are those registered for operation on public ways. Their access is restricted to certain maintained DCR roads at open gates. Motorized vehicles are prohibited on DCR roads beyond closed gates or bar-ways and within the Intake Zone.
☐2	Snowmobiles are allowed with specific restrictions on DCR designated snowmobile areas only. Restrictions include season, snow depth, and mph. DCR Designated Snowmobile Access Map is available from the Quabbin Visitor Center, Ware River Field Office, or on the DCR website listed below.
☐3	The operation of ORVs is prohibited on DCR-Watershed lands and roads.
☐4	Bicycling is allowed on DCR-Watershed roads. Off-road bicycling and off-road trail riding is prohibited. Bicycling is prohibited during mud season when DCR roads are closed by gates or signs. DCR Bicycle Access Map is available from the Quabbin Visitor Center, Ware River Field Office, or on the DCR website listed below.
☐5	Hunting is allowed with a valid Massachusetts hunting license according to State regulations. State regulations prohibit hunting on Sundays. Hunting within WMA has specific restrictions; see www.mass.gov/dfwele/dfw/regulations/regulations_wma.htm.
☐6	Fishing access is allowed with a valid Massachusetts fishing license according to State regulations.
☐7	DCR requests visitors to pickup and properly dispose of any fecal waste within 100' of a tributary or surface waters.
☐8	Horseback riding access is allowed on DCR Designated Horseback Riding Routes only in the Ware River Watershed and according to specific restrictions (e.g., no riding during mud season, permit required for group rides of 15 or more, no watering of horses in tributaries, etc.); see Fact Sheet for additional information. DCR Designated Horseback Riding Roads and Trails Map is available from the Quabbin Visitor Center, Ware River Field Office, or DCR website listed below.
☐9	Motorboat use within waters of the Ware River Reservation (e.g., Whitehall Pond) is prohibited.
☐10	Motorboat access from DCR lands in the Ware River Off-Reservation is allowed according to the AIS Management Plan and with these restrictions: ➢ Motorboat access facilities (ramps) are provided only on DCR lands at the following locations – Brigham Pond, Demond Pond, Comet Pond, and Long Pond. ➢ Boat motor size off DCR ramps is limited to 20 hp(2 stroke) and 25 hp (4 stroke). ➢ DCR annually issues a limited number of DCR Long Pond Access Permits for boats with motors greater that 20 hp. This permit allows the holder to use a 20+ hp motor on Long Pond from Memorial Day to the last day in September between 10 AM and 6 PM.
☐11	Non-motorized boating access is allowed from DCR lands in the Ware River Reservation and Off-reservation according to the AIS Management Plan.
☐12	Limited swimming access is allowed within a designated area of Rutland State Park and Comet Pond Beach – DCR-Park managed facilities – according to posted restrictions and designated season.
☐13	Camping includes the use of tents, trailers, lean-tos, and motor homes. Camping access is prohibited within the Ware River Reservation. Limited camping on DCR Off-Reservation is allowed only with written permission from the Regional Director. Contact the Quabbin Visitor Center for more information at (413) 323-7221.
☐14	These activities are allowed only by written permission by the Quabbin Section Regional Director.
☐15	Groups up to 25 individuals are asked to notify DCR prior to access on DCR lands. Groups exceeding more than 25 individuals or 15 horseback riders with horses (in the Ware River Watershed only) are required to submit a DCR Group Access Permit application at least two weeks prior to access date. Contact Quabbin Visitor Center, Ware River Field Office, or DCR's website for an access permit application.
☐16	Geocache placement requires prior DCR-Watershed permission using self-verification process with registration described on Fact Sheet.

Figure 5-1: Ware River Public Access Management Areas



The Long Pond Permit Program has been in effect since 1988 and controls access to larger boats (20+/25+ horsepower motors) on the pond between Memorial Day and September 30 through a permit system. DWSP and the Long Pond Boaters Association have worked out details of the program.

As part of the Aquatic Invasive Species program, DWSP has two voluntary self-certification locations at boat ramps at Long Pond and Comet Pond.

Accomplishments

The Ware River Public access plan was updated. Significant staff time was spent on the update, including the development of a user survey. Informational kiosks were updated with new and current public information. New signs were posted in the watershed.

Five Year Objectives

- Implement, evaluate, and update the *Ware Public Access Management Plan* by 2019.
- Collaborate with other organizations, such as Wachusett Greenways, for increased user education and public outreach.
- Enhance and simplify signage along boundaries and major access points.
- Enhance or maintain communication channels with major user groups and the Ware River Watershed Advisory Committee.

5.6 Watershed Security

Goal: Maintain and improve watershed security programs to provide surveillance of the watersheds and protect the watershed system from potential threats.

The components of the Water Supply System that are considered most vulnerable in the Ware River watershed are under the control of MWRA, who provides the majority of the security to those facilities. Watershed Rangers are assigned to Ware River watershed patrols on an regular basis. The ACOE also has a Ranger Section that provides additional security to the land they control within the watershed.

Security checks of the Oakham field office are made during all Ranger patrols, along with checks of MWRA and ACOE facilities made under agreements with those agencies. The area immediately surrounding the Shaft 8 Intake Works is identified as a high security zone, and thus receives special attention. Several shafts leading to the Quabbin Aqueduct are located in the Ware River watershed. While these are controlled by the MWRA, they nonetheless represent high security areas that require DWSP Watershed Rangers' and other staff's vigilance.

Watershed Security is also enhanced by a cooperative relationship with State Police, Environmental Police, local police and MWRA.

Physical barriers, such as gates and barways, serve to protect certain areas of the watershed. Vandalism of these barriers occurs infrequently.

Opportunities exist to utilize new technology opportunities (e.g., smart tags, dedicated email for reporting suspicious activities) as part of the security program.

Accomplishments
Watershed Rangers continued patrols and security checks, including gates, barways and facilities. They participated in several incidents which required EPO involvement.

Many security improvements have been made by both MWRA and DWSP over the past years. Due to security concerns, these improvements will not be listed here.

Five Year Objectives
- Continue to use, improve, and integrate Incident Command System (ICS) to respond to emergency situations.
- Coordinate with MWRA in order to maintain a comprehensive system-wide approach on all security issues.
- Finalize Quabbin/Ware River Emergency Response Manual.
- Improve physical access control structures, as necessary, and implement a maintenance program.
- Continue to work with local, state, and federal responders.
- Maintain and/or enhance working relationships and information-sharing among local enforcement personnel, MWRA, Watershed Rangers, Army Corps of Engineers and the DWSP Oakham office staff.

5.7 Infrastructure

Goal: Provide resources to maintain the integrity of all high hazard dams under DWSP control, to maintain and improve DWSP facilities long-term, and to maintain internal roadways to allow them to sufficiently support their use for the water supply protection program.

This program involves maintenance and/or inspection of DWSP-owned buildings, small dams, and associated roads, culverts, and bridges in the watershed. In addition, DWSP owns the trail, bridges, and tunnels associated with the rail trail, although Wachusett Greenways is partly responsible for maintenance of these structures.

Boat access at Long Pond and Comet Pond, although formally under control by the Office of Boating and Fishing, is seasonally controlled by DWSP staff. The parking lot at Comet Pond is plowed in winter, and jersey barriers are put in place during winter to prevent vehicles from driving onto the ice.

Accomplishments
DWSP has been working under a dam safety order since 2008 to repair the Brigham Pond Dam. New stop logs were installed. Engineering staff worked with a consulting firm on cost estimates for removal of Brigham Pond dam, then drafted rehabilitation plans for MWRA CIP funding, which was not approved. Work also continued on the removal of Cunningham Pond dam, including wetland flagging, mapping, topographic survey, and sediment sampling.

Staff performed numerous inspections, including storm-related surveys, of several dams in watershed, including Comet Pond dam, Demond Pond dam, and Brigham Pond dam. A culvert study was also conducted to document the locations of all culverts on DWSP lands.

As part of the rail trail expansion, Wachusett Greenways installed a tunnel under Rt. 56 in Rutland and several bridges over Parker Brook. Wachusett Greenways has started work on a new bridge over the Ware River downstream of the Shaft 8 building.

Five Year Objectives

- Continue maintenance and rehabilitation of DWSP facilities and roads.
- Continue to resolve structural and maintenance problems with particular small dams in the watershed in accordance with recommendations in dam inspection reports.
- Evaluate the feasibility of removing or repairing unsafe small dams in the watershed.
- Assure that all DWSP-owned small dams in the Ware River watershed are in compliance with Massachusetts dam safety regulations.

5.8 Watershed Protection Act

Goal: Enhance protection of the water supply through implementation of the Watershed Protection Act, which regulates land use in critical areas of the watershed.

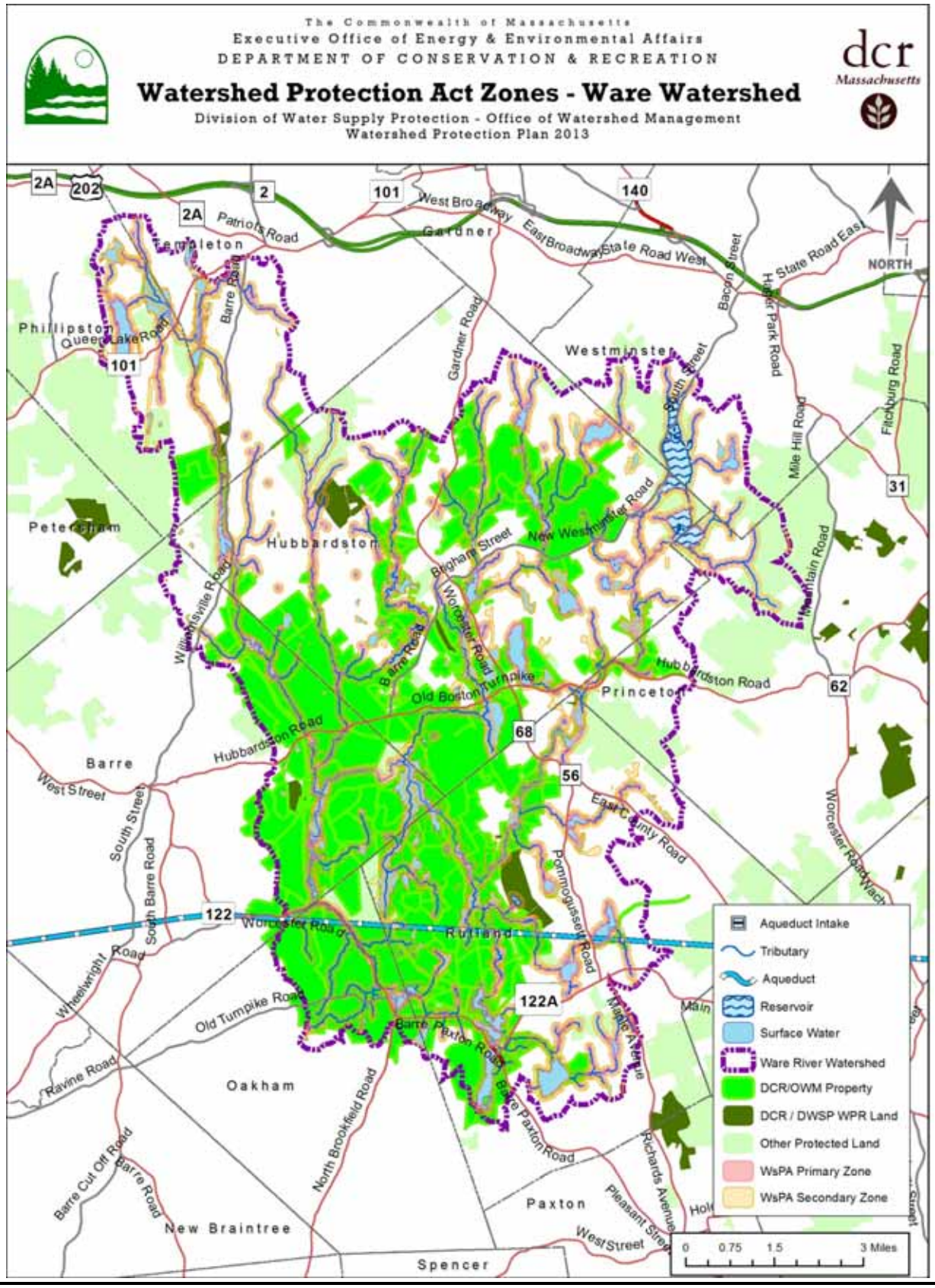
The WsPA regulations, 350 CMR 11.01-11.08, applies to these towns in the Ware River watershed: Barre, Hubbardston, Oakham, Phillipston, Princeton, Rutland, Templeton, and Westminster (Figure 5-2). Landowners proposing certain construction or other land use activities within established buffer zones along the rivers and streams or surface waters of the Ware River watershed must comply with such restrictions and may apply to the DWSP for either a determination of non-jurisdiction, exemption, or compliance, or for a variance that allows them to proceed with their plans (possibly with certain restrictions).

The WsPA legislation mandates that "a program of technical assistance" be provided to those watershed communities affected by the Act's regulations (Chapter 36 of the Acts of 1992, Section 15). Environmental Planning and Environmental Quality staff support initiatives that enhance local land use protection capabilities. Staff, upon municipal request, may assist local boards in their review of particular development proposals, and at times are asked to provide clarifications of the various statutes which govern land use planning and regulation.

Accomplishments

Staff effectively implemented the WsPA, maintaining both inter- and intra-agency coordination, and completed 124 WsPA applications in the Ware River watershed between 2008 and 2012.

Figure 5-2: Ware River Watershed Protected Open Space and Watershed Protection Act Regulated Areas



Numerous DWSP staff participated in several active enforcement cases, including the Bear Hill subdivision in Rutland. Judicial rulings have been made that support DWSP's enforcement of the WsPA, including decisions by the Division of Administrative Law Appeals, the MA Superior Court, and the Supreme Judicial Court. Staff also updated guidance documents and continued to work with local town officials. Staff purchased and distributed zoning, wetland, and soil testing manuals to each watershed community's planning and zoning boards, building inspectors, conservation commissions, and boards of health.

Five Year Objectives

- Continue to implement the Watershed Protection Act.
- Maintain good relations with building inspectors and other town permitting staff and boards to enhance the notification of potentially affected parties of WsPA requirements.
- Provide direct professional support on land use planning or other associated topics, to watershed communities upon request and within staff time and capabilities.
- Generate interest in the EOEEA/DWSP model Natural Resource Protection Zoning in the watershed towns and assist in the adoption of these zoning bylaws.
- Support regional or statewide initiatives, such as statewide zoning reform, that will improve local land use, environmental, or public health decision making.

5.9 Interpretive Services

Goal: Provide educational opportunities through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions to inform the public about watershed protection and drinking water issues.

The Interpretive Services program provides public education for students, local residents and visitors on the importance of watershed protection. Services are mainly provided by Interpretive Services staff based at Quabbin Reservoir. Ware River field staff handle inquiries occasionally and as time allows.

The program is administered in three ways:

- The Quabbin Visitors Center provides information and responds to inquiries about the Ware River watershed. The Quabbin Visitors Center also handles public relations and group access permitting and maintains a library of Ware related records.
- Visitor education is primarily through informational kiosks, as there are no interpretive services staff assigned to Ware River.
- Community education to the watershed and user communities for school groups and the general public is provided through the Quabbin Visitors Center and Watershed Rangers.

Accomplishments

Informational kiosks in the watershed were updated. Staff at the Ware River field office and Quabbin Visitor Center answered questions and provided information when requested. Work began on the Ware River Interpretive Plan.

Five Year Objectives

- Maintain and/or initiate new information sites (e.g., kiosks) and programs in the Ware River watershed.
- Collaborate with other organizations (e.g., Wachusett Greenways) for dissemination of visitor information.
- Add kiosk at Ware River snowmobile bridge with general information and brochures.
- Scan Metropolitan District Water Supply Commission Real Estate taking sheets into electronic format.
- Complete the Interpretive Services Plan for the Ware River watershed.
- Distribute the *Downstream* newsletters to watershed residents.
- Use Watershed Ranger patrols in the watershed as a vehicle for public education.
- Continue to offer guided interpretive walks and school group presentations.
- Expand the DWSP website to provide additional information and resources for the Ware River watershed.

5.10 Water Quality and Water Quantity Monitoring

Goal: Conduct tributary and reservoir sampling to identify short-term water quality problems and to maintain the historical record for long-term trend analyses. Collect hydrologic data to support water quality work and reservoir operations. Conduct analyses and assessments of data for use in management decisions.

The Water Quality Sampling Program is designed to characterize and monitor water quality in the different subbasins of the watershed, usually in conjunction with EQAs (see Section 5.13). Sampling results are summarized in an annual water quality report and are incorporated into EQA reports. Constituents are added to the sampling list as needed, such as calcium for zebra mussel evaluation. Additional sampling is performed in response to elevated bacteria at sample sites or during enforcement activities.

Tributary Monitoring

Surface water monitoring sites are monitored biweekly. The number and locations of sites varies annually, depending on assessment and monitoring needs (Figure 5-3). Some sites are sampled every year and provide long-term data. Tributary samples are analyzed for some or all of the following parameters: bacteria (total coliform and fecal coliform), turbidity, calcium, nutrients, alkalinity, UV, pH, temperature, dissolved oxygen, and specific conductance. This data is analyzed and reported annually and summarized every ten years.

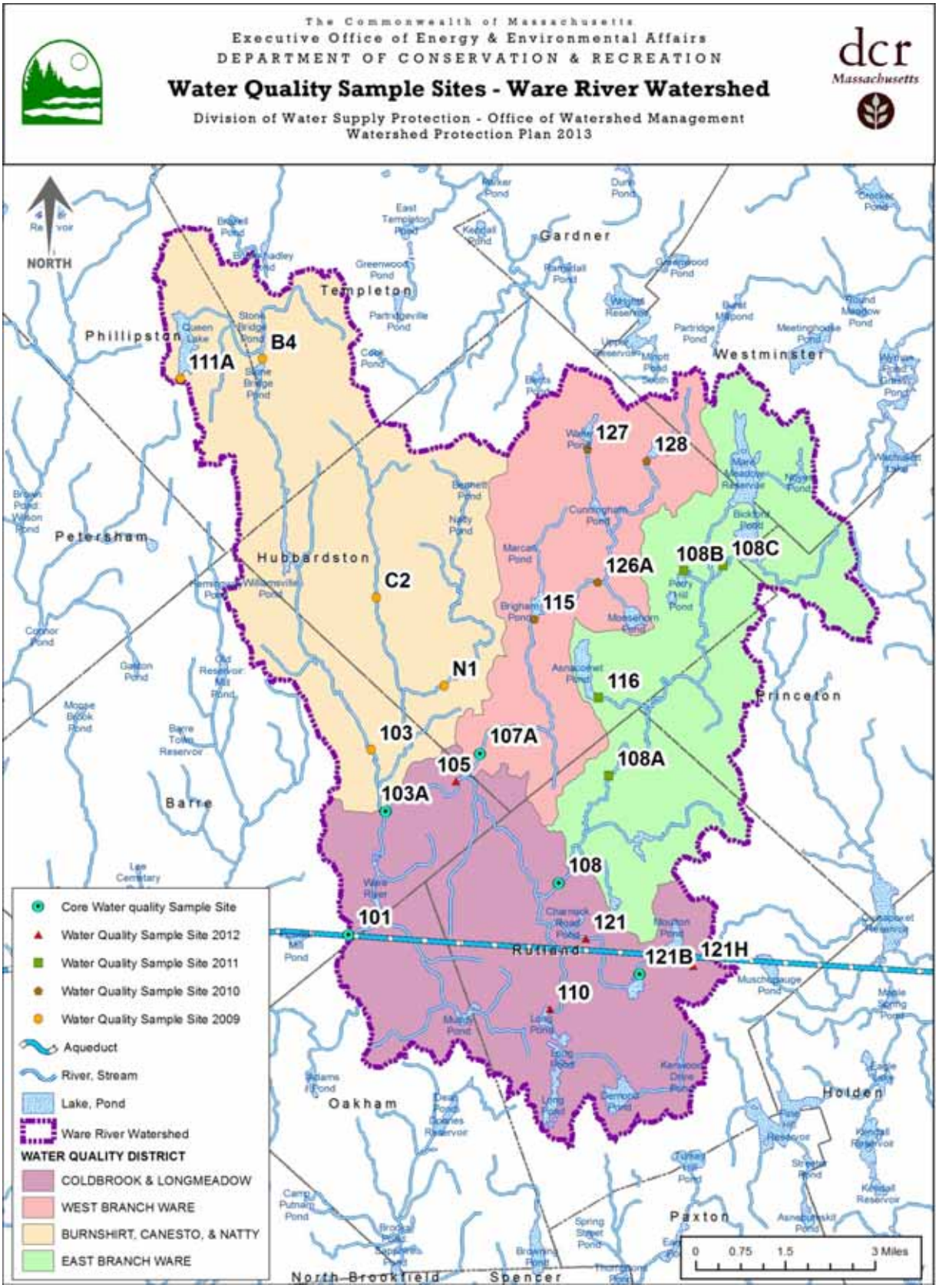
Shaft 8 - Intake

Samples are collected from Shaft 8 as part of routine tributary monitoring. This is a long-term, historical monitoring site.

Forestry

Within the Ware River watershed, forestry sampling consists of baseline samples prior to logging and periodic samples during work.

Figure 5-3: Water Quality Sample Sites – Ware River Watershed



Water Quantity
The US ACOE at Barre Falls Dam maintains stream gages below the dam and at Barre Plains. The USGS maintains a stream gage (number 01172500) on the Ware River downstream of Shaft 8. In addition, MWRA has gages in the Shaft 8 intake building.

Accomplishments
Routine tributary sampling and analysis, as well as macrophyte surveys on ponds and lakes, were completed throughout the watershed. Targeted investigations were performed at tributary sampling sites with high bacteria counts. A ten year water quality data review was produced.

Various activities were conducted related to Ware River diversions, including surveys of the intake area prior to diversions, sample collections at Shaft 11A for AIS during diversions, deployment of more effective *Didymo* samplers, and AIS sampling in the Ware River watershed following river drawdown.

Five Year Objectives
- Continue routine tributary and reservoir sampling program to identify short term water quality problems and to maintain the historical record for long term trend analysis, with annual adjustments to the sampling plan to adapt to changing conditions.
- Conduct a short-term forestry water quality monitoring program by developing and implementing a coordinated system of planning, implementation, feedback/review, and monitoring of forestry operations.
- Evaluate the need for expanded sampling and/or inspections in the vicinity of Shaft 8 during periods of water diversions.
- Continue to survey for aquatic invasive species.
- Conduct targeted sampling at specific problem sites (e.g., new subdivisions).

5.11 Watershed Monitoring and Surveillance

Goal: Use site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations

The Watershed Monitoring and Surveillance Program uses site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations or water quality problems. Potential issues are identified from sample results, field observations, file reviews and information from watershed users and residents. An informal network of town residents, local board members and officials, and employees of other state agencies routinely provide information to DWSP.

Suspected issues are investigated, identified, and mitigated. DWSP staff refer potential violations of other laws and regulations to appropriate agencies.

Accomplishments

During the previous five years, substantial staff time was spent on enforcement sites at Bear Hill subdivision, and to a lesser extent, Carlson's Way subdivision. Carlson's Way subdivision involved significant field monitoring and collaboration with DEP, Rutland Conservation Commission, and the site owners. The site is currently stable.

The most significant enforcement case was Bear Hill subdivision in Rutland. The case began in 2005 with permitting, however, after construction activities started, rapidly degrading site conditions resulted in numerous enforcement actions which reached a Final Judgment and Order in Superior Court. DWSP continues to work closely with the Office of the Attorney General and DEP on this case. Inspections and monitoring of corrective actions are ongoing at Bear Hill subdivision, and will likely continue for the next several years.

Conservation commission meetings were regularly attended in Rutland and Hubbardston, and a number of inspections were conducted on potential problem sites. Staff collaborated with other local officials on a number of issues.

Several potential water quality/quantity problems were investigated, including high bacteria levels at numerous sites and a potential dam removal site in the watershed. Road reconstruction projects on Rt. 62 and Rt. 122 were monitored and inspected. Staff also routinely monitored both the UST and the 21e databases from DEP for new sites and conducted file reviews on existing sites. Potential violations of other regulations – Wetlands Protection Act, Solid Waste regulations and local town bylaws – were referred to the appropriate enforcement agencies.

Five Year Objectives

- Continue to use fieldwork, local contacts, and EQAs to find violations of environmental regulations.
- Continue to enforce all environmental regulations and, when necessary, coordinate with other agencies, such as DEP and Office of the Attorney General.

5.12 Aquatic Invasive Species Management

Goal: Prevent introduction of Aquatic Invasive Species through monitoring, public education, exclusion, and decontamination measures at potential entry points.

AIS program activities within the Ware River watershed include surveys of ponds and rivers, and the identification, collection, and analysis of plants and zooplankton. Some water bodies are surveyed annually, while others are done in conjunction with EQAs.

Macrophyte surveys are done during the growing season and have been completed on a regular basis since 2010.

Monitoring is conducted at Shaft 8 to assess the potential for AIS in diversion water. Zooplankton are collected and analyzed monthly from Shaft 8. A *Didymo* sampler at Shaft 8 is

deployed (unless there is ice cover) and is also checked monthly. In addition, MWRA conducts invasive species surveys.

DWSP runs a self-certification program for boaters at Long Pond and Comet Pond. The Long Pond boat permit program serves as an educational and control program. Staff also conduct outreach and education through signage, newsletter articles, and talking with users at boat ramps in the watershed.

Accomplishments

DWSP staff hired an Aquatic Biologist for the Quabbin/Ware River watersheds. Staff monitored and collected samples from numerous water bodies in the watershed. Several invasive species of plants were found, but no invasive microorganisms have been found.

Five Year Objectives

- Continue monitoring for AIS.
- Evaluate feasibility of pre-diversion surveys for AIS at Shaft 8.
- Eradicate any new infestations of AIS before they become problematic.

5.13 Environmental Quality Assessments

Goal: Continue to conduct scheduled Environmental Quality Assessments and develop actions to correct identified problems.

Environmental Quality Assessments (EQAs) provide an important means of assessing conditions on specific portions of the watershed, and these help guide testing, enforcement, or mitigation actions. EQAs are based on field inspections, water quality data review, a review of records, and other available information. They are generally conducted on a district basis by EQ staff. Both the assessment and mitigation components of this program receive equal consideration during the EQA process.

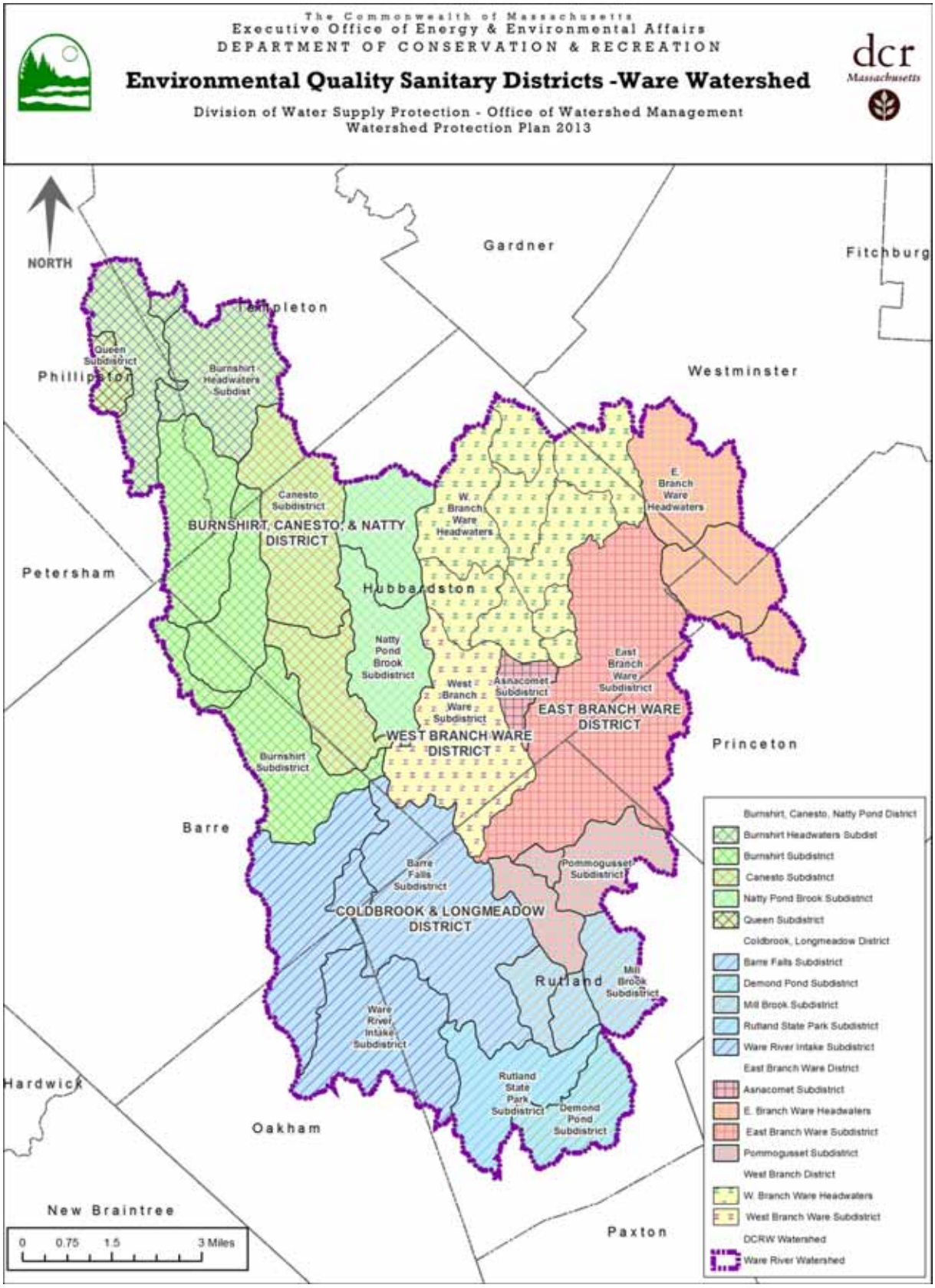
Four districts and 16 subdistricts have been delineated for the Ware River watershed (Figure 5-4). In general, one district assessment is completed each year, resulting in a four-year rotating cycle (Table 5-3).

Table 5-3: Ware River Watershed Environmental Quality Assessment Schedule

Sanitary District	Completed Plans	Future Schedule
East Branch Ware River	1994, 2012	2016
Coldbrook & Longmeadow	1992, 1994, 2009, 2013	2017
Burnshirt, Canesto, & Natty Pond	1992, 2010	2014
West Branch Ware River	2000, 2008, 2011	2015

Goals for the program are to continue to conduct Environmental Quality Assessments on the schedule and develop actions to correct identified problems.

Figure 5-4: Ware River Watershed EQA Districts



Accomplishments
EQ staff completed five EQAs: Coldbrook and Longmeadow 2009, 2013; Burnshirt Canesto & Natty Pond, 2010; West Branch Ware River, 2011; East Branch Ware River, 2012. Mitigation of several issues identified during EQAs was completed. Staff conducted an extensive file review for the Old Templeton Landfill and performed inspections at the landfill with DEP staff.

Five Year Objectives
- Continue to conduct Environmental Quality Assessments as scheduled; revise as needed and add stormwater treatment and gravel pits.
- Incorporate specific recommendations from EQAs into annual work plans. Present and share findings and mitigation measures annually.
- Evaluate options for an EQA database easily accessible to Ware River watershed staff.
- Coordinate with staff who may have additional information to include in the EQAs.

5.14 Wastewater Management

Goal: Monitor installation of on-site wastewater disposal systems and operation of Rutland-Holden sewer to ensure proper treatment of waste.

The majority of the Ware River watershed is served by on-site wastewater disposal systems. Staff monitors to ensure compliance with all applicable regulations, particularly in regulated areas.

Accomplishments
A pilot program through the EQA surveys conducted several desk top experiments to derive a better estimate of the number and location of septic systems in Rutland. The data had limited use in the sub-basin analysis, and it was determined that the program could not be implemented on a watershed-wide basis. DCR continues to communicate directly with each community's Board of Health on septic system issues. The septic system at DWSP Ware River field office was replaced.

Five Year Objectives
- Identify larger on-site systems with inspection requirements under DEP regulations.

5.15 Stormwater Management

Goal: Develop and implement actions to reduce stormwater loadings, including ongoing identification of stormwater inputs and continuation of stormwater BMP construction on DWSP land.

Stormwater management within the Ware River watershed is primarily treatment systems at newer subdivisions and road drainage. A significant portion of roads in the Ware River watershed have country drainage. Dirt roads, both DWSP and town owned, are common. Stormwater management of paved roads with culverts is handled cooperatively with other agencies, primarily MassDOT. Staff monitor and provide input on road projects, particularly those that involve stormwater discharge.

Accomplishments
Staff monitored and inspected road reconstruction projects on Rt. 62 and Rt. 122.

Five Year Objectives
- Strive for early input into state and local road reconstruction projects to more effectively influence stormwater management design aspects of the projects.

5.16 Emergency Response

Goal: Maintain and improve emergency response capabilities to assist local responders and protect the water supply.

Despite the best efforts to implement control over forestry, public access, maintenance, and other activities on the watershed, emergency situations – especially those involving spills of hazardous materials – can result in immediate threats to public drinking water supplies. Accordingly, DWSP strives to identify and control potentially hazardous situations in the watershed, including undergoing training and other preparation to deal with hazardous materials spills.

The components of this program include training, purchase and staging of spill response materials, development of SOPs for emergency situations, and follow-up procedures. Responsibility for emergency response in the Ware River watershed is divided among several work units: Administrative and Technical Support (ATS) staff are responsible for developing response plans and training; the Assistant Regional Director (ARD) serves as the Incident Commander during actual emergency situations; the Watershed Rangers are often the first responders in emergency situations and thus have additional training and response equipment; and staff from most other work units obtain training so they can conduct boom deployment and other spill response tasks.

Accomplishments
Preliminary activities for the Ware River Watershed Emergency Response Handbook have been completed, however the handbook has not been finished. Staff worked with EPOs and local law enforcement in pursuing an incident involving the dumping of construction debris in the watershed. All staff completed ICS 100 and NIMS 700 trainings. Selected staff also completed ICS 300 and/or ICS 400. Spill response plans were developed for all active harvest operations.

Five Year Objectives
- Continue to provide emergency response support services, maintain response supplies and up-to-date contact lists, and participate in mock hazardous release exercise for training purposes.
- Complete the emergency response handbook for the Ware River watershed, similar to the one currently being produced for Quabbin, including emergency contact information.
- Maintain inventories of emergency response equipment and supplies and stage them at appropriate locations in the watershed.
- Produce spill response plans and spill notification cards for logging operations, and continue to offer spill response training, with continuing education credits, for loggers working on the watershed.
- Develop emergency spill response kits that can be deployed at logging sites.

6. Wachusett Reservoir Watershed Control Programs

6.1 Land Procurement

Goal: Use money allocated for land acquisition in MWRA's capital budget for the purchase of critical lands by fee and Watershed Preservation Restriction (WPR).

DWSP formed the Land Acquisition Panel (LAP) to determine the most appropriate and efficacious way to prioritize land procurement options in the Wachusett Reservoir watershed. The LAP developed a land acquisition model that incorporated various geographic, hydrologic, and regulatory parameters to develop weighted criteria to identify critical parcels. The resulting Wachusett Land Acquisition Model Map has guided LAP's land acquisition prioritization process for the past fifteen years.

Accomplishments

Almost $103 million has been spent since 1985 on watershed land acquisition in the Wachusett Reservoir watershed. The MWRA's 1993 Consent Order with DEP required DWSP to acquire 25 percent of the Wachusett Reservoir watershed in order to avoid filtration. DWSP achieved that goal through a combination of aggressive land acquisition and a "care and control agreement" with State Parks and DFW that incorporated their lands located in the watershed. Approximately $9 million was spent on land acquisition in the Wachusett Reservoir watershed from FY08 to the first half of FY13, increasing the total acreage controlled by DCR to over just over 20,000 acres. In addition to the 28.6 percent controlled by DWSP, there are approximately 12,500 additional acres (17.7 percent) of protected open space in the Wachusett watershed (Table 6-1 and Figure 6-1).

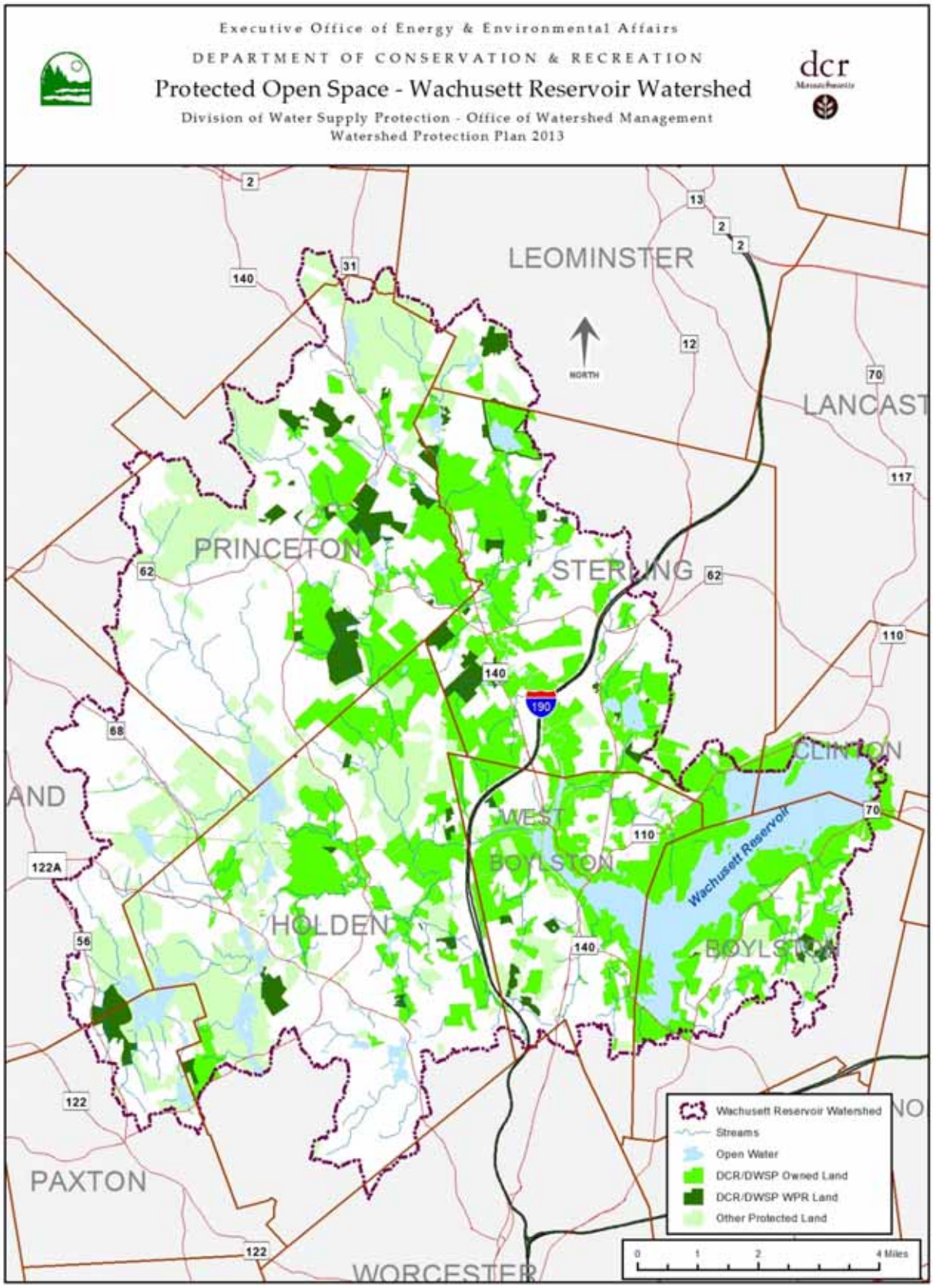
Table 6-1: DWSP Controlled Land within the Wachusett Watershed, 1985-2013

1985		2008		2013	
Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
5,608	7.9%	18,888	26.8%	20,233	28.6%

Source: GIS 2013 and Watershed Preservation Restrictions deed descriptions. Acres includes WPRs.

All recommendations from the *2008 Watershed Protection Plan Update* have been addressed. Highly rated properties were purchased by fee or protected through WPRs, with emphasis on WPRs. Staff made a concerted effort to acquire land through gifts or through cooperative efforts with land trusts. Both large-scale subdivision development and smaller scale commercial and residential development continues in the Wachusett Reservoir watershed although at a slower pace. Future land acquisition efforts are focused on highly rated remaining undeveloped land area.

Figure 6-1: Wachusett Reservoir Watershed Protected Open Space



Five Year Objectives

It is important to recognize that there may be opportunities to acquire important watershed property. Numerous smaller holdings within the watershed will continue to be offered as changes in ownership and market conditions motivate people to sell undeveloped tracts. The MWRA has agreed to continue to support land acquisition efforts for the next five years at an approximate level of $1 million per year, although that will be for the entire system and not just the Wachusett watershed. The program will be re-evaluated at the end of FY17, with new objectives and a proposed extended budget.

- Purchase land by fee or, whenever possible, through acquisition of Watershed Preservation Restriction.
- Consider highly rated parcels from the Wachusett Land Acquisition Model (Category 4-7) for future acquisition.
- Pursue opportunities to acquire land through gifts or through cooperative efforts with land trusts.
- Reduce the amount of time it takes to complete a land acquisition project.

6.2 Watershed Preservation Restrictions

Goal: Use Watershed Preservation Restrictions to increase control of watershed lands. Maintain good working relationships with land owners. Monitor for violations and resolve any that are found.

A Watershed Preservation Restrictions (WPR) is a legal agreement between DWSP and a private landowner where the landowner sells or donates the development rights of their property to DWSP while keeping ownership of the land. The WPR remains in effect in perpetuity and carries forward even if the landowner sells the property.

There has been a strong preference in recent years for acquisition of WPRs rather than acquiring land in fee. Lands protected through WPRs are less costly than outright acquisitions and do not involve payments in lieu of taxes to watershed towns. Because WPRs are still privately owned, the DWSP has ongoing stewardship obligations to make sure that the landowner is abiding by a list of restrictions, including prohibitions on construction, dumping, mining, and certain agricultural practices. Important aspects of the Watershed Preservation Restriction Program are documenting baseline conditions on all WPR properties, routine monitoring to check compliance with restrictions, resolution of any violations, and maintaining good working relationships with landowners.

Accomplishments

The proportion of WPRs to fee purchases has increased due to greater emphasis on trying to acquire a WPR on a piece of land before pursuing a fee option. There are currently 56 WPRs in the Wachusett Reservoir watershed, a 10% increase since 2008, covering 2,431 acres.

From 2005-2008, DWSP acquired a greater number of WPRs and the WPR monitoring program was faced with an increasing number of properties that needed initial baselines and continued

monitoring. In order to modernize the WPR process, several modifications to the program were proposed, including:

- Completion of WPR baseline inspections and then re-inspection of all WPRs annually.
- Creation and maintenance of a digital database of all WPRs to store WPR information. Existing data will be incorporated into the new database.
- Making the database information available to all DWSP staff.

With the addition of a new WPR Coordinator in 2009, the WPR program was able to meet many core stewardship obligations. Baseline documentation reports have been completed for all overdue WPRs, and they are now completed prior to acquisition. All WPRs have been monitored, with high-priority properties monitored two or three times. An annual monitoring schedule, however, has not been feasible with current resources.

DWSP staff is now more informed about the WPR program, as the WPR Coordinator meets regularly with other staff and distributes up-to-date GIS information. All paper data has been scanned into digital form and organized in databases. Creation of a digital database has not happened, however, due to lack of resources.

Five Year Objectives

DWSP continues to acquire new WPRs, with several large acquisitions anticipated in the next five years. As the number of WPRs increases, accomplishing basic stewardship goals with existing resources becomes less likely. This could lead to an increased risk for violations. However, with the following objectives, DWSP will be able to meet recommended stewardship responsibilities.

- Complete baseline documentation reports prior to WPR acquisition.
- Monitor each WPR every two years; monitor high-priority ones annually.
- Maintain good working relationships with landowners and resolve WPR violations.
- Maintain good records and distribute them to other staff as necessary.
- Investigate ways to increase DWSP's stewardship capabilities.

6.3 Land Management

Goal: Maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Manage all lands to minimize potential water quality impacts. Complete a comprehensive Land Management Plan for the watershed system.

The Land Management Program takes guidance from the *Wachusett Land Management Plan*, which addresses Land Protection, Forest Management, Wildlife Management, Management and Protection of Biodiversity, and Cultural Resources Protection, as well as maintenance of forest roads under DWSP control. Specific details of land management activities can be found in the Land Management Plan and are not reproduced here.

The Land Management Program incorporates principles from the current scientific knowledge of watershed and natural resource management to develop and implement policies, goals, and methods for managing DWSP lands. Forest cover provides the best protection for drinking water quality and maintaining a healthy forest will provide the best resistance and resilience to a variety of known and unknown threats. The remaining non-forested lands should also be managed in a manner to minimize potential water quality impacts.

In April 2010, the Secretary of EOEEA temporarily placed a moratorium on new timber sales and requested the existing Science and Technical Advisory Committee (STAC) conduct a review of the scientific principles that guide existing Land Management Plan objectives. The STAC was also asked to analyze DWSP proposed changes to implementation on issues such as opening sizes and retention standards. Resulting recommendations were reviewed by the existing public Advisory Committees and appropriate changes or clarifications to Land Management Plans and future watershed forestry projects will be implemented.

A clear finding of the STAC report was the need for short-term and long-term water quality monitoring of forest cutting practices. Existing monitoring programs will be supplemented to comply with this recommendation and are described in detail in Chapter 6.10.

Accomplishments

A draft Wachusett Land Management Plan 2011 – 2020 was completed and will be implemented after final review and approval. It addresses a wide range of management activities and provides specifics on a variety of topics.

Prior to the temporary moratorium on new timber sales, DWSP Foresters compiled a plan of all proposed timber harvesting activities each December that could occur during the upcoming fiscal year. The only operations not included were emergency salvage after natural events. Each January, the Foresters carefully mapped and described or marked the boundaries of each planned operation so that they would be distinguishable on the ground.

After mapping the areas where timber harvesting were proposed, the Foresters digitized site maps and completed forms describing the proposed operation in detail, including proximal wetlands and previously identified critical cultural and wildlife sites. Summaries of the planned harvests were submitted for review to the Regional Director, the DCR Archaeologist, DWSP's Wildlife Biologist, and the Director of Natural Resources.

Each spring, the DWSP's Wildlife Biologist reviewed the planned timber harvesting operations and, where necessary, conducted site visits. Environmental Quality staff also visited each site to determine if water quality sampling was necessary, and, if so, implemented baseline sample collection during dry and wet weather. Water quality sampling continued on all active sites throughout the moratorium. No significant problems were identified during the past five years.

A number of invasive plant species are currently established on DWSP properties. Control of these species is important to allow for the establishment of tree regeneration and the maintenance of native plant diversity. Invasive plant species currently found in the Wachusett Reservoir include Norway maple, Oriental bittersweet, Buckthorns, Honeysuckles, Olives, and Multiflora

rose. A comprehensive survey of invasive plant species and the extent of their spread has not been done, but an *Terrestrial Invasive Species Management Strategy* was completed in 2011.

The detection of Asian Longhorned Beetles (ALB) by a concerned resident of Worcester in August 2008 was a troubling discovery. ALB is one of the most destructive invasive insects in the country today, infesting a wide variety of hardwoods, many of which are found in the watershed forests. The Massachusetts Cooperative Asian Longhorned Beetle Eradication Project is a coordinated effort by federal, state, and local agencies; the USDA Animal and Plant Health Inspection Service (APHIS) is coordinating this effort with DCR, the City of Worcester, the US Forest Service, and the MA Department of Agricultural Resources. The goal of this project is to prevent the spread of ALB to other areas of New England. The ALB Eradication Project has established quarantine areas and protocols for surveying, and when necessary, eliminating host trees. DWSP Foresters have coordinated with this program in the removal of host tree species on approximately 250 acres of DWSP property. At present, there are 9,740 acres of DWSP land in the ALB Regulated Area.

Criteria have been developed to decide which DWSP-owned property will be maintained as fields through the agricultural permitting system. DWSP personnel created a management plan for every field that has been chosen for continued agricultural use. This plan includes a map of all required buffers, specifications for allowable fertilizers and soil testing, and restrictions on timing or number of cuts allowed and restrictions on the type and frequency of reseeding. In order to maximize wildlife value, some leased fields may be subject to additional restrictions when deemed necessary in order to conserve grassland nesting birds and other wildlife.

Reservoir shoreline areas provide breeding habitat and food resources for various wildlife species including some that could impact water quality. To address these concerns, shoreline management decisions sometime recommend conversion of grassy shoreline to woody vegetation. The North and South Dikes must be maintained free of woody vegetation in order to preserve the structural integrity of these earthen dikes, however, and are mowed several times annually to maintain a good grass condition. The downstream slopes of both dikes were recently cleared completely to meet new regulations.

The entire perimeter of DWSP land in the Wachusett Reservoir watershed, excluding the reservoir, is nearly 350 miles. Some properties are bounded by roads, railroad frontage, and shorelines, and there are sections of boundary that cross swamps and marshes that are considered too difficult to maintain, but the remaining 200+ miles of boundary line require the full scope of maintenance. Almost all have been maintained during the past five years. The remaining boundaries are scheduled for survey work and will be maintained shortly thereafter.

Although DWSP properties are clearly marked, private landowners sometimes encroach on these properties for their own use. DWSP has systematically located and investigated over 300 encroachments during the past five years. After an initial field investigation, a letter was sent to each property owner; in most cases the encroachment was easily rectified. In instances where the landowner was reluctant to comply, assistance was requested from state or local police.

Although the draft Land Management Plan also addresses wildlife management, management and protection of biodiversity, and maintenance of forest roads under DWSP control, these issues are discussed separately in Chapters 6.4 (Wildlife Management) and 6.7 (Infrastructure).

Five Year Objectives

Future land management plans will be developed for all four watersheds using a new structure. Instead of individual watershed plans, a comprehensive Land Management Plan will be developed that presents principles and practices common to all watersheds but also highlights management activities specific to each area. The Wachusett Land Management Plan will be incorporated into this new system-wide inclusive plan.

The Draft *Wachusett Land Management Plan 2011 – 2020* is complete and will be implemented after incorporating recommendations of the STAC report. An *Invasive Species Management Strategy* was completed in 2011 and will be implemented.

The completion of the STAC report and lifting of the moratorium on new logging activity will allow the DWSP to resume management of forested areas in a manner that protects water quality. Staff will also continue efforts to control terrestrial invasive plants, manage hayfields and other open areas, and deal with encroachments on DWSP property.

- Incorporate the Draft *2011-2020 Wachusett Land Management Plan* into a comprehensive system-wide plan similar in scope and format to the Watershed Protection Plan.
- Continue forestry operations and follow all documented management techniques, including oversight of active logging and monitoring of water quality.
- Continue cooperative efforts to monitor and control Asian Longhorned Beetle.
- Work to implement invasive species policy for DWSP properties.
- Complete boundary documentation and maintenance after remaining properties are surveyed. Continue to investigate all encroachment activities and follow through until situation is rectified.

6.4 Wildlife Management

Goal: Protect the water supply and infrastructure from adverse impacts caused directly or indirectly by wildlife. Continue bird harassment program, wildlife management in the reservoirs' Pathogen Control Zones, and implementation of the gull study recommendations. Protect common, rare, and significant wildlife species and their habitats.

The Wachusett watershed supports an abundance of wildlife, and a number of species are monitored by DWSP personnel or other agencies. The DWSP is required by state and a federal law to protect rare, uncommon, threatened, or endangered species, and consequently works to protect important wildlife and their habitats while minimizing or eliminating adverse wildlife impacts on watershed resources. In certain circumstances, where applicable, active management to enhance wildlife habitat may occur.

The Wildlife Management Program takes guidance from periodic Land Management Plans. The most recent version is the *Draft Wachusett Land Management Plan 2011 – 2020*. This plan includes an explanation of bird harassment activities, describes the control of aquatic mammals, and discusses problems caused by burrowing mammals. Specific details of wildlife management actions can be found in the Land Management Plan and are only summarized for this Watershed Protection Plan Update.

The bird harassment program is a year-round effort, although active harassment activities usually take place from September until the reservoir freezes and again after ice-out until April. During icy conditions, when boat use is impossible, DWSP uses an airboat to harass birds. Although some birds are present at the reservoir all day, most leave the roost shortly after sunrise, spend the day feeding away from the reservoir, and return to the reservoir to spend the night. As a result, harassment efforts are focused during the late afternoon to early evening. Daily harassment activities on the Wachusett Reservoir are supervised and carried out from shore primarily by Environmental Quality personnel. Watershed Rangers and maintenance personnel conduct harassment from boats when necessary. Staff from the Natural Resource section participate in the program through monitoring, passive harassment techniques, and program development. Active harassment is done using pyrotechnics, boats, and rarely live ammunition.

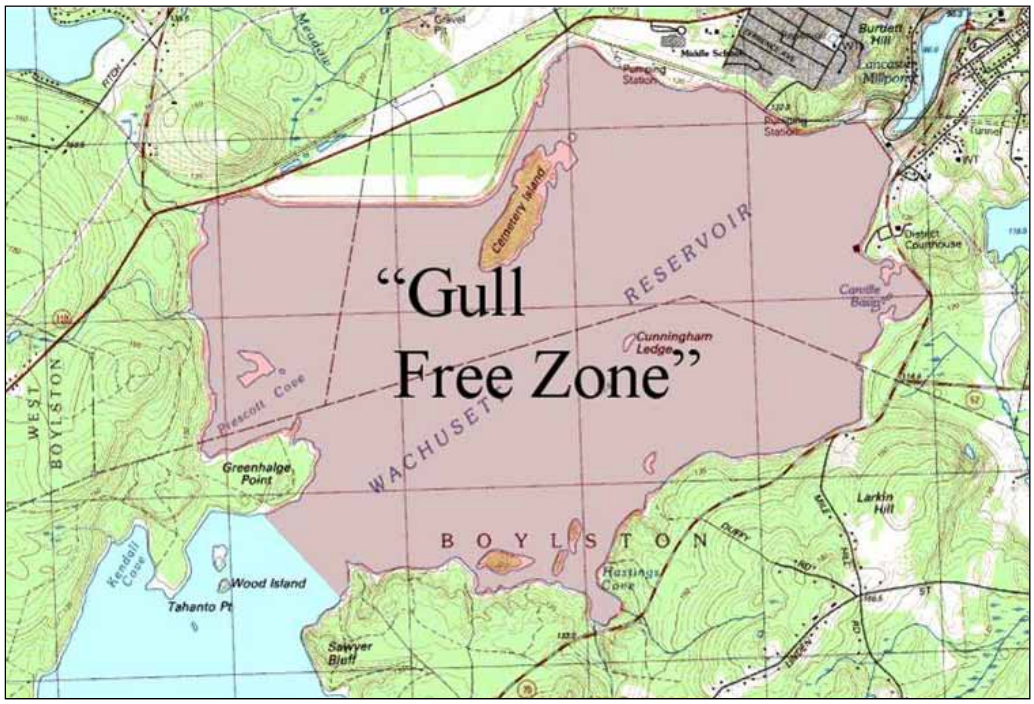
Program activities have been conducted annually since 1993. The goal of the program is to scare birds away from the north end of the reservoir as indicated in Figure 6-2. Documentation of bird numbers and movement is also important, and weekly counts of roosting birds are done just before dark. Daytime observation and harassment is done by a single observer from shore unless large numbers of birds (more than 50) are gathering at the north end of the reservoir and refuse to move. A boat is utilized when gull numbers exceed 50 and shore harassment is ineffective. Evening observation and harassment is done by one or two staff on shore and often involves two people in a boat as well. When bird numbers are excessive or birds difficult to move, a second boat is added. Observation and harassment activities usually occur five to seven days per week, with observations documented and weekly reports of activities produced and distributed.

A majority of the birds present year round at the Wachusett Reservoir are gulls, but there are also hundreds of resident and migratory geese and ducks. Harassment efforts directed at gulls are generally effective against these other birds as well. In addition, there is a seasonal population of cormorants present during the summer and fall. Although these birds are few in number relative to the other species, they usually do not respond to harassment efforts.

In addition to active harassment, several passive techniques have been used such as placing netting to exclude birds from critical areas, erecting structures that support “scary-eye” balloons, using remote activated sound deterrent stations, and manipulating habitat to discourage bird use. The DWSP has worked with other state agencies to reduce gull numbers at solid waste landfills.

To aid efforts to disperse and move gulls from the reservoir, long-term control has focused on reducing food resources. A multi-year research project is underway to identify and control alternative food sources and provide information on breeding sites and seasonal movement.

Figure 6-2: Wachusett Reservoir Gull Free Zone



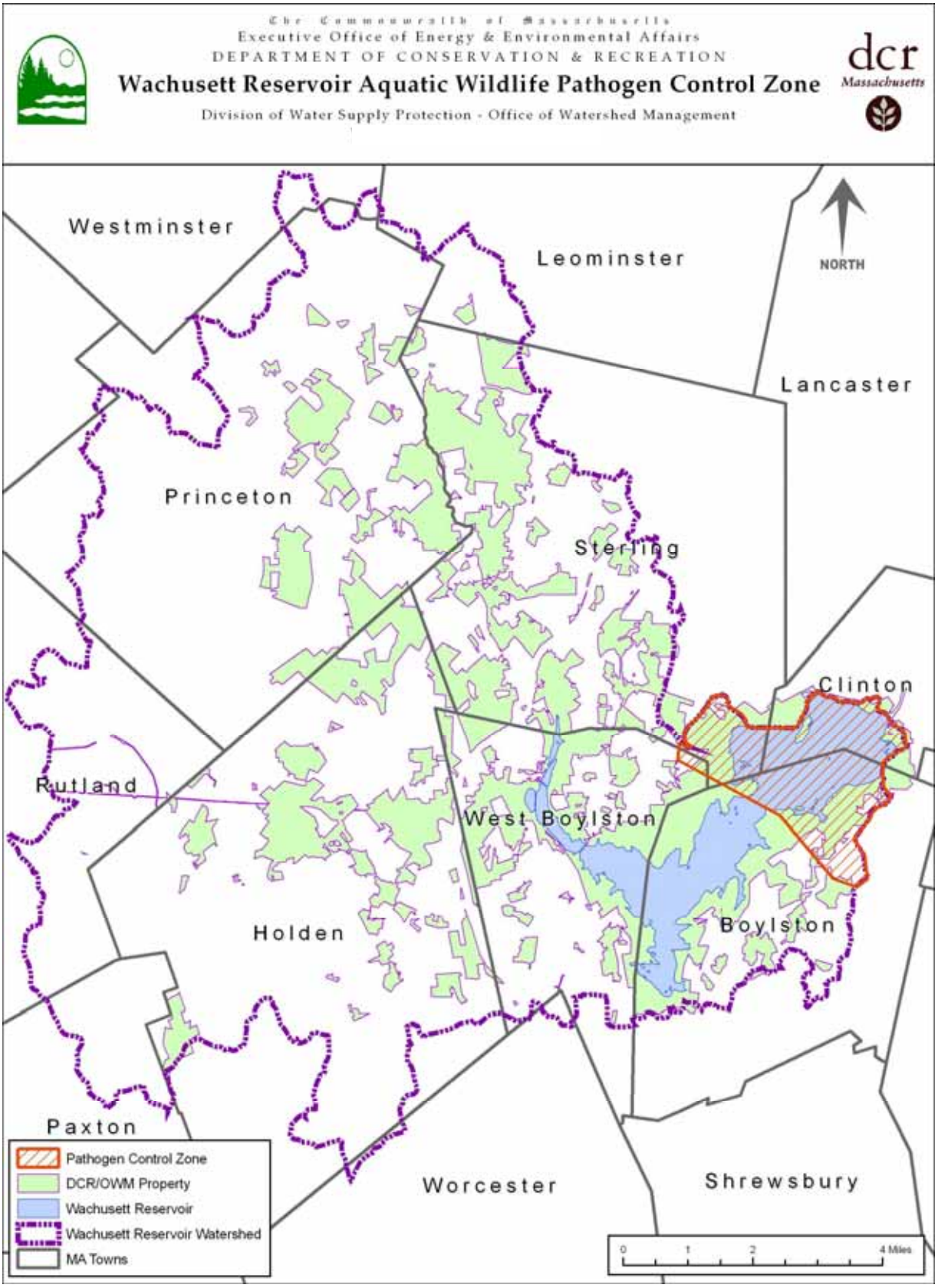
A program to reduce the year-round resident goose population focuses on locating all active nests and treating eggs to prevent hatching. The grassy shoreline along the reservoir and its islands provides breeding habitat and food resources, and habitat modification is a necessary component of any control effort.

DWSP monitors and controls populations of beaver and muskrat in the Pathogen Control Zone near the intake structure to prevent occurrence of *Giardia* spp. and *Cryptosporidium* spp. in the Wachusett Reservoir (see Figure 6-3). While most of the reservoir's shoreline provides marginal to poor beaver habitat, there are areas with sufficient resources to support beaver. Any populations at the north end of the reservoir are removed and fecal samples from all removed animals are tested for the presence of *Giardia* and *Cryptosporidium*. Individuals in other areas are removed as needed.

Aquatic and terrestrial mammals can cause damage to infrastructure including earthen dams, dikes, access roads, and other watershed structures. Lethal methods are used to remove these problem animals under the direction of the DWSP Wildlife Biologist when non-lethal methods would not be effective and as long as lethal methods will not threaten public safety, domestic animals, or other wildlife.

The DWSP works to avoid adversely impacting rare wildlife species or their habitats. It may be feasible to manage habitat in certain areas for the benefit of wildlife species that are rare or of special concern on a regional or statewide basis, but the DWSP recognizes that protection of the water supply must always take top priority.

Figure 6-3: Wachusett Reservoir Aquatic Mammal Pathogen Control Zone



Accomplishments

DWSP staff has monitored and harassed gulls and other water birds since the early 1990s. Water quality sampling determined that roosting gulls in the vicinity of the reservoir intake structure were responsible for elevated fecal coliform concentrations. Boats, pyrotechnics, and lasers were used effectively during the past five years to move birds away from the intake and maintain fecal coliform concentrations below the regulatory threshold. Documentation of all activities and results of these actions are included in weekly reports that are distributed to appropriate individuals.

A long-term study using wing tags and satellite telemetry to help understand the regional movements, feeding behavior, and roosting patterns of gulls in central Massachusetts has produced a significant amount of information. More than 1,000 gulls have been tagged and thousands of observations reported from location in Massachusetts and throughout the eastern United States to help document gull movements. A study of feeding behavior at wastewater treatment plants and large parking lots was combined with public information efforts in an attempt to modify the human behaviors that attract gulls. Data collected has been used to help formulate management activities to try and reduce local populations.

A landfill near Wachusett Reservoir supporting thousands of gulls was identified in 2008. Co-ordinated efforts between the landfill, DWSP, and USDA resulted in an active harassment program and substantial reductions in gull use. This landfill and others continue to be monitored opportunistically.

There has been a strong effort to reduce the local goose population through an intense population reduction program. Canada goose nests on the reservoir have been located and the eggs in each nest treated to prevent hatching. The goal of this program is the gradual long-term reduction in the resident adult goose population, and the number of goslings and resident adult geese has declined substantially since the effort was initiated.

Surveys for beaver and muskrat populations are done regularly. A group of beaver causing water quality problems on Muddy Brook was removed and their dams deconstructed with cooperation from railroad personnel. Beaver and muskrat identified in the exclusion zone of the reservoir near the intake were removed and tested for the presence of *Giardia* and *Cryptosporidium*. A random sampling of ring-billed and herring gulls were also captured and tested for these pathogens. Data collected to date indicate a very low level of infection.

Routine surveys of all dams and dikes were completed to look for damage caused by burrowing mammals. Approximately fifteen burrows were treated and filled annually.

Five Year Objectives

The DWSP will continue to manage wildlife in order to protect the water supply and its infrastructure from adverse impacts. Efforts to modify behavior or remove problem individuals have been very successful and many of the objectives are unchanged from previous Watershed Protection Plans. Natural Resources staff will continue efforts to better understand wildlife behavior and species presence in the watershed, and will protect rare, endangered, and threatened species when this does not interfere with water quality protection efforts.

- Continue year-round bird observation and harassment effort on the reservoir.
- Continue to control the resident Canada goose population.
- Reduce the amount of food available to gulls around Wachusett Reservoir by controlling public feeding and identifying and controlling alternative food sources.
- Eliminate aquatic mammals that threaten water quality or infrastructure.
- Continue to test mammal and bird fecal samples for presence of *Giardia* and *Cryptosporidium* through cooperative efforts, including Massachusetts Institute of Technology gull study.
- Manage habitat for rare species; monitor populations of select species.
- Attempt to eliminate roosting gulls from the Wachusett Reservoir.

6.5 Public Access Management

Goal: Manage public access to DWSP lands and waters in compliance with Public Access Plans to protect water quality. Utilize visitor contact to provide education and outreach on watershed issues.

The use of watershed lands for recreation can conflict with the primary mission of water supply protection and requires careful control of these activities to limit negative impacts. Specific practices and procedures that address recreational issues and help identify unauthorized activities, reduce future instances of encroachment or trespass, and propose solutions for problems are addressed in the *Wachusett Public Access Plan Update 2011* and should be consulted for details. Some of the information included in that plan is summarized below. Additional information on public access is available in the Wachusett Land Management Plan 2011-2020 and in this report in Chapters 6.1 (Land Procurement), 6.3 (Land Management), and 6.6 (Watershed Security).

Public access is controlled by regulations (350 CMR 11.09) and public access plans and policies. Watershed Ranger staff has the primary responsibility for monitoring and enforcing appropriate public access, with the police as the official enforcement entity if needed. Rangers spend most of their time utilizing visitor contacts to explain watershed protection efforts and public access controls. Enforcement through education and outreach is a priority and has been highly successful. Signs, kiosks, and other printed information provide guidance on allowed activities and locations where specific recreational uses can be enjoyed.

Although not previously a priority concern, public access on non-DWSP property has the potential to impact tributary water quality and eventually have an effect on the reservoir. Staff now assess permitted uses in state forests and parks, Division of Fisheries and Wildlife properties, Massachusetts Audubon Sanctuaries, private land trusts, and other protected open space to determine if there are any significant threats to water quality.

Accomplishments

DWSP completed the comprehensive *Wachusett Public Access Plan Update 2011*, which provides detailed descriptions of a wide range of public access issues and includes a number of tasks proposed to improve water supply protection efforts. The plan identifies three protection zones and associated policies for each area (Figures 6-4 and 6-5; Tables 6-2 and 6-3).

Figure 6-4: Wachusett Reservoir Public Access Protection Zones

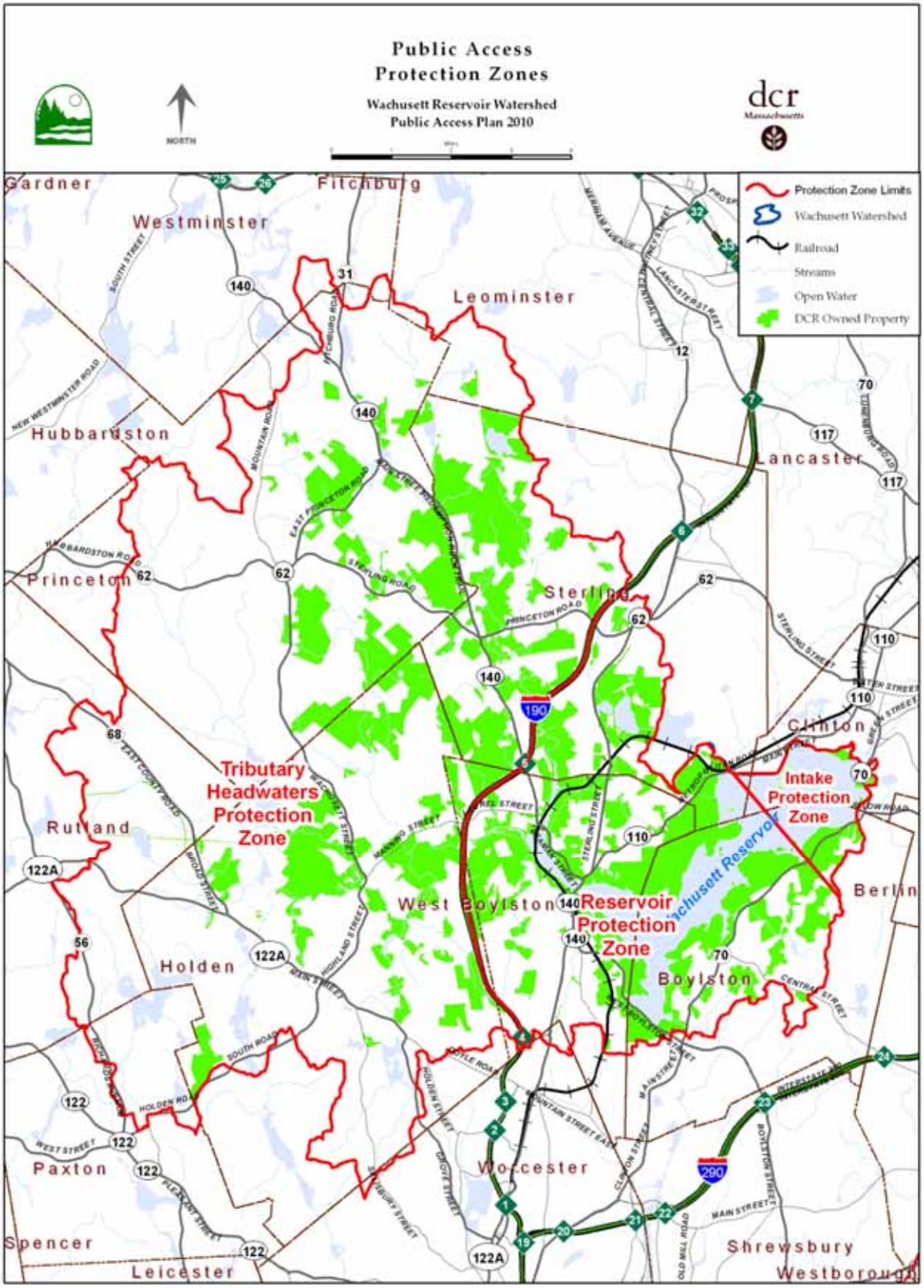


Figure 6-5: Wachusett Reservoir Public Access Intake Protection Zone

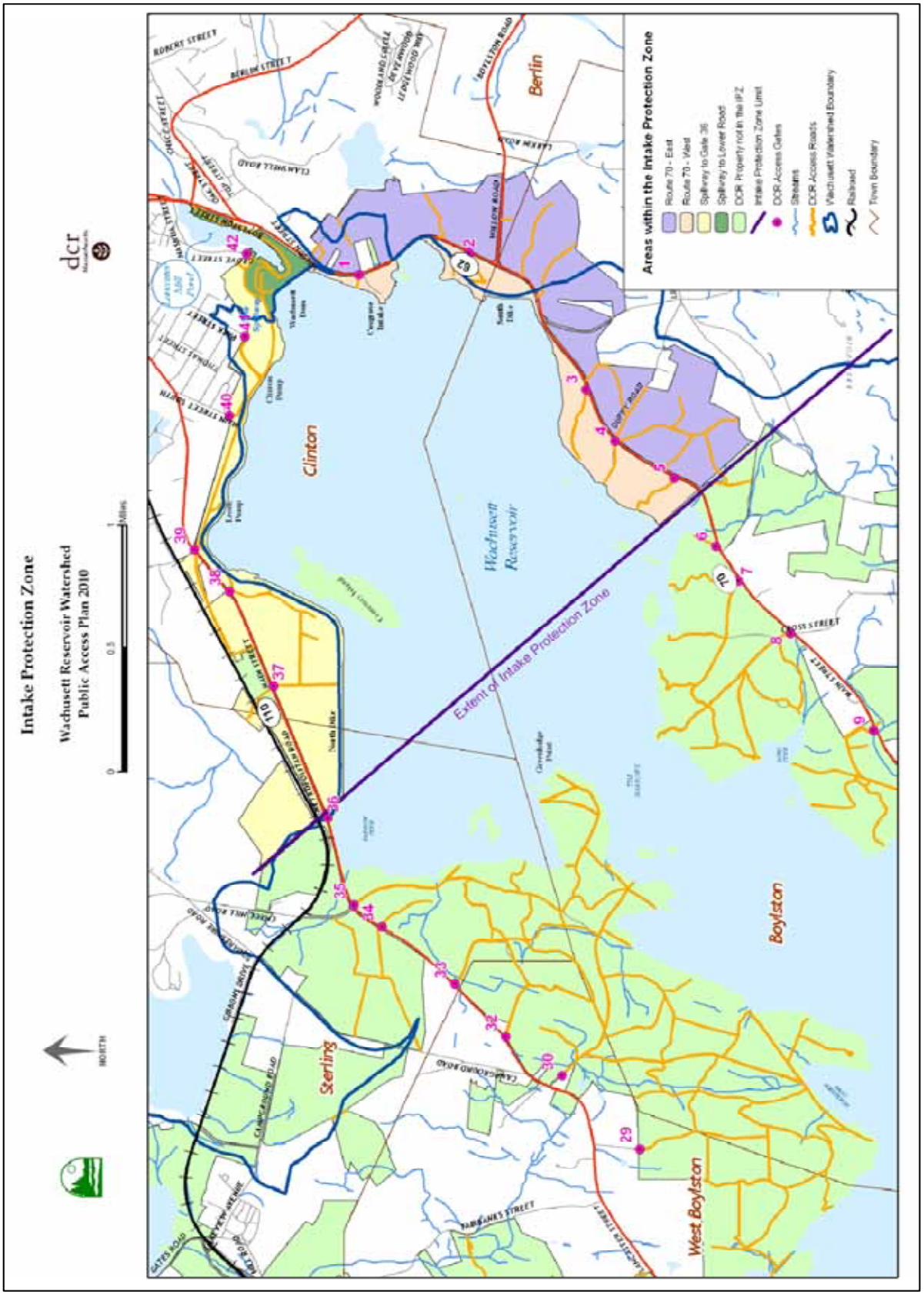


Table 6-2: Wachusett Reservoir Watershed Public Access Rules - Intake Protection Zone

Activity	Intake Protection Zone				
	East Side (Non-reservoir) Route 70 from Gate 5 to Promenade	West Side (Reservoir) Route 70 from Gate 5 to Promenade	Promenade	Road Below Dam and Spillway to Top of Dam	North Dike from Spillway to Area just before Gate 36
Off-Road Driving (ORVs, ATVs)	⊘	⊘	⊘	⊘	⊘
Snowmobiling	⊘	⊘	⊘	⊘	⊘
Bicycling	⊘	⊘	⊘	✓	✓1
Walking/Hiking	✓7	⊘	✓	✓	✓
Dog Walking	⊘	⊘	⊘	✓2	⊘
Cross-Country Skiing	✓7	⊘	⊘	✓	✓
Shoreline Fishing	⊘	⊘	⊘	✓3	⊘
Fishing with Waders	⊘	⊘	⊘	⊘	⊘
Horseback Riding	⊘	⊘	⊘	⊘	⊘
Hunting	⊘	⊘	⊘	⊘	⊘
Boating – non-motorized	⊘	⊘	⊘	⊘	⊘
Boating – motorized (including "jet skis")	⊘	⊘	⊘	⊘	⊘
Swimming	⊘	⊘	⊘	⊘	⊘
Ice Skating/Ice Fishing	⊘	⊘	⊘	⊘	⊘
Camping	⊘	⊘	⊘	⊘	⊘
Picnicking	✓4,7	⊘	⊘	✓4	✓4
Fires & Cooking	⊘	⊘	⊘	⊘	⊘
Programs/Assemblies	✓5,7	⊘	✓5	✓5	✓5
Trail Clearing/Trail Marking/Advertising	⊘	⊘	⊘	⊘	⊘
Collecting/Metal Detecting	⊘	⊘	⊘	⊘	⊘
Geocaching/Letterboxing	✓6,7	⊘	⊘	✓6	✓6

✓- Public access is allowed in designated areas only **⊘- Activity prohibited**

1. Allowed on rail bed from gate 39 to spillway only. 2. Dogs only allowed to top of spillway and must stop at sign. Dog waste must be picked up and disposed of properly. 3. Fishing allowed from fountain impoundment to approximately 275 feet after concrete abutments of old railroad bridge. 4. Trash must be carried off of DCR property. 5. DCR Special permit required. 6. Geocaching Guidelines must be adhered to and all DCR rules apply. 7. Except for property between Rte 62(Willow Rd) and Mile Hill Roads.

Table 6-3: Wachusett Reservoir Watershed Public Access Rules - Reservoir and Tributary Protection Zones

Activity	Reservoir Protection Zone	Tributary Headwaters Zone
Off-Road Driving (ORVs, ATVs)	⊘	⊘
Snowmobiling	⊘	⊘
Bicycling	⊘	✓
Walking/Hiking	✓	✓
Dog Walking	⊘	⊘[1]
Cross-Country Skiing	✓	✓
Shoreline Fishing	✓	✓
Fishing with Waders	✓[2]	✓
Horseback Riding	⊘	⊘
Hunting	⊘	✓[3]
Boating – non-motorized	✓[4]	✓
Boating – motorized (including "jet skis")	⊘	⊘
Swimming	⊘	⊘
Ice Skating/Ice Fishing	⊘	⊘
Camping	⊘	⊘
Picnicking	✓	✓
Fires & Cooking	⊘	⊘
Programs/Assemblies	✓[3]	✓[3]
Trail Clearing/Trail Marking/Advertising	⊘	⊘
Collecting/Metal Detecting	⊘	⊘
Geocaching/Letterboxing	✓[5]	✓[5]

✓ - Public access is allowed in designated areas only **⊘- Activity prohibited**

1. Dogs allowed with hunting permit only. 2. Upstream of DCR dam at Oakdale Power Station on Quinapoxet River and upstream of the Stillwater River confluence with Waushacum Brook. 3. DCR Special permit required. 4. Canoes/kayaks allowed at :West Waushacum Pond; on the Stillwater River upstream of Muddy Pond Road bridge; on the Quinapoxet River upstream of dam at Oakdale Power Station. 5. Geocaching Guidelines must be adhered to and all DCR rules apply.

Assessment of impacts from public access on DWSP land is done primarily by the Watershed Rangers. Watershed Rangers interact with the public to prevent or reduce inappropriate recreational uses. Increased Ranger presence has helped to identify problem areas and activities, provide public education, and change patterns of public access and recreational use on DWSP properties. The percentage of contacts that are due to illegal or inappropriate behavior has declined significantly.

DWSP continues to implement a fishing line recycling program, asking fisherman to discard old and unusable fishing line in specially made canisters located at several heavily used fishing areas. In addition to protecting wildlife, this line is kept out of landfills by recycling into other products. More than twenty four miles of fishing line has been removed and recycled from watershed lands.

Aquatic Invasive Species (AIS) can pose a serious threat to water supplies (see Section 6.12). While the DWSP prevents AIS entering the reservoir on boats and trailers by limiting use to official business and requiring those vessels to be thoroughly free of AIS, there is still a threat of introduction from anglers fishing from shore. The DWSP has begun conducting outreach on AIS and will continue to do so through the implementation of the 2010 *Aquatic Invasive Species Assessment and Management Plan*. Education and outreach on AIS has included:

- Fact cards for the Rangers to distribute to fishermen while in the field.
- Notices placed at local bait and tackle shops and Wal-Mart sporting section.
- Advisories posted at South Meadow Pond and DWSP bulletin boards and kiosks.
- Articles in the DWSP *Downstream* newsletter, and through e-mail with all watershed sportsmen's clubs.

Dogs are prohibited on DWSP land, but there are over 5,500 dogs licensed within the five watershed towns. Significant outreach has been conducted by staff to educate watershed residents and watershed visitors on the dangers of pet waste. Public education and outreach conducted to date has included:

- Fact cards for the Rangers that can be handed out to dog owners who are observed walking their dogs on watershed lands. The cards include an explanation as to why the no dog rule is in effect for water quality protection.
- A brochure reminding residents to pick up after their dogs has been made available at all watershed town clerk offices and veterinarian offices. Holden Veterinary Clinic has also used these brochures in their "puppy packets" distributed to all new puppy owners.
- Information has been posted on bulletin boards and kiosks.
- A letter has been sent out to neighborhoods where dog waste is the suspected cause of higher bacteria levels in tributaries.
- An article has been published in DWSP's *Downstream* newsletter.
- Information is posted at the Town of Sterling Greenery Park, adjacent to DWSP property.
- Dog waste pick up dispensers were donated to both the Sterling Greenery Park and West Boylston Cemetery Department, where drainage flows into main tributaries and dog waste had become a problem.

DWSP also acted as an advisor to a local elementary school class that chose to find a solution to the community problem of pet waste. The students' outreach included: public service announcements; presentations to the student body, school committee, and conservation commission; posters; brochures; and a video broadcast on community access television.

Many gates around the reservoir perimeter have been replaced with more secure structures to provide greater protection of the water supply from unauthorized vehicular access. Old cable gates have been replaced with "farm style" gates for safety. Several parking areas have been constructed to allow for signage and educational materials, bulletin boards, and kiosks to be in one common access point and to provide better public safety. These entry points are intentionally located near public roadways so they can be easily monitored by Rangers and police. A focused entry point also allows staff to control public access and monitor uses at each location.

A large parking lot was relocated near the Oakdale Rail Trail at Thomas Basin to assist the West Boylston Water District in complying with a Department of Environmental Protection directive to improve controls adjacent to their Oakdale well. Boulders have recently been placed to limit parking on the grassed area, which had become a problem.

All rules signs have been replaced with new DWSP universal symbol signs. "No Trespassing after Dark" signs have been placed at the Old Stone Church gate at the request of the Rangers and West Boylston Police to curb a growing trend in nighttime trespassing at this location.

In addition to rules signs, bulletin boards and kiosks have been placed at entry points at many areas around the watershed. Bulletin boards and kiosks have generally been placed in high use areas, typically near DWSP parking areas.

Large bulletin boards are located at the Manning Street Rail Trail parking lot, the Oakdale Rail Trail at Route I-190, the River Road parking area, and the Sterling Rail Trail. Smaller bulletin boards are present at Gate 8, Gate 19, Gate 25 and Gate 35. Bulletin boards allow DWSP to place upcoming interpretive programs, rules and regulations, emergency contact information, historical information, watershed maps, and general information on current water quality and/or watershed outreach topics. All bulletin board information is updated on a regular basis by the Ranger staff.

Four-sided kiosks have been placed at the Promenade of the Wachusett Dam, the Old Stone Church, Gate 36/North Dike, Bob's Hot Dogs triangle (Junction of Rtes 12 and 140), and at the Stillwater Farm. Information on kiosks also includes emergency contact information, historical information, water quality/watershed education and outreach, watershed maps, and current issues. These are also updated on a regular basis by the Ranger staff.

Several brochure boxes were placed at key kiosk locations around the watershed in 2010 to distribute take home information on water quality and public access issues. They have become an integral part of the DWSP outreach program and are monitored and filled by Ranger staff.

The DWSP reservoir fishing map has been updated to include all gate numbers for access points, fire roads, and the fishing limit. The reverse of the map has a listing of the most relevant

regulations for this activity and emergency contact information. Recommendations for the next revision and reprinting include adding No Public Access Zone and parking lots to the map and information on Aquatic Invasive Species prevention in the narrative.

There are a number of activities that are not permitted but remain popular. The Watershed Rangers have been able to reduce the number of swimmers and waders, but continue to encounter illegal use of ATVs on DWSP property.

Information on public access rules in local state forests and parks, Division of Fisheries and Wildlife properties, Massachusetts Audubon Sanctuaries, private land trusts, and other protected open space has been collected and is being used to determine if any activities are a significant threat to the reservoir.

Five Year Objectives

Implementation of the *Wachusett Public Access Plan Update 2011* focuses on continuation of access policies as detailed in the 2003 plan with additional reliance on routine maintenance and patrols due to staffing and funding limitations. Staff began to implement the policies, control measures, activities and programs cited in this plan in July 2011 and will continue during the next five years. It is anticipated that there will be continued interest by the public to increase access to DWSP lands. The DWSP will need to respond to these requests and determine if proposed activities are consistent with watershed protection principles.

- Continue overall education and enforcement efforts and document effectiveness by reviewing and analyzing visitor contact data.
- Maintain working relationships with State, Environmental, and local police.
- Expand use of electronic media to disseminate information.
- Continue existing protocol for maintaining gates and other structural controls.
- Evaluate and modify, as necessary, specific access plan policies.

6.6 Watershed Security

Goal: Maintain and improve watershed security programs to provide surveillance of the watersheds and protect the watershed system from potential threats.

Watershed Security Programs provides surveillance of the watershed for potential threats to the water supply system. The events of September 11, 2001 heightened concerns regarding security and the need to protect public works from possible terrorist action. The probability of intentional contamination of a drinking water supply is relatively low, but it is possible to contaminate a portion of a drinking water system and cause adverse public health consequences.

The DWSP must be able to evaluate the credibility of any contamination threat and identify appropriate response actions in a very short period of time. DWSP coordinates with MWRA on all security issues in order to maintain comprehensive, system-wide approach. DWSP also works cooperatively with local, state and federal responders. In the case of an emergency, DWSP will use Incident Command System (ICS) protocols to develop and carry out a response.

Accomplishments
Many security improvements have been made by both MWRA and DWSP over the past years. Due to security concerns, these improvements will not be listed here.

Watershed Rangers provide a visible presence and monitor for and respond to all suspicious activities. Security has been enhanced at key locations throughout the watershed and at DWSP facilities. Communication and coordination with MWRA has been enhanced and there is ongoing communication and coordination with local Emergency Responders.

ICS training has been provided to key staff . DWSP and MWRA hold annual drills to acquaint the workforce with how to react to an ongoing emergency. MWRA has prepared a vulnerability assessment per EPA requirements.

Five Year Objectives
Staff will continue to provide surveillance throughout the watershed and monitor for suspicious activities.

- Coordinate with MWRA in order to maintain comprehensive system-wide approach on all security issues.
- Continue to work with local, state, and federal responders.
- Continue to use ICS protocols to respond to emergency situations and provide adequate training to essential staff.
- Continue to monitor watershed land, roadways, and buildings for suspicious activities.
- Coordinate and conduct proactive patrols and operations to ensure compliance of access rules on watershed properties.

6.7 Infrastructure

Goal: Provide resources to maintain the integrity of all high hazard dams under DWSP control, to maintain and improve DWSP facilities long-term, and to maintain internal roadways to allow them to sufficiently support their use for the water supply protection program.

The Infrastructure Program provides resources to maintain the integrity of dams under DWSP control, maintain and improve DWSP facilities, and construct and maintain roadways to support DWSP activities. The program also determines operating policies for the water supply system, including yield, public safety, and the generation of hydropower. The objective is to optimize delivery of high quality drinking water while ensuring adequate volume in storage to respond to fluctuations in precipitation and demand, meeting downstream minimum flow release requirements, and preventing violations of minimum pool reservoir stage limitations.

The Draft *Wachusett Land Management Plan 2011 – 2020* includes a discussion of construction and maintenance of forest roads under DWSP control. Specific details and supporting documentation are not reproduced in this Watershed Protection Plan Update.

Buildings owned by DWSP must comply with the Americans with Disabilities Act (ADA) Accessibility for Buildings Guidelines and should also incorporate recommendations for energy

efficiency and clean energy established by recent Executive Orders from the Governor of the Commonwealth. DWSP strives to make infrastructure decisions that conserve energy and reduce greenhouse gases without compromising public safety and can be accomplished within budgetary restrictions.

Accomplishments

DWSP inspects and maintains a number of large and small dams, miles of improved and unimproved roads, and facilities ranging from administrative offices to maintenance garages and storage sheds throughout the watershed.

Monthly inspections of the Wachusett Dam and dikes continued during the past five years. DWSP worked with MWRA to remove trees from both the north and south dike to preserve the structural integrity of these earthen dikes. Civil Engineering and Environmental Quality staff evaluated Edwards Pond Dam for possible removal, but due to prohibitive sediment mitigation costs it was determined not to be economically feasible at this time. A similar investigation of possible removal of a small dam in Princeton is underway.

DWSP forest roads were inspected regularly and a number of areas needing maintenance were addressed. Civil Engineering and Environmental Quality staff worked together to develop an inspection and review protocol, and combined efforts to ensure proper design and environmental review.

The West Boylston Maintenance Crew Headquarters was replaced in 2010. Several sheds were constructed to house equipment, including the air boats and response trailers. Transformers containing PCBs were removed and the roof was replaced at John Augustus Hall during 2011. Renovations were made to several additional DWSP buildings in the Wachusett watershed.

Efforts to reduce energy use and lessen the production of greenhouse gas have included changes in behavior (e.g., staff have been encouraged to turn off lights when not present), purchasing shades to reflect sunlight, replacing incandescent lights, and investigating possible improvements to an outdated and inefficient heating system in John Augustus Hall.

Staff continued to participate in quarterly Reservoir Operations Working Group meetings to help determine operating policy. Work to complete periodic updates of the Emergency Action Plan for Wachusett continued as needed.

Five Year Objectives

Maintenance of infrastructure is an important responsibility for the DWSP, but must be accomplished in an environmentally responsible manner. All activities should have specific environmental safeguards incorporated into standard protocols and serve as an example for the public.

- Continue to monitor and maintain large dams, spillways, and dikes, and periodically update Emergency Action Plan.
- Continue to evaluate feasibility of removing unsafe or unnecessary small dams.
- Conduct annual inspection of roads and develop annual plan for repairs.
- Assess infrastructure and oversee repairs, maintenance, and renovation projects at DWSP facilities.
- Construct and maintain BMPs to manage stormwater.
- Continue to reduce energy use through simple energy efficiency practices.
- Work with MWRA and Mass Wildlife to evaluate removal or breaching of Quinapoxet Dam.

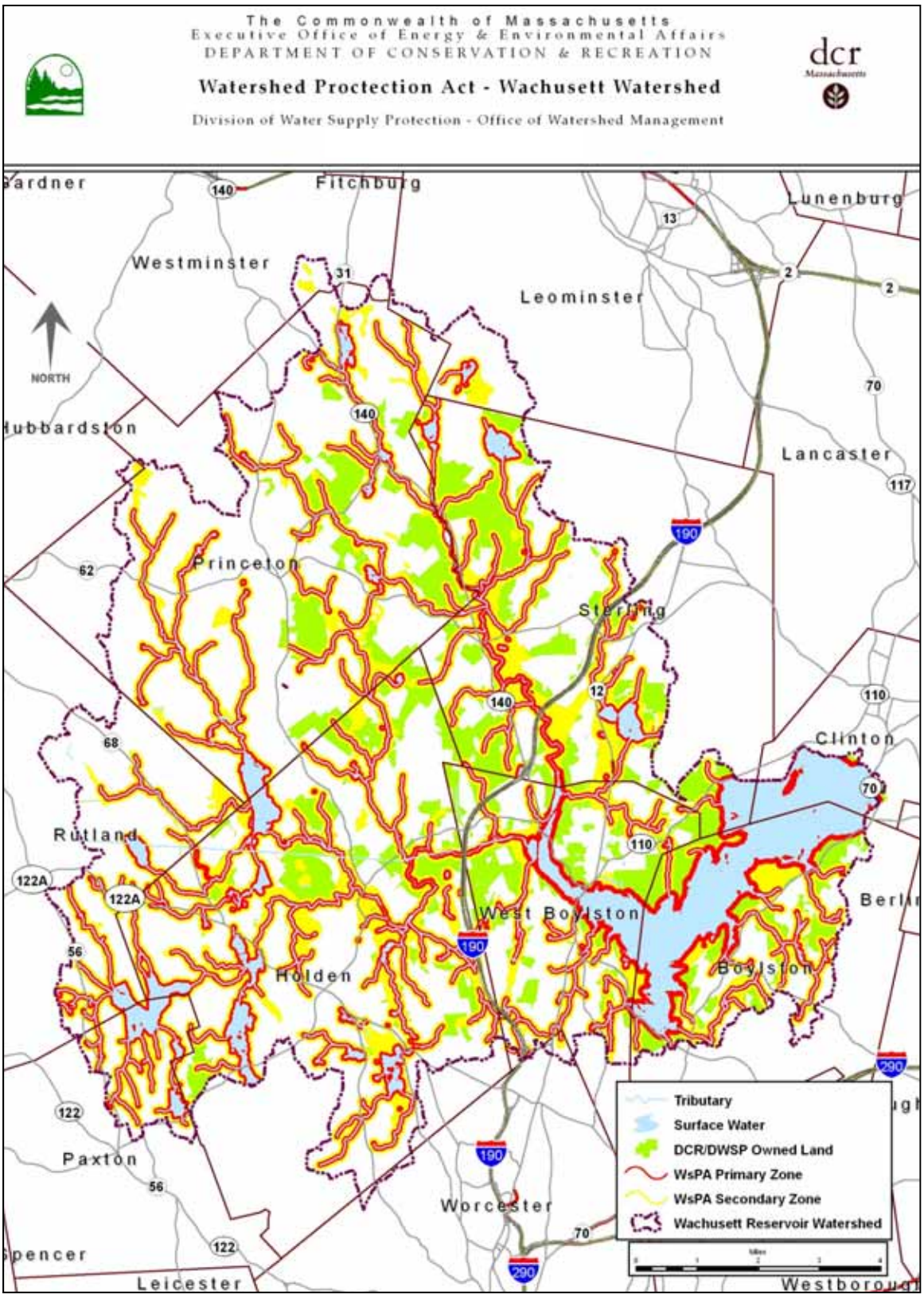
6.8 Watershed Protection Act

Goal: Enhance protection of the water supply through implementation of the Watershed Protection Act, which regulates land use in critical areas of the watershed.

The WsPA regulations (350 CMR 11.01-11.08) apply to regulated areas in Boylston, Clinton, Holden, Leominster, Paxton, Princeton, Rutland, Sterling, West Boylston, and Worcester (Figure 6-6). WsPA regulations promote both water quality and community land use protection that is accepted by landowners, realtors, developers, and town officials. Development is monitored by DWSP staff through attendance of meetings of municipal boards and committees and review of legal advertisements and other information in local newspapers. Landowners impacted by the WsPA are notified of requirements and staff works closely with them to develop projects that comply with WsPA regulations.

The WsPA legislation mandates that "a program of technical assistance" be provided to those watershed communities affected by the Act's regulations (Chapter 36 of the Acts of 1992, Section 15). Outreach and education help landowners and town officials find common areas of concern about the effects of development on water quality and ways to mitigate these impacts. DWSP staff provide information to landowners and town boards, helping them understand the relationship between the many environmental regulations that place limitations on land use and development. Information is provided through training, project review, and distribution of educational literature.

Figure 6-6: Watershed Protection Act Regulated Areas in the Wachusett Reservoir Watershed



Accomplishments

Development was monitored by DWSP staff who attended meetings of municipal boards and committees and reviewed legal advertisements in local newspapers. Landowners impacted by the WsPA are notified of requirements and staff works closely with them to develop projects that comply with WsPA regulations. Since 2008 over 400 WsPA inquiries have been addressed.

Staff from across the DWSP who implement the WsPA meet regularly as part of the Watershed Protection Act Working Group (WsPAWG) to discuss confusing or controversial issues and to resolve problems related to the Act. The group ensures that an adequate supply of WsPA related materials and information are available to landowners and local officials.

Within the past five years, the Massachusetts Supreme Judicial Court ruled in *Blair vs. DCR* that the WsPA is constitutionally valid and that its implementation does not rise to the level of a taking without just compensation under either the state or federal constitution.

There has been an increase in both inter- and intra-agency coordination on regulations that often intersect with the WsPA, including the Wetlands Protection Act and Title 5 (for septic system control) as well as the federal stormwater program. DWSP worked in close collaboration with DEP and the Attorney General on a significant violation of the WsPA and the Wetlands Protection Act, resulting in both a monetary penalty and court-ordered site remediation. Staff utilize the Massachusetts Environmental Policy Act (MEPA) to identify, review, and comment on projects in the watershed system.

DWSP utilized a contractor in 2010 to update digital parcel and landowner information for seven towns in the Wachusett Reservoir watershed. The Commonwealth's Office of Geographic Information subsequently updated this information for the vast majority of all other watershed towns in 2011 and 2012 through a statewide initiative and is continuing the project with the objective of completing statewide standardized parcel mapping by the end of June 2013.

Outreach and education are important for landowners and town officials in order to find common areas of concern about the effects of development on water quality and ways to mitigate these impacts. DWSP provided technical assistance to watershed communities by working cooperatively, upon request by local boards, on projects of mutual concern, including development of local regulations. Staff supported local implementation of state environmental regulations through training, project review, and professional services, such as GIS mapping, environmental engineering, and planning.

Five Year Objectives

DWSP will continue to use Watershed Protection Act regulatory authority to guide development in a manner that protects water quality. Much of the easily developable land has been utilized and there is pressure to develop marginal land with increased risks from both short-term site development impacts and long-term land use alteration.

- Continue to implement Watershed Protection Act and regulations.
- Review building permits and sales and notify property owners of their need to file.
- Inspect previous filings for compliance with decisions and conditions.
- Provide training and information to local boards, town officials, and others.

6.9 Interpretive Services

Goal: Provide educational opportunities through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions to inform the public about watershed protection and drinking water issues.

The Interpretive Services Program provides educational opportunities for users, watershed residents, and visitors to learn about the importance of watershed protection and environmental stewardship. Educational programs are an effective way to protect watershed resources over the long term by instilling a better understanding and appreciation of stewardship of natural resources. Many water suppliers incorporate interpretive services into their watershed protection programs to enhance their measure of water quality and resource protection.

Interpretive services are delivered through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions that inform the public about watershed protection and drinking water issues.

Accomplishments

DWSP has an established program of public education in the Wachusett Reservoir watershed. Education is provided through school programs, interpretive programs on DWSP properties, Watershed Ranger contact with visitors, and the biannual *Downstream* newsletter. Wachusett Reservoir staff maintains several interpretive sites and numerous informational kiosks within the watershed. Staff developed and updated materials for the DWSP website on issues related to public access, stormwater management programs, and water quality issues including aquatic invasive species control.

The previous Watershed Protection Plan Update included a recommendation for the development of an interpretive services plan to formalize the existing public education program. A draft interpretive Services Plan was developed and has been implemented. Specific materials and programs were also developed for the Stillwater Farm seasonal interpretive site and on the topic of climate change.

Five Year Objectives

Many of the existing interpretive programs are successful and will be continued. Improving understanding of the issues that are important to water supply protection provides strong public support for necessary restrictions and improvements. The DWSP remains committed to working with the public and continues to expand the scope and delivery of the information provided.

- Implement and amend, as needed, the *Wachusett Interpretive Services Plan*.
- Conduct and monitor established program of public education and add information on Aquatic Invasive Species and climate change.
- Conduct programs at Stillwater Farm interpretive site and investigate opportunities to expand addressed topics.
- Conduct environmental education teacher training and support Mass Envirothon.
- Continue to participate in environmental programs with other environmental groups.
- Research alternatives for use of electronic media for interpretation.

6.10 Water Quality and Quantity Monitoring

Goal: Conduct tributary and reservoir sampling to identify short-term water quality problems and to maintain the historical record for long-term trend analyses. Collect hydrologic data to support water quality work and reservoir operations. Conduct analyses and assessments of data for use in management decisions.

The Water Quality and Quantity Monitoring Program conducts routine tributary and reservoir sampling to identify short term water quality problems and to maintain the historical record for long term trend analysis, with annual adjustments to the sampling plan to adapt to changing conditions. Hydrologic data is collected to support water quality work and reservoir operations. Stormwater sampling is conducted to establish stormwater pollutant loads. DWSP plans to develop more integrated assessments of water quality across the entire system and to develop and use mathematical models, as needed, to assist water quality assessments of watershed management issues.

Water quality data provide information on a variety of physical, chemical, and biological parameters. Water quantity (flow) data are necessary to develop and compare watershed loadings. These data are used to identify water quality problems, better understand reservoir responses to physical, chemical, and biological inputs, assess the ecological health of the reservoir and watershed, measure the effectiveness of watershed management programs, and ensure protection of the water supply sources. DWSP monitoring is entirely for internal assessment purposes. All system monitoring for compliance with federal drinking water regulations is done by the MWRA, and is not discussed in this report.

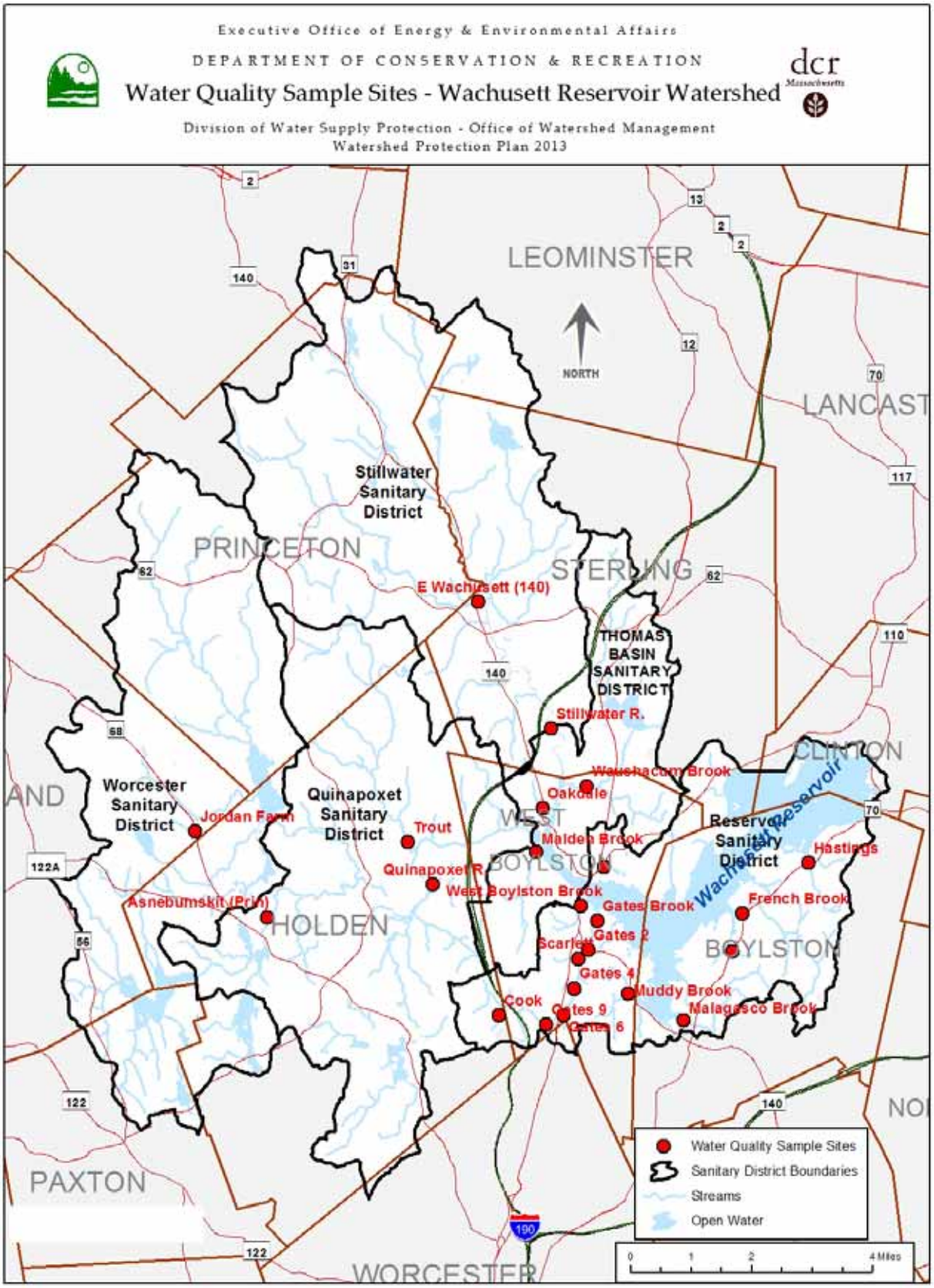
Environmental Quality staff develops and implements water quality monitoring programs. In some cases, water quality impacts may not be apparent due to limitations in methodology or due to extended time periods for impacts to become discernible. DWSP continually reviews its sampling programs to meet changing priorities and public health concerns, as well as to incorporate newly developed analytical methods and updated regulatory requirements. All monitoring programs are developed and executed in coordination with MWRA. To further this cooperation, DWSP and MWRA staff holds quarterly or as needed Water Quality Sampling and Analysis Team (WQSAT) meetings.

Accomplishments

An extensive monitoring system is in place for tributary and reservoir sampling in the Wachusett Reservoir watershed. DWSP staff collects water quality samples and provides analysis for physical and biological parameters. All bacteriological and chemical analyses are performed by MWRA at the Southborough and Deer Island Laboratories.

Environmental Quality staff collected routine water quality samples from 54 stations on 30 tributaries during 2008. Samples were collected from 34 stations on 22 tributaries in 2009 and 2010, from 26 stations on 20 tributaries in 2011, and from 23 stations on 19 tributaries in 2012. After five years of an expanded sampling program that collected data from a large number of stations to be able to address issues identified in previous water quality summaries and Environmental Quality Assessment reports, sampling has gradually been reduced to include only direct tributaries to the reservoir and those stations deemed historically significant or potentially

Figure 6-7: Water Quality Sample Sites – Wachusett Reservoir Watershed



threatened. Additional stations were sampled occasionally to support special studies or potential enforcement actions (Figure 6-7).

Each tributary station was visited weekly throughout the entire year, as long as there was adequate flow; samples were collected for bacteria, conductivity, temperature, and turbidity. Nutrient samples were historically collected on a somewhat irregular basis from selected tributaries but have been collected monthly at nine stations since January 2011.

Sampling of the Wachusett Reservoir was done once or twice weekly from the back of the Cosgrove Intake or from a boat at Station 3417 (Basin North) to monitor plankton concentrations, predict potential taste and odor problems, and recommend copper sulfate treatment when necessary. Temperature, dissolved oxygen, pH, and conductivity profiles were measured weekly in the reservoir in conjunction with routine plankton monitoring, and quarterly at two additional reservoir stations. Bacteria sampling was conducted once, twice, or four times per month at 23 reservoir locations to document the relationship between seasonal bacteria variations and roosting populations of gulls and geese on the reservoir as well as the impact of harassment on birds and bacteria concentrations.

Macroinvertebrate samples are periodically collected from selected tributaries to supplement routine water quality sampling. Biotic communities integrate the effects of short-term environmental stresses and reflect impacts of intermittent or low level pollution events often missed by routine sampling programs. A biomonitoring program compares biotic communities at different stream sites and then uses a variety of numerical measurements (metrics) to calculate the degree of site impairment. DWSP uses aquatic macroinvertebrates to determine the degree of site impairment because they are easy and inexpensive to sample, relatively easy to identify, abundant in most streams, and indicative of localized conditions as a result of their sessile nature.

DWSP cooperates with U.S. Geological Survey to maintain continuous, real time recording gages at three sites in the Wachusett watershed and one just downstream of the Wachusett Dam (Table 6-4). Real time data are available from these stations at the USGS website http://waterdata.usgs.gov/ma/nwis/current. Staff gages are located at six other sites and DWSP personnel are developing stage-discharge relationships to provide additional flow data. Stream flow data are used to quantify tributary inflow, document required downstream releases, and allow calculation of nutrient loads.

Table 6-4: Flow Monitoring in the Wachusett Watershed

Station	Location	Purpose	Parameters
01095220	Stillwater River, Sterling	Stream flow monitoring	Index-Velocity, Temp, Cond, Precip
01095375	Quinapoxet River, Holden	Stream flow monitoring	Stage-Q, Temp, Cond, Precip
01095434	Gates Brook, West Boylston	Stream flow monitoring	Stage-Q, Temp, Cond
01095503	Nashua River Water Street, Clinton	Monitors reservoir release to Nashua River	Stage-Q, Temp

Stormwater sampling has been done regularly to supplement routine water quality sampling at four locations beginning in August 2011. Standardized sampling methodologies have been developed with collection of flow based composite samples of nutrients, total organic carbon, and total suspended solids during both the rising limb and falling limb of fifteen storms. Bacteria grab samples were collected from the early rising limb stage of several storms. Preliminary analysis shows high bacteria at all locations including an undeveloped forested site. Nutrient loading estimates will be available after final approval of USGS flow data.

Sampling for turbidity at all active logging operations occurs regularly during both dry and wet weather. Samples are collected above and below all stream crossings. Sampling is initiated prior to any disturbance in order to establish baseline conditions, and continues until all activity has been completed.

Five Year Objectives

Environmental Quality staff will continue routine tributary and reservoir sampling to identify short term water quality problems and to maintain the historical record for long term trend analysis, with annual adjustments to the sampling plan to adapt to changing conditions. It has become clear that unmanaged stormwater is a significant threat to water quality, and there is a need for increased focus on collection of accurate hydrologic data and storm event samples to quantify stormwater loading and to detect variations in water quality and quantity due to climate change.

Water quality in the Wachusett Reservoir watershed is impacted by water quality in other watersheds within the MWRA water supply system, and has an impact on water quality within the distribution system. Efforts will include looking at water quality, water quantity, and sampling efforts throughout the system, with a goal of developing a comprehensive and consistent sampling and analysis plan to provide additional answers to water quality questions and concerns. A continuation of cooperative efforts with area colleges and universities provides additional low or no-cost help with monitoring, assessment, and modeling efforts.

- Continue routine and non-routine reservoir and tributary sampling, compile data, and interpret in annual report.
- Monitor hydrologic budget (stream flow, precipitation data, snow pack) and continue to make necessary improvements.
- Continue expanded stormwater sampling program to quantify stormwater loading.
- Maintain and improve reservoir and watershed water quality models in-house and in coordination with UMass.
- Compile and interpret data. Write a ten year Water Quality Summary report, including correlation of subbasin percent impervious data with tributary water quality (2008-2017).
- Assess impact of climate change on water quality and hydrology.
- Develop and implement long-term paired subbasins assessment of the impacts of forestry on water quality and quantity in the Wachusett watershed.

6.11 Watershed Monitoring and Surveillance

Goal: Use site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations

DWSP uses site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations and potential water quality threats. Threats may be identified by unusual water quality sampling results, field observations by DWSP staff, review of public records, or notification from watershed residents. Suspected threats are investigated, identified, and then corrective actions are pursued utilizing the legal support of all applicable environmental laws. DWSP relies on its own specific watershed protection regulations (350 CMR 11.00) as well as a wide array of federal and state regulations to promote private land owners' responsibility for environmental and public health protection. DWSP works with the appropriate local, state, and federal government agencies to enforce these laws.

Accomplishments

DWSP has worked with the EPA, DEP, and local boards and commissions to correct situations where pollution has entered watershed tributaries. Results have included both environmental remediation and fines. Hundreds of sites have been inspected for a variety of possible water quality threats and corrective actions taken when necessary. Highlights include final resolution of significant problems at Wachusett Regional High School and at a residential subdivision development in Holden.

Coordination of monitoring and enforcement efforts has been greatly enhanced by the development and utilization of an electronic database. All activities are documented in site specific files and clear timelines established for future monitoring and enforcement activities. More than 400 files have been created since January 2009. An internal group to coordinate on interpretation of regulations and decisions regarding enforcement has been organized.

Five Year Objectives

Interpretation and enforcement of environmental regulations can be complicated, with multiple projects on a single site, overlapping regulations, project changes over time, or other issues that present irregularities. Staff must continue to coordinate and communicate with each other, take actions in a timely manner, communicate clearly and consistently with landowners, provide consistent interpretation of regulations, an accurate log of issues, correspondence, conversations, expectations, and potential consequences, and establish and follow reasonable timelines for resolution of issues. Use of the database will help facilitate this process.

- Continue to use fieldwork, local contacts, and EQAs to find violations of environmental regulations.
- Continue to enforce all environmental regulations and coordinate with other agencies when necessary.
- Continue to update, improve, and use database(s) to help tracking and coordination efforts.

6.12 Aquatic Invasive Species Management

Goal: Prevent introduction of Aquatic Invasive Species through monitoring, public education, exclusion, and decontamination measures at potential entry points.

The Aquatic Invasive Species (AIS) management program attempts to prevent the introduction of AIS through monitoring, exclusion, decontamination measures at potential entry points, and public education. Public education focuses particularly on recreational anglers and boaters, but also includes those involved in the sale of bait, aquarium fish, water gardens, and exotic pets.

The 2010 *Aquatic Invasive Species Assessment and Management Plan* explains the threat and current status of AIS in the Wachusett Reservoir watershed and describes the management program implemented to control existing infestations and prevent new introductions. AIS currently known to occur in the DCR/MWRA reservoir system consist of five species of macrophytes, one species of snail, and one species of crayfish. Two species of invasive macrophytes – Eurasian Water-milfoil and fanwort – have been actively managed in the upper reaches of Wachusett Reservoir since 2002.

Potential impacts from the spread of AIS vary according to the characteristics of the invading organism. Many AIS cause local extinctions of native species through competition or predation. This loss of biodiversity causes changes in the trophic structure of the community because of disruptions of food web connections, productivity, energy flow, and nutrient cycling. Invasive aquatic macrophytes aggressively displace native plants and grow so densely that littoral zone habitats become choked with vegetation. Water quality is impaired by excessive macrophyte growth because macrophytes function as nutrient pumps, extracting nutrients from the sediment with their roots and releasing them to the surrounding water.

As long as Eurasian Water-milfoil and fanwort are established in the Stillwater Basin they will be putting colonization pressure on the main basin of the reservoir. Passive management of fragments originating from this source had been an effective short-term solution mainly because the main basin of the reservoir provides relatively poor macrophyte habitat. Passive management, however, may not be a suitable long-term strategy to prevent these invasive aquatic plants from becoming established in the main basin of the reservoir. As a result, an aggressive approach, done in cooperation with MWRA, utilizing Diver Assisted Suction Harvesting (DASH) to attack the established invasive aquatic plants in the Stillwater basin is scheduled to begin in 2013 and will be followed by continuing control efforts in the future.

Accomplishments

A dense population of Eurasian Water-milfoil and fanwort is present in the Stillwater Basin and smaller populations have been detected throughout the Oakdale and Thomas Basins and occasionally in coves of the main body of the reservoir. Monitoring and control of aquatic invasive macrophytes and invertebrates has been underway since 2002. The main components of this program are deployment of floating fragment barriers, deployment and maintenance of benthic barriers, annual hand-harvesting efforts, and routine scouting throughout the reservoir system to insure early detection of pioneering infestations. DWSP and MWRA added a DASH component in 2012 to enhance hand harvesting efforts and target the densest areas of plant growth in Oakdale and Thomas Basins.

DWSP routinely scouts the reservoir and associated basins for invasive macrophytes throughout the watershed. Priority is given to water bodies with ramps suitable for launching trailered boats or other related risk factors. These efforts are supplemented by MWRA through periodic macrophyte surveys performed by independent contractors.

Five Year Objectives

Continue routine tributary and reservoir sampling by Environmental Quality staff to identify short term and long term threats from aquatic invasive species. Education and outreach are important tools to help inform the public and change behaviors to help reduce the risk of introduction and spread. Efforts will continue to locate and remove aquatic invasive macrophytes in the reservoir and throughout the watershed, including expanding routine monitoring beyond the reservoir and the tributaries to include lakes and ponds in the watershed.

- Continue established program of public education on AIS.
- Continue joint effort with MWRA for detection and control of AIS.

6.13 Environmental Quality Assessments

Goal: Continue to conduct scheduled Environmental Quality Assessments and develop actions to correct identified problems.

Environmental Quality Assessments (EQAs) provide a systematic method to locate and control all sources of pollution. EQAs are comprehensive inventories and evaluations of threats to water quality. These reports are conducted on a recurring basis and within the Wachusett watershed focus on five geographic areas called sanitary districts which are based on watershed hydrology (Figure 6-8). The EQAs incorporate field inspections, water quality data analysis, and records review, and develop recommendations for actions to improve watershed protection and water quality that will be incorporated into annual work plans.

An important component of each EQA is a thorough review of the sanitary district for compliance with environmental regulations, including those addressing wastewater, stormwater, agriculture, and hazardous materials and waste. Both wastewater and stormwater are significant threats in the Wachusett watershed and are addressed separately in Chapters 6.14 and 6.15.

Accomplishments

The Wachusett Reservoir watershed has been subdivided into smaller districts based on watershed hydrology to facilitate comprehensive assessment of potential threats. A rotating schedule was developed to complete a detailed investigation of the entire Wachusett Reservoir watershed on a periodic basis. DWSP's goal is to comprehensively evaluate each district once every five years (Table 6-5). Assessments and summary reports have been prepared for four of the five districts in the Wachusett Watershed since 2008. The fifth Environmental Quality Assessment of the period is currently underway. Recommendations from all recent EQAs are being implemented.

Figure 6-8: Wachusett Reservoir Watershed EQA Districts

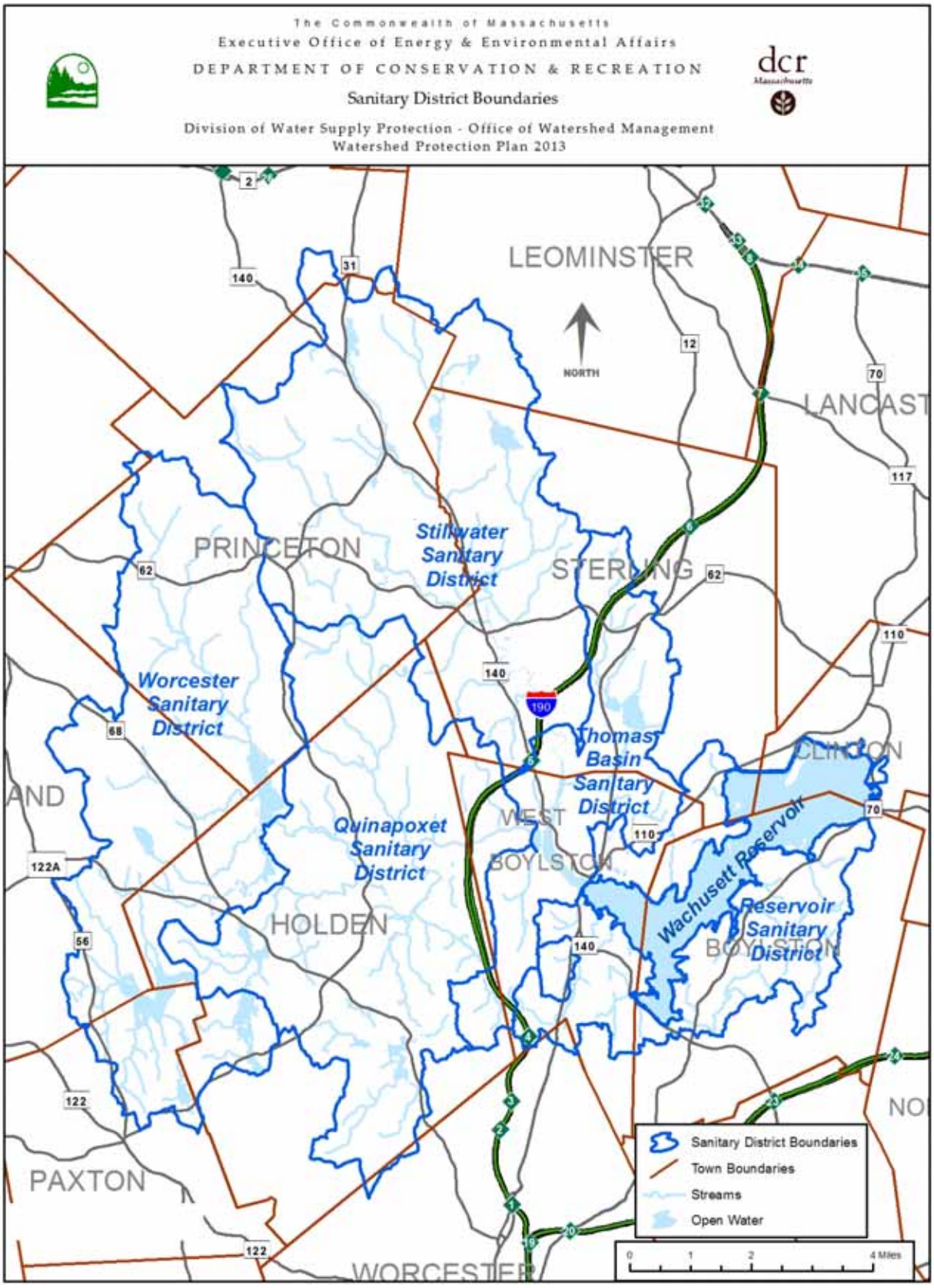


Table 6-5: Wachusett Reservoir Watershed Environmental Quality Assessment Schedule

Sanitary District	Completed Plans	Future Schedule
Thomas Basin	2008	2013
Quinapoxet	2009	2014
Stillwater	2010	2015
Worcester	2010	2016
Reservoir	2013	2017

Data produced and analyzed in the EQA process have helped to advance projects including construction of sewers in portions of the watershed to remediate failed septic systems, development of a stormwater inspection program for construction sites regulated by the EPA Construction General Permit Program, construction of stormwater treatment BMPs on DWSP sites, and cooperative projects with USDA to make improvements at agricultural sites.

Data gathering has continued and several spreadsheets have been created to store information on agriculture, hazardous material use and storage, USTs, ASTs, and accidental releases. Field inspections and review of third-party databases have been used by staff to obtain all necessary information. Besides data gathering, staff have provided educational materials and provided technical assistance to help reduce agricultural impacts to water quality.

There are no longer any active landfills in the watershed, but closed landfills remain a potential threat to water quality due to the possibility of contaminated leachate. Staff reviews periodic reports on closed landfills in the watershed and take necessary action when problems are noted.

Five Year Objectives

Comprehensive assessments that compile detailed information on land use, water quality, and subbasin level threats should continue on an annual basis. Subbasin-based information allows staff to develop specific recommendations at both the subbasin and district level. Detailed plans targeted at specific problems within individual subbasins help produce tangible goals and progress is more easily quantified. Recommendations developed for each EQA should be included as specific tasks in the next year's work plan so that progress might be easily tracked.

- Continue field inspections and review of state and federal databases, identify sources of pollution, and develop mitigation measures for one EQA per year
- Develop and implement EQA recommendations and include recommendations as specific tasks in annual workplans.
- Continue to maintain database of agricultural operations, hazardous waste generators, spills, and hazardous materials use through field inspections and record review.
- Continue to update inventory of USTs and ASTs.
- Continue to assess status of municipal facilities and practices including DPW yards, closed landfills and road maintenance practices. Work with towns and DEP to resolve any water quality issues.

6.14 Wastewater Management

Goal: Monitor installation of on-site wastewater disposal systems and operation of Rutland-Holden sewer to ensure proper treatment of waste.

Improper disposal of wastewater is a serious threat to the water supply due to the potential for contamination by pathogens and nutrients, and any release of untreated wastewater must be considered of highest priority for action by DWSP staff. Staff work with state and local regulators to ensure compliance with all applicable regulations and will continue to work to obtain cooperative agreements with the user communities.

Accomplishments

Problems in areas of the Wachusett Reservoir watershed unsuitable for on-site septic systems have been reduced with completion of an $83 million construction of sewers in West Boylston and Holden. Connections to the sewer have improved tributary water quality and reduced the threat from wastewater. The DEP has strengthened requirements for onsite wastewater, providing greater protection for water resources, and DWSP staff have improved mapping of water resources and shared information with DEP and local Boards of Health. Staff continues to provide technical support as requested.

DWSP and MWRA continue to cooperatively manage the Rutland-Holden Trunk sewer, although there have been legal challenges due to a lack of agreements with the Towns of Holden and Rutland. MWRA completed a TV inspection of the trunk sewer and relief line and found both sewers to be in good condition.

An earlier plan recommended compiling a complete inventory of onsite septic systems, but it was determined to be unworthy of the staff time necessary to complete the task. It was determined that a close relationship with local Boards of Health is a more effective way to monitor septic system issues in the watershed. Staff have been able to track connections to the municipal sewers and regularly enter the data in an spreadsheet and a GIS datalayer.

Five Year Objectives

Completion of a sewer system in West Boylston and expansion of the system in Holden has greatly reduced the threat from untreated wastewater and seems to have improved water quality in a number of urban tributaries. Management of the system is crucial to maintaining the protective benefits of the sewer, and monitoring areas both with and without sewers remains an important part of wastewater management efforts.

- Continue to monitor and enforce provisions of Title 5, using water quality data and working with Boards of Health and DEP. Provide technical assistance, upon request.
- Track connections to new sewer lines and maintain database and GIS datalayer.
- Manage, with MWRA, the Rutland-Holden trunk sewer and Rutland-Holden Relief trunk sewer.
- Pursue updated sewer agreements with Holden and Rutland.
- Review operation and maintenance plans for sewer pump stations.

6.15 Stormwater Management

Goal: Develop and implement actions to reduce stormwater loadings, including ongoing identification of stormwater inputs and continuation of stormwater BMP construction on DWSP land.

Stormwater carries pollutants from multiple sources to watershed tributaries and reservoirs. It is currently considered the most significant threat to water quality in the Wachusett Reservoir watershed. The DWSP Stormwater Program identifies stormwater inputs and develops and implements strategies to reduce pollutant loads from stormwater, including assisting private individuals, businesses, and local municipalities in their efforts.

Water quality testing shows that pollutant concentrations increase, and significant portions of the annual pollutant loads are contributed, during storm events. DWSP works with the appropriate agencies and watershed communities to increase compliance with stormwater regulations, including Federal NPDES stormwater requirements and Massachusetts Stormwater Standards. DWSP designs and constructs stormwater BMPs on its properties to help control stormwater and supports the direct discharge elimination program.

Accomplishments

DWSP completed a study in 2008 that created a comprehensive inventory of locations where stormwater runoff discharges directly to the reservoir. Remediation efforts were divided into two phases, based initially on proximity to the Cosgrove Intake. Phase I included Route 70 from Mile Hill Road in Boylston to the intersection with River Road just below the Clinton Dam. Phase II included the Route 12/110/140 Causeway in West Boylston, the Beaman Street bridge in West Boylston, and Route 140 in West Boylston/Boylston (South Bay).

MassDOT provided $1.9 million for the Phase I work, which consisted of drainage redesign of 2.1 miles of paved road. Road drainage was both closed (catch basin with piping) and country (grass shoulders and drainage swales). Five pipes located within this road segment no longer discharge directly to the reservoir. Work was completed in the fall of 2012.

Phase II involved more complex BMPs due to design challenges presented in the study area. An engineering study developed, assessed, and ranked conceptual BMP alternatives and recommended specific BMPs for implementation. The recommendations include combinations of several BMPs, which if installed in each of the study areas, will completely treat or eliminate all the direct discharges covered under the Phase II study. Engineering design is occurring in FY13 with construction to follow once sufficient funding is available.

DWSP continues to locate and map all stormwater drainage structures to help understand potential pollutant flow pathways, adding hundreds of points to a GIS datalayer. All stormwater outfalls in the watershed have been identified. All public and private structural stormwater BMPs have also been located, mapped, and inspected. Information has been added to a newly created database and letters were sent to all responsible parties of any BMPs that required maintenance. In addition, a number of structural BMPs have been constructed on DWSP property to provide stormwater treatment and to act as demonstration projects for watershed

residents. All BMPs have been recently mapped and inspected and a maintenance schedule developed.

DWSP staff and MassDOT worked with a group of Worcester Polytechnic Institute students to design and install a stormwater basin at Routes 62 and 140 in conjunction with a bridge reconstruction project. Turbid stormwater that previously discharged without treatment directly to the Stillwater River is now diverted and allowed to settle and infiltrate in a stormwater basin. Informational signage has been established to provide a public education component to the project.

A comprehensive cooperative effort to assist towns with Municipal Separate Storm Sewer Systems (MS4) compliance efforts is underway. A binder of stormwater educational materials has been provided to each watershed community for public distribution to help meet the public education and outreach requirements. Training on Best Management Practices was provided to DPW employees in Boylston and Leominster. DWSP is working with two regional collaborative efforts to provide additional assistance with stormwater management efforts.

All construction sites larger than one acre were inspected monthly during dry weather and after most storm events (200-300 visits annually). Any potential problems were addressed and all erosion and sedimentation issues corrected. Monthly summaries of all inspections and remedial actions were completed.

DWSP has worked to obtain compliance with stormwater regulations for all development in the watershed. Stormwater BMPs are recommended, wherever possible, on all new construction sites. DWSP has worked with local conservation commissions and with state and federal agencies for compliance with stormwater regulations. Joint enforcement action has been taken against sites with serious violations. DWSP staff attended conservation commission meetings and provided technical assistance when requested.

Studies of Gates Brook, Muddy Brook, West Boylston Brook, and Chaffins Brook were completed to look for impacts from unmanaged stormwater and to suggest and implement solutions.

Stormwater problems are exacerbated by increases in impervious surfaces. The latest percent impervious data have been compiled by subbasin. Assessment and attempts to correlate to water quality will occur during the next five year period (see Chapter 6.10).

Five Year Objectives

The control and treatment of stormwater has great potential to protect and improve water quality in tributaries and the reservoir. DWSP will continue to commit significant staff and financial resources to stormwater management efforts, with a top priority of eliminating untreated stormwater discharges to the reservoir. Cooperative efforts with federal, state, and local authorities are an effective way to accomplish shared goals, including the six minimum control measures (CM) that operators of regulated small MS4s must incorporate into stormwater management programs. Improvements through designed water quality studies and long term assessments need documentation.

- Continue design and construction of Phase II of direct discharge elimination program and develop plan, including funding, to remove or treat all remaining direct discharges to the Wachusett Reservoir.
- Continue to locate, assess, and require maintenance of public and private stormwater BMPs as well as BMPs on DWSP property.
- Continue investigations on priority streams to identify areas impacted by erosion and sedimentation, locate discharges, and develop recommendations to eliminate or minimize negative impacts on stream water quality.
- Continue to work with MassDOT and local DPWs to improve infrastructure to control stormwater and with conservations commissions, DEP, and EPA for compliance with state and federal stormwater requirements.
- Continue to work with town officials to implement program of public education and outreach related to stormwater [MS4 CM #1].
- Cooperate with local stormwater working group or target selected groups for specific stormwater projects [MS4 CM #2].
- Continue to update map of stormwater conveyance structures and define 'stormwater subbasins' [MS4 CM #3].
- Continue to inspect all construction sites larger than one acre to ensure compliance with Stormwater Pollution Preventin Plans (SWPPPs), and review, summarize, and assist in the development of bylaws to manage construction site runoff [MS4 CM #4].
- Review, summarize, and assist in the development of bylaws to regulate post-construction runoff, and assist communities with mapping and impervious surfaces analysis [MS4 CM #5].
- Continue to provide regional training on stormwater issues for town employees, DWSP staff, and others [MS4 CM #6].

6.16 Emergency Response

Goal: Maintain and improve emergency response capabilities to assist local responders and protect the water supply.

Release of chemicals and other hazardous materials within the watershed is a serious potential threat to water quality. DWSP maintains and improves emergency response capabilities to assist local emergency responders and protect the water supply should a release occur. A prompt response that recognizes the importance of the tributaries and reservoirs can help minimize any impact to the water supply. DWSP staff provides expertise regarding the hydrologic characteristics of the reservoir and its tributaries, on-water spill control, and specialized equipment for reservoir response. DWSP has developed emergency response capabilities to support local responders, such as fire and police departments. Components of this program include Incident Command training, first responder training, the purchase and staging of equipment, and mathematical modeling of potential spill scenarios.

Accomplishments

DWSP and the MWRA have deployed Emergency Response trailers in key areas throughout the watershed. Annual training has been conducted for DWSP staff in spill response, boom deployment, and Incident Command System. Nearly all staff has taken ICS 700 and ICS 100 classes, and several have taken ICS 200, ICS 300, and Oil Pollution Act of 1990 Qualified Individual training. Training has been successful; for example, DWSP was able to react quickly to an accident and minor spill at the southern end of the reservoir. Response time was excellent; staff successfully deployed boats, containment boom, and absorbents as trained, thus preventing any significant water quality impacts.

DWSP used a consultant to design BMPs to eliminate direct discharges to both the north and south ends of the reservoir. The primary goal was to stop untreated stormwater discharges to the reservoir, but it effectively protected these areas from the impacts of any future accidental releases. Additional information can be found in Chapter 6.15 (Stormwater Management).

Mathematical modeling of the reservoir, in conjunction with UMass Amherst Department of Civil and Environmental Engineering, has been conducted to evaluate spill scenarios. This information was presented in a report titled *Modeling of Contaminant Spills to Wachusett Reservoir Summary of Results and Recommendations.* The MWRA is currently working with a consultant to collect hydrodynamic data that will be used to refine these assessments.

DWSP continues to monitor any spills in the watershed and work with federal, state, and local officials to ensure successful remediation. DWSP, Boylston fire department, and DEP conducted an unannounced mock drill at Tahanto Regional High School in 2009. DWSP has participated in table-top exercises and field exercises as part of the South Wachusett Regional Emergency Planning Committee.

Anchor points around the reservoir have been upgraded and are available for boom attachment.

Five Year Objectives

Continued training and cooperation with local emergency responders will help protect the reservoir from the impacts of an unexpected event.

- Coordinate with MWRA and local officials to provide emergency response training and annual tabletop or field exercises.
- Continue to provide emergency response support services and maintain response supplies and up-to-date contact lists.
- Continue to provide Incident Command System training to appropriate staff.
- Construct additional structural controls to reduce likelihood of spills reaching the reservoir.
- Evaluate, monitor, oversee, and help remediate spills that threaten water quality or DWSP property.

7. Sudbury Reservoir Watershed Control Programs

7.1 Land Procurement

The Sudbury and Foss Reservoirs are an emergency source supply for the MWRA. DWSP and the MWRA focus the limited resources available for land procurement in the active water supply watersheds of Quabbin Reservoir, Ware River, and Wachusett Reservoir, so there is no land acquisition occurring in the Sudbury Reservoir watershed. DWSP manages the area acquired during the development of this water supply in the late 19th century (Table 7-1 and Figure 7-1).

Table 7-1: DWSP Protected Lands in the Sudbury and Foss Reservoirs Watershed

DWSP Fee (acres)	DWSP WPR (acres)	Other Protected (acres)	Total Protected (acres)	Land Area (acres)	Protected as % of Land Area
2,381	0	1,715	4,096	16,350	25.1%

7.2 Watershed Preservation Restrictions

There are no Watershed Preservation Restrictions in the Sudbury Reservoir watershed.

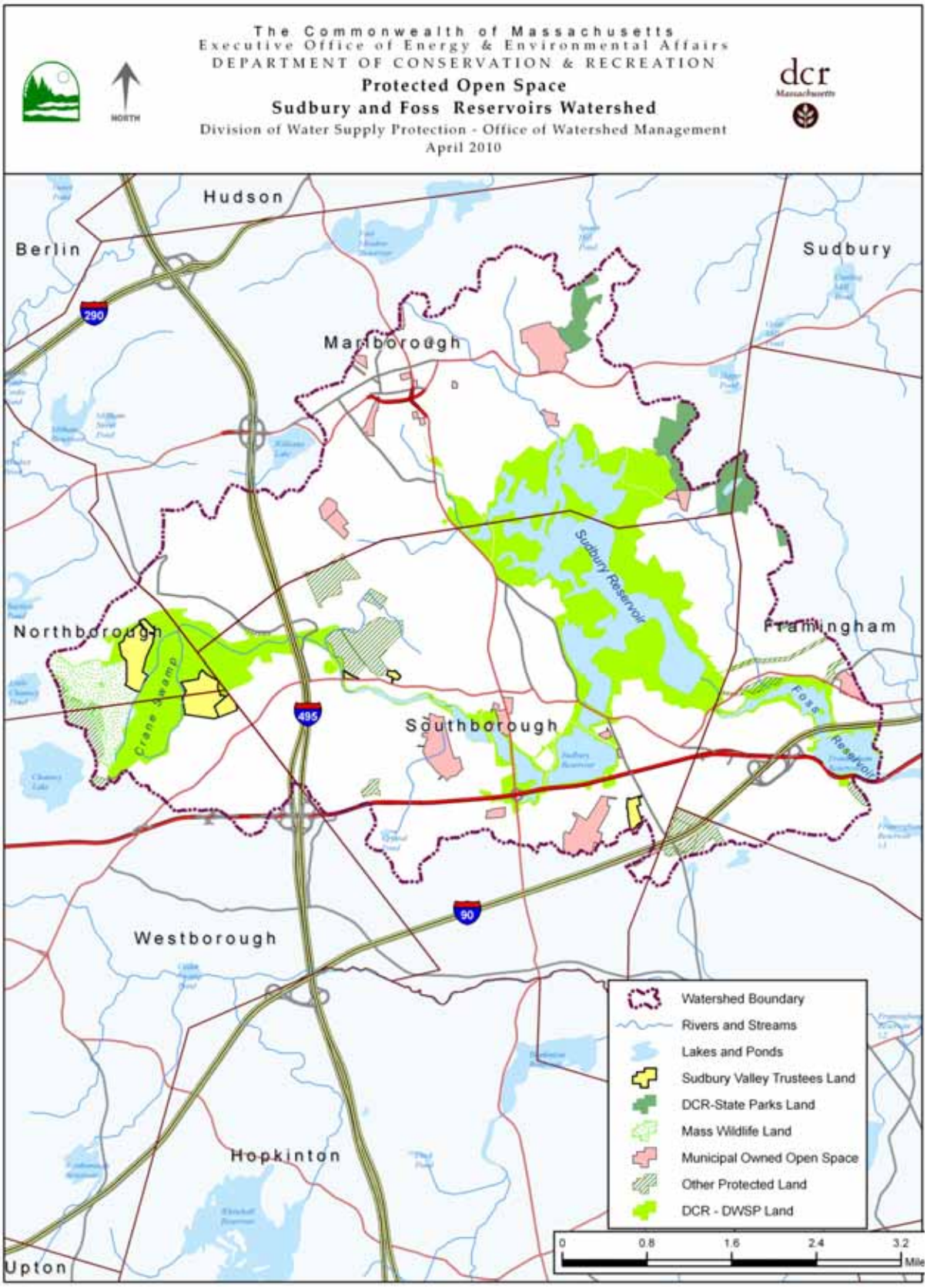
7.3 Land Management

Goal: Maintain a vigorously growing, multi-aged, multi-species forest using forest management programs developed by DWSP staff. Manage all lands to minimize potential water quality impacts. Complete a comprehensive Land Management Plan for the watershed system.

The *2005-2014 Sudbury Land Management Plan* lays out a comprehensive approach towards land management in the Sudbury watershed. Continued implementation of the Land Management Plan, which is to be updated during this Watershed Protection Plan period, provides the best possible protection to the reservoirs.

Land acquisition is one of the most successful approaches for protecting water quality. However, given the Sudbury and Foss Reservoirs' emergency status, DCR has no plans to add to the existing 2,381 acres in DWSP ownership (Figure 7-1). These current holdings remain a critical buffer to the impacts of future growth in the watershed. Encroachment by abutters onto the Commonwealth's properties is a significant problem in the Sudbury watershed. This is due in part to limited ownership, unclear boundaries, and a lack of monitoring and enforcement. Some of these encroachments are minor (e.g., mowing onto commonwealth property), while others are quite significant (e.g., re-grading, landscaping, or placing structures directly adjacent to the reservoirs). Work over the past few years has been completed to identify these encroachments.

Figure 7-1: Sudbury Reservoir Watershed Protected Open Space



There is relatively little timber harvesting activity in the Sudbury watershed, especially compared to the amount performed in the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. An average of one operation occurs annually on DWSP property, with a targeted coverage of approximately 40 acres. DWSP Foresters receive all Forest Cutting Plans for activity on private property in the Watershed System; the limited private timber harvesting in the Sudbury and Foss Reservoirs watershed means few are ever submitted for DWSP review

Accomplishments
DWSP completed marking all boundaries within the Sudbury Reservoir watershed and encroachment letters were sent to responsible property owners. DWSP is working with DCR's legal department to remedy larger or more difficult incidences.

Five Year Objectives

- Continue forestry operations and follow all documented management techniques including oversight of active logging and monitoring of water quality.
- Plan future forestry operations with the goal of maintaining a forest cover that is diverse in species composition and tree sizes and ages across the vast majority of the North Sudbury forest.
- Work to implement invasive species policy for DWSP properties.
- Complete Sudbury and Foss Reservoir chapter for comprehensive Land Management Plan.
- Monitor known boundary encroachments and seek resolutions.

7.4 Wildlife Management

Goal: Protect the water supply and infrastructure from adverse impacts caused directly or indirectly by wildlife. Continue bird harassment program, wildlife management in the reservoirs' Pathogen Control Zones, and implementation of the gull study recommendations. Protect common, rare, and significant wildlife species and their habitats.

The *2005-2014 Sudbury Land Management Plan* (to be updated during this Watershed Protection Plan period) includes extensive discussions on wildlife management in the watershed. The Canada goose population is the primary target of DWSP's wildlife management activities in the Sudbury watershed. A population control program initiated in 2007 has curbed the growth of the resident population.

Data collected by DWSP Natural Resources Staff indicates that the Sudbury Reservoir System is used by roosting gulls on a regular, but intermittent, basis. In the event that this system was to go online as an emergency supply, particularly during the fall or winter months, it may be necessary to assess the extent of the roosting and/or initiate a harassment program if conditions warranted.

Accomplishments
DWSP Natural Resources staff has annually surveyed watershed lands for loon and bald eagle nesting sites. All potential vernal pool sites were visited and field inspected by NR staff. All

reservoir islands and the area around the MWRA facilities were surveyed each spring to locate nesting Canada Geese; eggs found in nests were oiled to prevent hatching. Shoreline surveys were completed each summer to measure the success of oiling.

Five Year Objectives

- Mitigate adverse impacts of wildlife on infrastructure and other watershed resources.
- Protect uncommon, rare, and otherwise significant wildlife species and habitats wherever they exist on DWSP lands.
- Maintain, where feasible and applicable, and on limited acreage, early successional forested and non-forested habitats on DWSP lands.
- Implement goose population control program on Sudbury Reservoir.

7.5 Public Access Management

Goal: Manage public access to DWSP lands and waters in compliance with Public Access Plans to protect water quality. Utilize visitor contact to provide education and outreach on watershed issues.

DWSP policies regarding public access in the Sudbury system are detailed in the *2010 Sudbury Reservoir Watershed System Public Access Plan*. A key component to the plan is the designation of resource management districts and corresponding public access rules (Figure 7-2 and Table 7-2). Many activities are not allowed in the Sudbury and Foss Reservoirs watershed due to the limited resources available to protect both the public and DWSP property. There are ongoing enforcement issues surrounding illegal uses and encroachments, such as chronic swimming at the railroad trestle crossing the Foss Reservoir. This activity resulted in the death of a teenager in 2008. Illegal camping and fires have become a problem on the peninsula behind the Meadows Apartments located on Broadmeadow Road. More enforcement is occurring but the issue remains a challenging one.

Aquatic Invasive Species pose a threat when using fishing gear that has been submerged in an infested lake, pond, or stream area. Therefore, while fishing is allowed from the shoreline at many areas around the Sudbury Reservoir, it is important that users be vigilant about cleaning any fishing equipment. DWSP encourages that any visible mud, plants, fish or animals be removed before transporting equipment, and any fishing equipment that comes into contact with the water should be thoroughly cleaned and dried before using at the Sudbury Reservoir or any of its tributaries.

Bacterial contamination and nutrient contribution from dog waste is a threat to water quality due to the amount of residential neighborhoods abutting tributaries and surrounding the reservoir. There were over 8,000 licensed dogs in 2012 within the five communities that make up the Sudbury Reservoir watershed. It is estimated that each dog produces about ¾ lb. waste/day. This is an unimaginable amount of bacteria, about 7.8 billion fecal coliform/day/dog, that could enter the surface waters in the watershed either directly or carried in stormwater.

Figure 7-2: Public Access Zones in the Sudbury and Foss Reservoirs Watershed

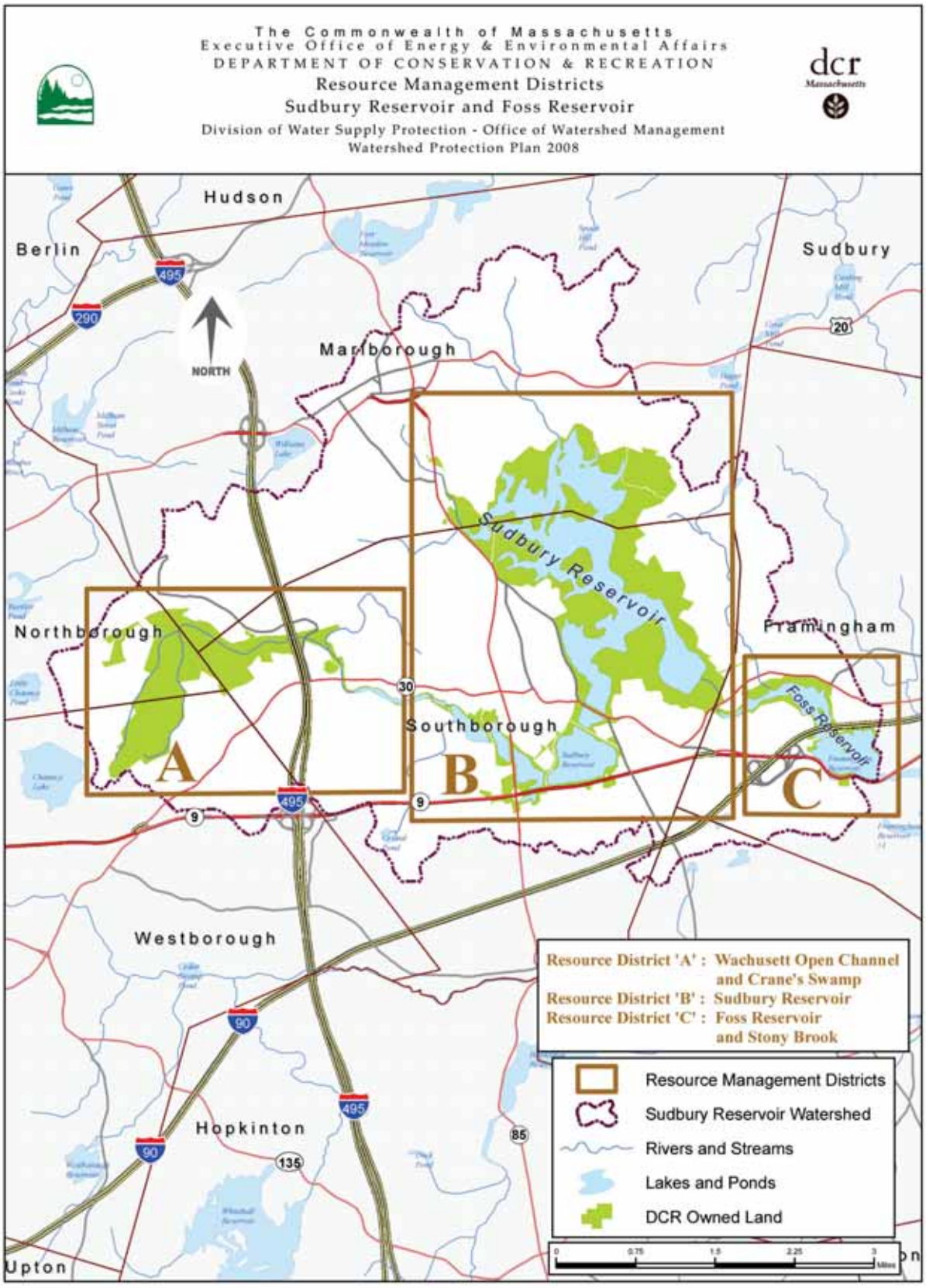


Table 7-2: Public Access Policy Summary in the Sudbury and Foss Reservoirs Watershed

ACTIVITY	Wachusett Open Channel/Crane's Swamp (Area A)	Sudbury Reservoir (Area B)	Foss Reservoir (No. 3)/Stony Brook (Area C)
VEHICLE ACCESS			
Off-Road Driving (ORVs, ATVs)	⊘	⊘	⊘
Snowmobiling	⊘	⊘	⊘
Bicycling	⊘	⊘	⊘
FOOT ACCESS			
Hiking	✓	✓	⊘*
Dog Walking	⊘	⊘	⊘
Cross-Country Skiing	✓	✓	⊘
Shoreline Fishing	✓	✓	⊘*
Horseback Riding	⊘	⊘	⊘
Hunting	⊘	⊘	⊘
WATER ACCESS			
Boating - non – motorized	⊘	⊘	⊘
Boating – motorized (including "jet-skis")	⊘	⊘	⊘
Swimming	⊘	⊘	⊘
Ice Skating/Ice Fishing	⊘	⊘	⊘
OTHER ACTIVITIES			
Camping	⊘	⊘	⊘
Picnicking	✓	✓	⊘*
Fires & Cooking	⊘	⊘	⊘
Collecting/Metal Detecting	⊘	⊘	⊘
Geocaching	✓	✓	⊘*

✓ – Public access is allowed in designated areas only ⊘ – Activity prohibited

⊘* – Activity prohibited, but may be allowed in the future if suitable access is identified

Public access is allowed in designated areas only. Any activity which injures or defaces the property of the Commonwealth is strictly prohibited. All alcoholic beverages are prohibited. Night access is prohibited on DCR land in the Sudbury Reservoir watershed. See 350 CMR 11.09(2) for complete list of regulations. For additional information, contact the Wachusett/Sudbury Watershed Ranger Station at (978) 365-3800 or go to www.mass.gov/eea/agencies/dcr/water-res-protection/watershed-mgmt/public-access.html. In an emergency, contact the Watershed Rangers or the Massachusetts State Police at (508) 829-8410.

The Sudbury Reservoir watershed includes many open space and recreation fields not owned by DWSP. Callahan State Park allows for a variety of public recreation, including dog walking. Lands are also owned by the Sudbury Valley Trustees, Boy Scout organization, municipal departments and private schools, offering vast areas of open space for use.

Numerous sports fields are located along tributaries to the reservoir, where chemical use, in addition to human activity, pose a risk to the water supply. These fields offer wide open spaces for Canada geese and are often an area for dog walkers, providing a pathway for bacteria and pathogens to get into the water supply.

A portion of the Bay Circuit Trail, a 184 mile permanent recreation trail and corridor that travels through 34 communities, is located within the watershed. The trail, where it was in close proximity to the dam and reservoir, had been diverted after the events of September 11, 2001 to the roadway. As of the spring of 2013, the Pine Hill Trail follows a wide logging road through woodlands along the eastern shoreline of the reservoir for 2.1 miles. Maps and information made available to the public list the area as a drinking water supply and instruct users to follow posted rules and regulations.

Accomplishments

An update to the Public Access Plan was completed in 2010. Watershed Rangers have routinely patrolled and educated visitors within the watershed and have worked with local and state law enforcement to curb activities such as trespassing and illegal hunting and trapping. Signage has been updated on DWSP lands and ATV access at some gates has been blocked. Old campsites have been removed; Rangers have stepped up patrols to deter any camping and hunting activity. Rangers have hosted "cache in/trash out" geocaching events in 2011 and 2012 which resulted in a large turnout. An Earth Day clean-up event was held in 2010.

Five Year Objectives

- Monitor DWSP lands to ensure compliance with rules and regulations designed to protect the water supply and protect the public.
- Protect water and DWSP lands from negative impacts caused by public access activities and continue to implement and update the Public Access Plan.
- Protect DWSP watershed land and water quality from impacts due to activities on adjacent, non-DWSP owned lands.
- Maintain working relationships with State, Environmental, and local police.

7.6 Watershed Security

Goal: Maintain and improve watershed security programs to provide surveillance of the watersheds and protect the watershed system from potential threats.

Many security improvements have been made by both MWRA and DWSP over the past years. Due to security concerns, these improvements will not be listed here.

The largest security concern in the Sudbury watershed is the amount of roadway and the railroad lines that abut or cross the reservoir. There are also many technological, chemical and biomedical companies in the watershed. The *Wachusett/Sudbury Watershed Spill Response/Prevention Plan* was written in 2008, providing guidance for releases of hazardous materials. An Emergency Action Plan, containing the details the procedures to follow in several scenarios associated with a breach at the Sudbury Dam, will be revised to include additional information and locations.

A Vulnerability Assessment was required by the federal 2002 Public Health and Bioterrorism Preparedness and Response Act. DWSP and MWRA are implementing the recommendations of this assessment; due to the sensitive nature of this matter, however, specific details cannot be included in this report

A section of the Bay Circuit Trail, which used to follow the perimeter of a portion of the reservoir, has been closed by the MWRA since the terrorist attacks of 2011. Users are now diverted away from the reservoir onto Route 30.

Watershed Rangers regularly patrol the area. Local, State, and Environmental police are also responsible for monitoring the watershed.

Accomplishments

Regular maintenance and installation of access gates is ongoing. DWSP has completed a Comprehensive Emergency Management Plan that details actions and procedures for incidents that occur on DWSP property or that have the potential to impact the water supply.

Five Year Objectives

- Plan and prepare for both large and small incidents with possible water quality impacts.
- Remain up to date with any guidance materials available from EPA, American Water Works Association, and Department of Homeland Security.
- Continue to work with local, state and federal responders.
- Coordinate and conduct proactive patrols and operations to ensure regulatory compliance on watershed properties.

7.7 Infrastructure

Goal: Provide resources to maintain the integrity of all high hazard dams under DWSP control, to maintain and improve DWSP facilities long-term, and to maintain internal roadways to allow them to sufficiently support their use for the water supply protection program.

The main infrastructure elements in the Sudbury and Foss Reservoirs watersheds are the reservoirs' respective dams, spillways, gatehouses, and associated dikes. There are also emergency pipelines that connect Foss Reservoir Gatehouse to Stearns Reservoir Gatehouse and the Sudbury Aqueduct. DWSP and MWRA work cooperatively to ensure that the biannual dam safety inspections required under 302 CMR 10.00 are completed and results reported to the DCR Office of Dam Safety. DWSP's Civil Engineers perform routine monthly inspections, while

MWRA provides capital maintenance and improvements in response to any deficiencies discovered by inspections.

DWSP maintained fire roads and improvement projects on DWSP property are monitored by EQ staff and follow or exceed all applicable state, federal and municipal regulations during the work phase.

Accomplishments
DWSP has performed routine maintenance and roadway improvements when necessary for operations of the water supply.

Five Year Objectives
- Continue to monitor and maintain large dams, spillways, and dikes, and periodically update Emergency Action Plan.
- Identify annual and long term capital needs when applicable.
- Maintain fire roads for water supply operations as necessary.

7.8 Watershed Protection Act

The Watershed Protection Act's regulations do not encompass the Sudbury Reservoir watershed.

7.9 Interpretive Services

Goal: Provide educational opportunities through school programs, interpretive programs on DWSP properties, and through Watershed Ranger interactions to inform the public about watershed protection and drinking water issues.

Watershed Rangers, besides patrolling DWSP property, are also able to educate visitors on DWSP rules and regulations, the DCR/MWRA water supply system, and DWSP efforts to manage the watershed. The publications and education material developed and distributed by DWSP's Interpretive Service staff at the Quabbin Visitor's Center, Stillwater Farm, and Wachusett Environmental Quality staff can also be shared with the Sudbury Reservoir watershed communities.

The suburban communities that comprise the Sudbury watershed, unlike many of the rural towns that are within the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds, are municipalities with professional staff. DWSP relies on this knowledge base to support local environmental regulatory implementation. DWSP maintains communication, as needed, with key boards in offering technical assistance and community outreach.

Accomplishments
Routine "in the field" education has been ongoing by the Watershed Rangers. DWSP has also hosted a "cache in/trash out" public event, encouraging a day of geocaching and carrying out found trash, as well as an Earth Day clean up event encouraging public participation to clean

watershed lands. Environmental Quality staff has assisted local Boards of Health when dealing with issues related to dog waste by providing educational brochures.

Five Year Objectives

- Educate the public of the importance of Sudbury and Foss Reservoirs as a reserve drinking water supply and natural resource.
- Instill behavior change in watershed residents to protect reservoirs from pollutants and contamination.
- Continue ongoing efforts to reduce threats from public access through programs (e.g., Earth Day cleanups, fishing line collections, Cache In-Trash Out, etc.).

7.10 Water Quality and Water Quantity Monitoring

Goal: Conduct tributary and reservoir sampling to identify short-term water quality problems and to maintain the historical record for long-term trend analyses. Collect hydrologic data to support water quality work and reservoir operations. Conduct analyses and assessments of data for use in management decisions.

The Sudbury and Foss Reservoirs, as emergency source water supplies, are not subject to the same level of thorough examination as the Quabbin and Wachusett Reservoirs, the active drinking water sources in the DCR/MWRA water supply system. MWRA has a program of water quality monitoring for all of its reserve water supplies, both source (Sudbury and Foss) and distribution (Chestnut Hill, Fells, Norumbega, Spot Pond, and Weston) reservoirs.

Samples from six tributaries located in Marlborough and Southborough were tested monthly from 2009 to 2011 for bacteria, specific conductivity, temperature, and turbidity. Results were in ranges expected for all sample sites, which were located within residential areas. Having a baseline for water quality in these tributaries, the sampling program for the near future will focus on augmenting water quality investigations.

Accomplishments

Data collected from the tributary sampling has resulted in an excellent baseline for water quality parameters.

Five Year Objectives

- Utilize tributary samples to aid in water quality investigations.
- Target potential water quality problems.

7.11 Watershed Monitoring and Surveillance

Goal: Use site inspections, Environmental Quality Assessments, local board meetings, and information from Watershed Rangers and other DWSP staff to identify possible violations of state and federal regulations

Assessments of the Sudbury watershed can be obtained from maintaining communication with local, state, and federal regulatory and planning authorities, as well as DWSP's review, as needed, of MEPA filings. DWSP will support enforcement of all local, state, and federal environmental regulations regarding wastewater management, stormwater management, agriculture, and hazardous materials and waste. DWSP Environmental Quality staff will track and monitor hazardous materials releases and spills until a permanent solution has been achieved when cleanup efforts fall under the DEP's Mass Contingency Plan (310 CMR 40.0000). When staffing and time allows, visual outdoor inspections of industrial and commercial sites will be conducted and any issues that could impact water quality will be followed up through DWSP and/or local boards or commissions. Watershed Rangers, through regular patrols, inform DWSP Environmental Quality staff of situations that they feel requires investigation. DWSP will continue to follow through with reports made by Ranger staff.

Threats to the reservoir persist from the Town of Southborough's reliance on septic systems. As larger developments are constructed, so are larger septic systems. There were three notable large septic system failures in 2012. Vickery Hills Condominiums on Mount Vickery Road and Carriage Hill at Southborough on Carriage Hill Road are both over-55 communities. Although the systems are generally designed to last 20 or 30 years, both of these were only about a decade old, and reasons for failure were not found. The septic system at an office building at 118-120 Turnpike Road also failed, and sewage seeped into the parking lot. Minutes from the Town Board of Health May 9, 2012 stated that "some of the large systems have not been maintained." The Fay School constructed a wastewater treatment plant in 2008 to treat wastewater from two dormitories and primary school on campus. Water is now reclaimed from these new areas instead of being disposed in a traditional septic system. Replacement or repair of large failing septic systems or alternative systems will be monitored as staff is made aware of them through media outlets or local Boards of Health.

CSX freight rail company completed construction in October 2012 of a bulk material transfer station in Westborough along the Southborough border. Storage on-site will consist of hazardous materials, including: chemicals for water treatment, raw materials used in pharmaceuticals and cosmetics, oil for recycling, de-icing fluids for Hanscom and Logan Airports, biofuels, and plastics. Although this site is located off-watershed, it would be prudent to monitor the transport of these materials and any changes to ensure awareness if they are being carried over the reservoir, or even through this watershed, at some point during the process. In addition to hazardous materials transport, this construction is expected to increase commuter train traffic from Worcester to Boston by an estimated 20 trains per day.

There is the potential for Global Petroleum Corp. to ship large amounts of ethanol from a facility in Albany N.Y. to Revere, MA utilizing rail corridors that bisect the watershed. This situation will be watched closely, as ethanol requires unusual firefighting equipment and causes unique environmental impacts. It is miscible in water and is soluble at any concentration, and will

persist in the ground many years after a release or spill. It is important to note that ethanol fires cannot be extinguished with the traditional use of water; dry chemical agents and foam are required, both of which pose a risk if they enter into the surface water supply. Activity at the CSX bulk materials transfer facility will also be monitored for any possibility of future ethanol transport.

Spills or releases of hazardous materials of certain concentrations are reportable to DEP under the Mass Contingency Plan (MCP). DWSP monitors submitted reports of cleanup efforts and relays concerns to DEP as conditions warrant for sites within the watershed.

There are several modes of commercial and industrial activities in the Sudbury and Foss Reservoirs watershed, mostly clustered around the major transportation arteries of the Mass Turnpike, I-495, and Rt. 9. While many of these sites are in the western edge of the watershed, the Framingham Technology Park is situated adjacent to Foss Reservoir. Commercial activity also spreads along the length of Rt. 9 as it borders the two reservoirs, and there is a strip of commercial sites along Rt. 85 to the northwest of Sudbury Reservoir. According to a 2010 study completed by the MetroWest Regional Collaborative and the Metropolitan Area Planning Council, it is noted that the Route 9 corridor along Southborough, Framingham, Natick and Wellesley has the potential to expand commercial space by 88 percent under current zoning by-laws. In addition, traffic would also be expected to grow by 40 percent with this development. While towns are pushing to increase this economic development, "smart growth" design would decrease commercial space, according to the Collaborative.

DWSP relies on the buffering of its land to mitigate against the most serious impacts of commercial and industrial activity. As described in previous sections, DWSP also depends on local implementation and DEP oversight of state regulations to provide protection to the reserve water supply.

Solid waste facilities do not pose a threat to the Sudbury Reservoir. According to MassGIS and DEP, there are three closed or inactive solid waste facilities in the Sudbury basin. One is in Framingham, situated between Rt. 9 and the MA Turnpike. The other two are in Southborough, one on land owned by the town, the other south of Rt. 9. DWSP will continue to review DEP monitoring of the landfills under the state's Solid Waste Regulations.

There is minimal water impact from crop and pasture lands to water quality in the Sudbury and Foss Reservoirs due to the limited amount of agricultural areas within the watershed.

Accomplishments

Several investigations and monitoring efforts were performed in the watershed over the past five years. A report of snow storage in close proximity to storm drainage on Bose Hill was determined to be insignificant as it was determined that any storage of snow in the entire area of the lot would drain to this storm drain system, so no action was necessary by DWSP. Sites of hazardous materials releases were monitored until clean-ups were successfully completed under the MA Contingency Plan (MCP), including incidents at Cumberland Farms on Turnpike Road in Southborough and the BP Gasoline Station on Worcester Road in Framingham. Hazardous materials release at the former Exxon Mobil terminal on Maple Street in Marlborough and the

Mobil Service Station on Turnpike Road in Southborough continue to be monitored through DEP reports and Licensed Site Professional submittals to DEP under the MCP.

Five Year Objectives

- Observe and determine sources of water impairment and rectify to improve the quality of the water resource.
- Identify sites impacting water resource and/or DWSP lands and work with town boards and commissions to improve the situation.
- Monitor sites of releases or spills and follow submitted reports until clean up has been completed under Mass Contingency Plan.
- Review large projects, as necessary, which have the potential to impact DWSP lands and/or water quality.

7.12 Aquatic Invasive Species Management

Goal: Prevent introduction of Aquatic Invasive Species through monitoring, public education, exclusion, and decontamination measures at potential entry points.

Sudbury Reservoir is host to two invasive aquatic plants: Eurasian Water-milfoil (*Myriophyllum spicatum*) and Water Chestnut (*Trapa natans*). Eurasian Water-milfoil is present throughout the entire Sudbury Reservoir system at relatively high densities, indicating that it was introduced into this system many years ago, probably in the 1990s. It is not targeted for control in Sudbury Reservoir because the population is so well-established that removal efforts would be futile.

A pioneer infestation of Water Chestnut was detected in 2006 in the Sudbury Reservoir. The rosette of floating leaves formed by this plant could blanket extensive areas of the reservoir surface, so it was deemed necessary to mount a control effort against this species. The obvious status of this plant as a recent introduction in only the early stages of infestation (limited distribution and coverage) also facilitated the decision to initiate removal efforts.

Unlike Eurasian Water-milfoil, Water Chestnut is an annual that overwinters as a nut-like seed, so this species could potentially be eradicated if harvesting efforts remove plants before they produce seeds. Harvesting efforts have been conducted annually since 2006 in the expectation that eventually the existing seed bank will be exhausted (seeds can remain viable for up to 12 years). DWSP staff continue to monitor Water Chestnut and other macrophytes in Sudbury Reservoir on an annual basis.

Accomplishments

Yearly harvesting of Water Chestnut has been performed by contractors since its discovery by DWSP Aquatic Biologists in 2006. The contractor recommended utilizing a mechanical harvester in 2010 to remove a majority of the water chestnut, followed by a more reasonable hand-pulling effort to address the remaining plants in subsequent years. The extent of the infestation has recently shown signs of reduction, as the seed-bank becomes depleted. In 2013, a few Brittle Naiad (*Najas minor*) plants were found and targeted for removal. Annual surveys will continue to target new infestations of these and other aquatic invasive species.

Five Year Objectives

- Protect infrastructure from harmful effects of Water Chestnut and other invasive species.
- Educate fishermen on the harmful effects of AIS and encourage proper fishing equipment cleaning.

7.13 Environmental Quality Assessments

Environmental Quality Assessments are not performed in the Sudbury Reservoir watershed.

7.14 Wastewater Management

There is no specific Wastewater Management program in the Sudbury Reservoir watershed. Wastewater issues are covered under the Watershed Monitoring and Surveillance program.

7.15 Stormwater Management

Goal: Develop and implement actions to reduce stormwater loadings, including ongoing identification of stormwater inputs and continuation of stormwater BMP construction on DWSP land.

Education and outreach on stormwater pollution prevention, as a non-traditional Best Management Practice, can be an invaluable tool to improve the quality of stormwater entering into the Sudbury and Foss Reservoirs. Almost one third of the watershed is in residential development, with over 140,000 residents in the five towns encompassing this watershed. DWSP has the ability to perform outreach and education to watershed residents in the form of brochures and presentations and will consider this approach in an effort to minimize this source of pollution. For example, Wachusett Reservoir watershed staff has developed a series of brochures on various stormwater topics (dog waste, car washing, construction sites, illicit discharges, and others) which will be shared with town departments, boards and commissions for use in the Sudbury Reservoir watershed.

DWSP investigated a toxic algae bloom at the Sudbury Reservoir during the summer of 2011. Staff noted that a majority of the abutting residential properties in the area upstream of the bloom had cleared vegetation and planted lawn to the edge of their property. A lawn management company was seen in one back yard spreading chemicals, and all lawns were lush and bright green during an extremely dry period. In addition to the probable fertilizers contributing nutrients to the water body, Canada Geese are given a clear pathway to and from the Reservoir. Past surveying done by staff have shown no encroachments, but there are several areas where improvements can be made to keep runoff from directly entering the water body. This is an example where education might elicit a positive behavior change in residents.

Accomplishments

DWSP staff assisted the Southborough Board of Health by providing a brochure on the impacts of dog waste on surface water supplies to be distributed to residents in an effort to keep dog waste out of storm drains and catch basins**.**

Five Year Objectives

- Raise awareness of stormwater as a pollutant, including techniques for reducing runoff and improving the quality of stormwater runoff, as an effort to create a behavior change among watershed residents that will protect natural resources.
- Provide stormwater programs, resources and/or support, as resources allow, to town departments, boards, and commissions.
- Educate watershed communities, through town offices, about specific pollutant sources and what individuals can do to reduce and improve urban runoff pollution.

7.16 Emergency Response

Goal: Maintain and improve emergency response capabilities to assist local responders and protect the water supply.

The level of threat from an accident depends on the type and volume of the product released, the location of the incident, and weather conditions. While not the same high priority as the Quabbin and Wachusett Reservoirs, DWSP and MWRA must still be prepared for accidents near the Sudbury and Foss Reservoirs. Updated protocols for the Sudbury watershed are integrated into the 2008 *Wachusett and Sudbury Watersheds Emergency Spill Response/Prevention Plan* and the *2012 Wachusett/Sudbury Comprehensive Emergency Management Plan*. In addition to a hazardous materials spill, damage, interruption or contamination of the public water supply could result from a major natural disaster such as flooding or tornadoes. A critical component to any Emergency Response is communication, cooperation, and coordination with the local first responders as well as DEP's Bureau of Waste Site Cleanup Response and Remediation Division.

Accomplishments

DWSP staff has been regularly trained in reservoir boom deployment and terrestrial spill response. DWSP has completed a Wachusett/Sudbury Watershed Spill Response/Prevention Plan which details actions and procedures for incidents that occur on DWSP property or that have the potential to impact the water supply or surrounding property.

Five Year Objectives

- Ensure that DWSP and town emergency responders are aware of emergency protocols put in place by DWSP.
- Ensure that proper authorities are provided updated emergency contact list and phone numbers on a regular basis.
- Provide emergency response training for new DWSP employees and refresher training for veteran staff.

8. Implementation

8.1 Organization and Management

DCR's Division of Water Supply Protection, Office of Watershed Management (DWSP) implement the watershed management program developed and described in this report. The organizational structure of the Office of Watershed Management is shown in Table 8-1.

Table 8-1: DCR/DWSP Office of Watershed Management Organization

Section		
Division	**Wachusett/Sudbury**	**Quabbin/Ware**
Management Division Director Budget Director Natural Resources Director	Management Regional Director Assistant Regional Director	Management Regional Director Assistant Regional Director
Budget and Administrative Support	Administrative and Technical Support	Administrative and Technical Support
Program Coordination and Technical Support – GIS	GIS – Wachusett	GIS - Quabbin
Natural Resources	Forestry	Forestry
Program Coordination and Technical Support – Environmental Planning	Environmental Quality	Environmental Planning
		Environmental Quality
	Civil Engineering	Civil Engineering
	Watershed Rangers	Watershed Rangers
	Interpretive Services	Interpretive Services
	Watershed Maintenance	Watershed Maintenance

8.2 MWRA Memorandum of Understanding and the Water Supply Protection Trust

A Memorandum of Understanding (MOU) was signed in 2004 between the DCR and the MWRA that coordinates the implementation of the respective agencies responsibilities in regard to the "protection, construction, operation, maintenance and improvement of water supply resources, facilities, and infrastructure within the [Metropolitan Boston water supply] watershed and waterworks system" (see www.mass.gov/eea/docs/dcr/watersupply/watershed/2004dcrmwramou.pdf). Section 7.0 of this MOU details the development of an annual Work Plan for the Office of Watershed Management.

The legislature further enhanced the ability of the Office of Watershed Management to maintain the drinking water supply by establishing a Water Supply Protection Trust, created by Chapter 149 of the Acts of 2004, §27, and written into the general laws at MGL c. 10, §73. The trust provides a more efficient mechanism for MWRA's funding of the Office of Watershed Management. The Trust has also allowed the Office of Watershed Management to more efficiently manage its budget.

The Water Supply Protection Trust has a five person board of trustees responsible for approving the Office of Watershed Management's annual work plan and budget each spring for the following fiscal year beginning in July. The members of the board of trustees are:

1. The Secretary of the Executive Office of Energy and Environmental Affairs
2. The Executive Director of the MWRA
3. A representative jointly selected by the North Worcester County Quabbin Anglers Association, Inc. and the Quabbin Fishermen's Association, Inc.
4. A representative from the Swift River Valley Historical Society
5. The Chairman of the MWRA Advisory Board.

The Water Supply Protection Trust works diligently to ensure that the Office of Watershed Management has sufficient funding to staff and implement the *2013 Watershed Protection Plan Update*.

8.3 Work Plan and Annual Budget

DWSP prepares an Annual Work Plan that meets all of the requirements set forth by the MOU and achieves the watershed protection goals and objectives developed in this report. The Annual Work Plans include a detailed description of tasks for the two operational sections – Quabbin/Ware and Wachusett/Sudbury. The Work Plan's tasks are developed and organized by the programs described in this report.

The Quabbin/Ware and the Wachusett/Sudbury Five Year Program Objectives are presented, respectively, in Table 8-2 and Table 8-3. These tables will be the basis for developing Annual Work Plans for Fiscal Years 2014 through 2018. Annual Work Plans and the associated budget process to ensure that DWSP achieves the five-year objectives and overall system-wide goals of the watershed protection program. All objectives unless noted otherwise are ongoing throughout this five year period.

Progress reports are submitted to MWRA to keep the agency informed on DWSP's progress towards achieving annual goals set out in the budget. Implementation also requires ongoing evaluation of the effectiveness of the programs and modification to adapt to changing conditions or concerns

The creation of the Water Supply Protection Trust and the reporting parameters established by the MOU has created an efficient and transparent mechanism for MWRA's funding of DWSP activities. The funding of major capital expenditures, Payments in Lieu of Taxes, and land acquisition are also the responsibility of MWRA.

8.3.1 Quabbin/Ware Ware Operational Section Five Year Implementation Plan

Table 8-2: Quabbin/Ware Operational Section Five Year Implementation Table

Key to Abbreviations: ARD = Asst. Regional Director; ATS = Administrative and Technical Support; CE = Civil Engineering; D = Division of Water Supply Protection Director; EP = Environmental Planning; EQ = Environmental Quality; F = Forestry ; GIS = Boston GIS staff; HACCP = Hazardous Analysis Critical Control Point; IS = Interpretive Services ; NR = Natural Resources; P = Planning (Boston); Q = Quabbin Section; Q/W= Quabbin and Ware Sections; RD = Quabbin Regional Director; W = Ware Section; WEQ = Wachusett EQ; WM =Watershed Maintenance; WR = Watershed Rangers.

#	Objective	Lead	Additional Staff	Projected FY
A.	**Land Procurement**			
1.	Identify opportunities in the field for land procurement and forward information to LAPP.	NR	GIS	FY14-18
2.	Collaborate with Land Trusts and other land protection groups (e.g., Forest Legacy Program) to acquire lands through gifts and other means.	NR		FY14-18
3.	Reduce the amount of time it takes to complete land acquisition projects.	NR	F, GIS, EQ, P, WM, CE, EP	FY14
B.	**Watershed Preservation Restrictions Program**			
1.	Monitor each Watershed Preservation Restriction (WPR) at least once every two years; annually monitor high-priority WPRs.	NR	EQ, EP, F	FY14-18
2.	Maintain good working relationships with landowners and resolve WPR violations.	NR	EP, F, EQ, P	FY14-18
3.	Use WPRs to increase control of watershed lands in an economical way.	NR		FY14-18
4.	Complete baseline documentation reports prior to WPR acquisition.	NR	GIS	FY14-18
5.	Maintain good records and distribute them to other staff as necessary.	NR		FY14-18
C.	**Land Management**			
1.	Write the Quabbin and Ware chapters of the comprehensive Land Management Plan.	NR	F, P	FY14
2.	Design and begin to implement research and monitoring to verify the effectiveness of the existing statewide and DWSP forestry Best Management Practices/Conservation Management Practices in protecting the water supply.	EQ	F, NR	FY14-18
3.	Continue regeneration monitoring in the Quabbin watershed.	F	NR	FY14-18
4.	Continue forestry operations and follow all documented management techniques including oversight of active logging.	F	EQ	FY14-18

#	Objective	Lead	Additional Staff	Projected FY
5.	Coordinate monitoring and analysis efforts with National Ecological Observatory Network (NEON) regarding Climate Change.	F		FY14-18
6.	Assess and monitor status of encroachments onto DWSP property in the Ware watershed and take appropriate follow-up actions.	F	CE	FY14-18
D. Wildlife Management				
1.	Control aquatic mammals that threaten water quality or infrastructure.	NR	WM	FY14-18
2.	Reduce the amount of food available to gulls in central MA by controlling public feeding and identifying and controlling alternative food sources.	NR		FY14-18
3.	Monitor moose populations and their impact on forest dynamics through browsing surveys, annual moose sign surveys, and exclosure studies.	NR		FY14-18
4.	Continue year-round bird observation on the Quabbin Reservoir.	NR	EQ, WM	FY14-18
5.	Continue to control the resident Canada goose population.	NR	EQ, WM	FY14-18
6.	Manage habitat for rare species; monitor populations of select species.	NR		FY14-18
7.	Continue to test mammal and bird fecal samples for the presence of *Giardia* and *Cryptosporidium*.	NR		FY14-18
8.	Administer the White-tailed Deer Management Program in the Quabbin watershed, including the application, permit, biological data collection, and orientation components of the program.	NR	RD, IS, WM, P	FY14-18
9.	Assess deer management options in Quabbin Park.	RD	NR	FY14
10.	Manage burrowing animals to prevent damage to infrastructure.	NR		FY14-18
11.	Protect wildlife and their habitats while minimizing or eliminating adverse impacts caused directly or indirectly by wildlife.	NR		FY14-18
12.	Develop management plans for existing DWSP fields in the Ware watershed.	NR		FY14
E. Public Access Management				
1.	Implement, evaluate, and update Quabbin Public Access Management Plan by 2016 and Ware Public Access Management Plan by 2019.	EQ	RD, WR, IS	FY15 & FY19
2.	Continue to provide educational opportunities through school programs, interpretive programs and Watershed Ranger interactions.	IS	WR	FY14-18
3.	Maintain working relationships with State, Environmental, and local police.	RD		FY14-18
4.	Continue to address illegal access to DWSP lands and water.	RD	WR	FY14-18
5.	Expand use of electronic media to collect and disseminate information.	IS		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
6.	Begin implementation of Quabbin Park Plan and incorporate into the operations of the Watershed Maintenance crews.	RD	WM	FY14-18
7.	Collaborate with other organizations for increased user education and public outreach.	IS		FY14-18
8.	Enhance and simplify signage along boundaries and major access points in the Ware River watershed.	F		FY14-18
9.	Enhance or maintain communication channels with major user groups and the Ware River Watershed Advisory Committee.	ATS		FY14-18
F. Watershed Security				
1.	Continue to use, improve, and integrate Incident Command System (ICS) to respond to emergency situations.	RD		FY14-18
2.	Coordinate with MWRA on all security issues, in order to maintain a comprehensive system-wide approach.	RD		FY14-18
3.	Finalize Quabbin/Ware River Emergency Response Manual.	ATS		FY14-18
4.	Continue Watershed Ranger patrols of High Vulnerability Sites.	WR		FY14-18
5.	Improve physical access control structures, as necessary, and implement a maintenance program.	WM		FY14-18
6.	Continue to work with local, state and federal responders.	RD	WR	FY14-18
7.	Maintain and/or enhance working relationships and information-sharing among local enforcement personnel, MWRA, Watershed Rangers, Army Corps and Oakham office staff.	RD		FY14-18
G. Infrastructure				
1.	Continue maintenance and rehabilitation of DWSP facilities and roads, including evaluation of Quabbin Administration Building drinking water system.	CE	WM	FY14-18
2.	Operate Quabbin Reservoir to maximize water quality, minimize flood risk, and meet operational needs.	RD		FY14-18
3.	Develop a Long Range Capital Project Improvement Plan to target maintenance repairs and to budget for future capital funding needs.	RD	CE	FY14-18
4.	Assess infrastructure needs and explore alternative mechanisms for funding to make needed repairs to small dams, small bridges, etc.	CE		FY14-18
5.	Operate DWSP fuel storage facilities in proper working order and in compliance with all applicable codes and regulations. Continue to investigate feasibility of upgrading or converting underground storage tanks to above ground structures.	CE		FY14-18
6.	Improve procurement coordination within the Region, Division, and A&F.	RD		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
7.	Continue to reduce energy use through energy efficiency practices.	RD		FY14-18
8.	Complete individual Gravel Management Plans for all gravel pits (active/closed) on DWSP lands in the Quabbin Reservoir Watershed.	CE	WM	FY14-18
9.	Continue to incorporate changing regulations, ADA requirements and updated Codes into project planning and all major construction activities.	CE		FY14-18
10.	Maintain 24-hour access to Administration Facility, State Police, and MWRA laboratory. Maintain facility access for staff. Maintain access to Quabbin Park for public. Provide access, as needed, for others (e.g., researchers, Boat Launch Areas).	WM		FY14-18
11.	Continue to resolve structural and maintenance problems with particular small dams in the Ware watershed in accordance with recommendations in dam inspection reports.	CE		FY14-18
12.	Evaluate the feasibility of removing or repairing unsafe small dams in the Ware watershed.	CE	RD, NR, EQ	FY14-18
13.	Assure that all DWSP-owned small dams in the Ware watershed are in compliance with Massachusetts dam safety regulations.	CE		FY14-18
H.	**Watershed Protection Act**			
1.	Continue to implement the Watershed Protection Act.	EP	RD, P	FY14-18
2.	Maintain good relations with building inspectors and other town permitting staff and boards to enhance the notification of potentially affected parties of WsPA requirements.	EP		FY14-18
3.	Provide direct professional support on land use planning or other associated topics, to watershed communities upon request and within staff time and capabilities.	EP		FY14-18
4.	Generate interest in the EOEEA/DWSP model Natural Resource Protection Zoning in the watershed towns and assist in the adoption of these zoning bylaws.	EP		FY14-18
5.	Support regional or statewide initiatives, such as statewide zoning reform, that will improve local land use, environmental, or public health decision making.	EP		FY14-18
6.	Continue to review WsPA applications for stormwater applicability, including NPDES construction general permit, MA Stormwater Performance Standards, and/or town stormwater bylaws.	EP		FY14-18
I.	**Interpretive Services**			
1.	Maintain and/or initiate information sites, such as kiosks, and programs in watersheds.	IS	EQ, ATS	FY14-18
2.	Operate Quabbin Visitor Center.	IS		FY14-18
3.	Implement and amend Interpretive Services Plan, as needed.	IS		FY14-18
4.	Conduct and monitor established program of public education. Expand educational outreach efforts on aquatic invasive species and climate change.	IS		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
5.	Continue to participate in environmental programs with other environmental groups, including environmental education teacher training and Mass Envirothon.	IS		FY14-18
6.	Develop interactive electronic interpretation for visitors.	IS		FY14-18
7.	Collaborate with other organizations, such as the Wachusett Greenways, for dissemination of visitor information in the Ware River watershed.	IS		FY14-18
8.	Add kiosk at Ware River snowmobile bridge with general information and brochures.	RD		FY14-18
9.	Scan Metropolitan District Water Supply Commission Real Estate taking sheets of the Ware River into electronic format.	CE		FY14-18
10.	Complete the Interpretive Services Plan for the Ware River watershed.	IS		FY14-18
11.	Distribute the *Downstream* newsletters to watershed residents.	NR	IS, P	FY14-18
12.	Use Watershed Ranger patrols in the watershed as a vehicle for public education.	WR		FY14-18
13.	Continue to offer guided interpretive walks and school group presentations.	IS		FY14-18
14.	Utilize the DWSP website to provide information and resources for the public.	P		FY14-18
J.	**Water Quality and Quantity Monitoring**			
1.	Continue routine tributary and reservoir sampling program to identify short term water quality problems and to maintain the historical record for long term trend analysis, with annual adjustments to the sampling plan to adapt to changing conditions.	EQ		FY14-18
2.	Conduct a short-term forestry water quality monitoring program by developing and implementing a coordinated system of planning, implementation, feedback/review, and monitoring of forestry operations.	EQ	F	FY14-18
3.	Assure that water entering the CVA meets DEP standards for microbial and chemical parameters.	EQ		FY14-18
4.	Continue to operate and improve the Quabbin Gull Harassment Program.	EQ		FY14-18
5.	Implement a team approach with Natural Resources staff to develop a long term water quality monitoring program for forestry operations.	EQ	NR	FY14-18
6.	Engage researchers to investigate climate change questions related to algae blooms and invasive species in the Quabbin Reservoir.	RD		FY14-18
7.	Evaluate the need for expanded sampling and/or inspections in the vicinity of Shaft 8 during periods of water diversions.	EQ		FY14-18
8.	Continue to survey for aquatic invasive species in the Ware River watershed.	EQ		FY14-18
9.	Conduct targeted sampling at specific problem sites, such as new subdivisions, in the Ware River watershed.	EQ		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
K.	**Watershed Monitoring and Assessment**			
1.	Continue to use fieldwork, local contacts, and EQAs to find violations of environmental regulations.	EQ		FY14-18
2.	Continue to enforce all environmental regulations and coordinate with other agencies, such as DEP and Attorney General, when necessary.	EQ	EP, P	FY14-18
L.	**Aquatic Invasive Species**			
1.	Continue to implement the comprehensive 2010 Aquatic Invasive Species Management Plan (2010); update as needed.	EQ		FY14-18
2.	Continue to operate and improve the Quabbin Boat Seal Program.	EQ	WM	FY14-18
3.	Continue efforts to survey, monitor, and prevent the spread of aquatic invasive macrophytes in the Quabbin Reservoir and throughout water bodies in the Quabbin watershed.	EQ		FY14-18
4.	Evaluate feasibility of pre-diversion surveys of AIS at Shaft 8.	EQ		FY14-18
M.	**Environmental Quality Assessments (EQAs)**			
1.	Continue to conduct Environmental Quality Assessments as scheduled Revise as needed, adding stormwater treatment and gravel pits. Incorporate specific recommendations from EQAs into Annual Work Plans. Present and share findings and mitigation measures annually.	EQ	CE	FY14-18
2.	Continue to maintain database of agricultural operations, Above-ground Storage Tanks, hazardous waste generators, spills, and hazardous materials use through field inspections and record review.	EQ		FY14-18
3.	Evaluate options for an EQA database easily accessible to the Ware River watershed staff.	EQ		FY14-18
4.	Coordinate with staff who may have additional information to include in the Ware River EQAs.	EQ		FY14-18
N.	**Wastewater Management**			
1.	Review water quality data, and other pertinent information to identify potential problem sites.	EQ		FY14-18
2.	Continue to monitor and enforce the provisions of Title 5, working with local Boards of Health and DEP.	EP		FY14-18
3.	Provide technical assistance, upon request, to towns regarding onsite wastewater management issues.	EQ	CE	FY14-18
4.	Identify larger on-site systems with inspection requirements under DEP regulations in the Ware River watershed.	EQ		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
O.	**Stormwater Management**			
1.	Strive for early input into state and local road reconstruction projects to more effectively influence storm water management design aspects of projects.	EQ		FY14-18
2.	Integrate, maintain, and monitor structural storm water Best Management Practices (BMPs) needed and/or constructed on DWSP property.	CE	EQ	FY14-18
P.	**Emergency Response**			
1.	Continue to provide emergency response support services. Maintain response supplies and up-to-date contact lists. Participate in mock hazardous release exercise for training purposes.	ATS		FY14-18
2.	Coordinate with MWRA and local emergency officials to provide ICS, emergency response training, and annual tabletop or field exercises.	ATS		FY14-18
3.	Construct additional structural controls to reduce likelihood of spills reaching the Quabbin Reservoir.	CE		FY14-18
4.	Evaluate, monitor, and oversee spills that threaten water quality or DWSP property and work with appropriate federal, state, and local agencies to contain and remediate.	EQ		FY14-18
5.	Complete the emergency response handbook for the Ware River watershed, similar to the one currently being produced for Quabbin, including emergency contact information.	ATS	RD, ARD, EQ, WR, WM	FY14-18
6.	Maintain inventories of emergency response equipment and supplies and stage them at appropriate locations in the Ware River watershed.	ATS		FY14-18
7.	Produce spill response plans and spill notification cards for logging operations, and continue to offer spill response training, with continuing education credits, for loggers working on the Ware River watershed.	F		FY14-18
8.	Develop emergency spill response kits that can be deployed at logging sites.	F		FY14-18

8.3.2 Wachusett/Sudbury Operational Section Five Year Implementation Plan

Table 8-3: Wachusett/Sudbury Operational Section Five Year Implementation Table

Wachusett/Sudbury Staff: A=Administration; CE=Civil Engineers; EQ=Environmental Quality; F=Forestry; GIS-W = Geographic Information Services Wachusett; IS=Interpretive Services; RD=Regional Director, Assistant Regional Director; WM=Watershed Maintenance; WR=Watershed Rangers
Boston/Division Staff: A=Administration and Finance; D= Director; Director's Staff; NR= Natural Resources; GIS=Geographic Information Services; P= Environmental Planning

#	Objective	Lead	Additional Staff	Projected FY
A.	**Land Procurement**			
1.	Purchase land by fee or whenever possible through acquisition of Watershed Preservation Restriction.	NR	GIS	FY14-18
2.	Consider highly rated parcels from the Wachusett Land Acquisition Model (Category 4-7) for future acquisition.	NR		FY14-18
3.	Pursue opportunities to acquire land through gifts or through cooperative efforts with land trusts.	NR		FY14-18
4.	Reduce the amount of time it takes to complete a land acquisition project.	NR	F, GIS, EQ, P, WM, CE, EP	FY14
B.	**Watershed Preservation Restrictions**			
1.	Complete baseline documentation reports prior to WPR acquisition.	NR	GIS	FY14-18
2.	Monitor each WPR every two years; monitor high-priority ones annually.	NR	EQ, EP, F	FY14-18
3.	Maintain good working relationships with landowners and resolve WPR violations.	NR	EP, F, EQ	FY14-18
4.	Maintain good records and distribute them to other staff as necessary.	NR		FY14-18
5.	Investigate ways to increase DWSP's stewardship capabilities.	NR		FY14-15
C.	**Land Management**			
1.	Incorporate the Draft *2011-2020 Wachusett Land Management Plan* into a comprehensive system-wide plan similar in scope and format to the Watershed Protection Plan.	NR	F, EQ, RD	FY14
2.	Continue forestry operations and follow all documented management techniques including oversight of active logging and monitoring of water quality.	F	EQ	FY14-18
3.	Continue cooperative efforts to monitor and control Asian Longhorned Beetle.	F		FY14-18
4.	Work to implement invasive species policy for DWSP properties.	F	NR	FY14-18
5.	Complete boundary documentation and maintenance after remaining properties are surveyed. Continue to investigate all encroachment activities and follow through until situation is rectified.	F		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
6.	Plan future forestry operations with the goal of maintaining a forest cover that is diverse in species composition and tree sizes and ages across the vast majority of the North Sudbury forest.	F		FY14-18
7.	Complete Sudbury and Foss Reservoir chapter for comprehensive Land Management Plan.	F	NR	FY14
8.	Monitor known boundary encroachments and seek resolutions in Sudbury watershed.	F	A	FY14-18
D.	**Wildlife Management**			
1.	Continue year-round bird observation and harassment effort on the Wachusett Reservoir.	EQ	NR, CE, RD, WM	FY14-18
2.	Continue to control the resident Canada goose population on the Wachusett and Sudbury Reservoirs.	NR	CE, RD, WM	FY14-18
3.	Reduce the amount of food available to gulls around Wachusett Reservoir by controlling public feeding and identifying and controlling alternative food sources.	NR		FY14-18
4.	Eliminate aquatic mammals that threaten water quality or infrastructure.	NR		FY14-18
5.	Continue to test mammal and bird fecal samples for presence of *Giardia* and *Cryptosporidium*.	NR		FY14-18
6.	Manage habitat for rare species; monitor populations of select species.	NR		FY14-18
7.	Attempt to eliminate roosting gulls from the Wachusett Reservoir.	NR		FY14-16
8.	Mitigate adverse impacts of wildlife on infrastructure and other watershed resources.	NR		FY14-18
9.	Maintain early successional forested and non-forested habitats on DWSP lands in the Sudbury watershed, where feasible, applicable, and on limited acreage.	F	NR	FY14-18
E.	**Public Access Management**			
1.	Continue overall education and enforcement efforts and document effectiveness by reviewing and analyzing visitor contact data.	WR		FY14-18
2.	Maintain working relationships with State, Environmental, and local police.	WR		FY14-18
3.	Expand use of electronic media to disseminate information.	WR		FY14-18
4.	Continue existing protocol for maintaining gates and other structural controls.	WR		FY14-18
5.	Evaluate and modify specific access plan policies as necessary.	RD	WR	FY14-18
6.	Monitor DWSP lands to ensure compliance with rules and regulations designed to protect the water supply and protect the public.	WR		FY14-18
7.	Protect water and DWSP lands from negative impacts caused by public access activities and by continuing to implement and update the Public Access Plan.	WR		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
8.	Protect DWSP watershed land and water quality from impacts due to activities on adjacent, non-DWSP owned lands.	WR	EQ	FY14-18
F.	**Watershed Security**			
1.	Coordinate with MWRA in order to maintain comprehensive system-wide approach on all security issues.	WR		FY14-18
2.	Continue to work with local, state and federal responders.	WR		FY14-18
3.	Continue to use ICS protocols to respond to emergency situations and provide adequate training to essential staff.	WR	CE	FY14-18
4.	Continue to monitor watershed land, roadways, and buildings for suspicious activities.	WR		FY14-18
5.	Coordinate and conduct proactive patrols and operations to ensure compliance on watershed properties.	WR		FY14-18
6.	Plan and preparation for both large and small incidents with possible water quality impacts.	RD	CE	FY14-18
7.	Remain up to date with any guidance materials available from EPA, AWWA and Department of Homeland Security.	RD	CE, EQ	FY14-18
G.	**Infrastructure**			
1.	Continue to monitor and maintain large dams, spillways, and dikes, and periodically update Emergency Action Plan	CE		FY14-18
2.	Continue to evaluate feasibility of removing unsafe or unnecessary small dams.	CE		FY14-18
3.	Conduct annual inspection of roads and develop annual plan for repairs.	CE		FY14-18
4.	Assess infrastructure and oversee repairs, maintenance, and renovation projects at DWSP facilities.	CE		FY14-18
5.	Construct and maintain BMPs to manage stormwater.	CE	EQ	FY14-18
6.	Continue to reduce energy use through simple energy efficiency practices.	CE	All	FY14-18
7.	Identify annual and long term capital needs when applicable.	CE	RD	FY14-18
8.	Maintain fire roads for water supply operations as necessary in Sudbury watershed.	CE		FY14-18
H.	**Watershed Protection Act**			
1.	Continue to implement Watershed Protection Act and regulations.	EQ	RD, P	FY14-18
2.	Review building permits and sales and notify property owners of their need to file.	EQ		FY14-18
3.	Inspect previous filings for compliance with decisions and conditions.	EQ		FY14-18
4.	Provide training and information to local boards, town officials, and others.	EQ	P	FY14-18

#	Objective	Lead	Additional Staff	Projected FY
I.	**Interpretive Services**			
1.	Implement and amend, as needed, the Wachusett Interpretive Services Plan.	IS	WR	FY14-18
2.	Conduct and monitor established program of public education and add information on Aquatic Invasive Species and climate change	IS	WR	FY14-18
3.	Conduct programs at Stillwater Farm interpretive site and investigate opportunities to expand topics addressed]	IS	WR	FY14-18
4.	Conduct environmental education teacher training and support Mass Envirothon	IS	EQ	FY14-18
5.	Continue to participate in environmental programs with other environmental groups	IS		FY14-18
6.	Research alternatives for use of electronic media for interpretation	IS		FY15
7.	Educate the public of the importance of Sudbury and Foss Reservoirs as a reserve drinking water supply and natural resource.	WR	IS	FY14-18
8.	Instill behavior change in watershed residents to protect Sudbury and Foss Reservoirs from pollutants and contamination.	WR	IS	FY14-18
9.	Continue ongoing efforts to reduce threats from public access through programs (e.g., Earth Day cleanups, fishing line collections, Cache In-Trash out, etc.)	WR		FY14-18
J.	**Water Quality and Quantity Monitoring**			
1.	Continue routine and non-routine reservoir and tributary sampling, compile data, and interpret in annual report.	EQ		FY14-18
2.	Monitor hydrologic budget (stream flow, precipitation data, snow pack) and continue to make necessary improvements.	EQ		FY14-18
3.	Continue expanded stormwater sampling program to quantify stormwater loading.	EQ		FY14-18
4.	Maintain and improve reservoir and watershed water quality models in-house and in coordination with UMass.	EQ		FY14-18
5.	Compile/interpret data. Write 10-yr Water Quality Summary Report including correlation of subbasin percent impervious data with tributary water quality (2008-2017).	EQ		FY18
6.	Assess impact of climate change on water quality and hydrology.	EQ		FY14-18
7.	Develop and implement long-term paired subbasins assessment of the impacts of forestry on water quality and quantity in the Wachusett watershed.	EQ		FY14-18
8.	Target potential water quality problems in the Sudbury watershed.	EQ		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
K.	**Watershed Monitoring and Assessment**			
1.	Continue to use fieldwork, local contacts, and EQAs to find violations of environmental regulations.	EQ		FY14-18
2.	Continue to enforce all environmental regulations and coordinate with other agencies when necessary.	EQ		FY14-18
3.	Continue to update, improve, and use database(s) to help tracking and coordination efforts.	EQ		FY14-18
4.	Observation to determine sources of impairment and rectify to improve the quality of the water resource.	EQ		FY14-18
5.	Identify sites impacting water resource and/or DWSP lands and work with town boards and commissions to improve the situation.	EQ		FY14-18
6.	Monitor sites of releases or spills and follow submitted reports until clean up has been completed under Mass Contingency Plan.	EQ		FY14-18
7.	Review large projects, as necessary, which have the potential to impact DWSP lands and/or water quality.	EQ		FY14-18
L.	**Aquatic Invasive Species**			
1.	Continue established program of public education on AIS.	IS	WR, EQ	FY14-18
2.	Continue joint effort with MWRA for detection and control of AIS.	EQ		FY14-18
3.	Protect infrastructure from harmful effects of *Water Chestnut* and other invasive species in the Sudbury watershed.	EQ		FY14-18
4.	Educate fishermen on the harmful effects of AIS and encourage proper fishing equipment cleaning.	WR	EQ	FY14-18
M.	**Environmental Quality Assessments (EQAs)**			
1.	Continue field inspections and review of state and federal databases, identify sources of pollution, and develop mitigation measures for one EQA per year.	EQ		FY14-18
2.	Develop and implement EQA recommendations and include recommendations as specific tasks in annual workplans.	EQ		FY14-18
3.	Continue to maintain database of agricultural operations, hazardous waste generators, spills, and hazardous materials use through field inspections and record review.	EQ		FY14-18
4.	Continue to update inventory of USTs and ASTs.	EQ		FY14-18
5.	Continue to assess status of municipal facilities and practices including DPW yards, closed landfills and road maintenance practices. Work with towns and DEP to resolve any water quality issues.	EQ		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
N.	**Wastewater Management**			
1.	Continue to monitor and enforce provisions of Title 5, using water quality data and working with Boards of Health and DEP. Provide technical assistance, upon request.	EQ		FY14-18
2.	Track connections to new sewer lines and maintain database and GIS datalayer.	EQ	GIS	FY14-18
3.	Manage with MWRA, the Rutland-Holden trunk sewer and Rutland-Holden Relief trunk sewer.	CE		FY14-18
4.	Pursue updated sewer agreements with Holden and Rutland.	RD		FY14
5.	Review operation and maintenance plans for sewer pump stations.	RD		FY14-18
O.	**Stormwater Management**			
1.	Continue design/ construction of Phase II of direct discharge elimination program and develop plan (including funding) to remove or treat all remaining direct discharges to the Wachusett Reservoir .	EQ		FY14-18
2.	Continue to locate, assess, and require maintenance of public and private stormwater BMPs and BMPs on DWSP property.	EQ		FY14-18
3.	Continue investigations on priority streams to identify areas impacted by erosion and sedimentation, locate discharges, and develop recommendations to eliminate or minimize negative impacts on stream water quality.	EQ		FY14-18
4.	Continue to work with MassDOT and local DPWs to improve infrastructure to control stormwater and with conservations commissions, DEP, and EPA for compliance with state and federal stormwater requirements.	EQ		FY14-18
5.	Continue to work with town officials to implement program of public education and outreach related to stormwater. [MS4 CM #1]	EQ		FY14-18
6.	Cooperate with local stormwater working group or target selected groups for specific stormwater projects. [MS4 CM #2]	EQ		FY14-18
7.	Continue to update map of stormwater conveyance structures and define ‘stormwater subbasins.’ [MS4 CM #3]	EQ		FY14-18
8.	Continue to inspect all construction sites > 1 acre to ensure compliance with SWPPPs, and review, summarize, and assist in the development of bylaws to manage construction site runoff. [MS4 CM #4]	EQ		FY14-18
9.	Review, summarize, and assist in the development of bylaws to regulate post- construction runoff, and assist communities with mapping and impervious surfaces analysis. [MS4 CM #5]	EQ		FY14-18

#	Objective	Lead	Additional Staff	Projected FY
10.	Continue to provide regional training on stormwater issues for town employees, DWSP staff, and others. [MS4 CM #6]	EQ		FY14-18
11.	Raise awareness of stormwater as a pollutant, techniques for reducing runoff and improving the quality of stormwater runoff in an effort to create a behavior change among Sudbury watershed residents to protect natural resources.	EQ	WR, IS	FY14-18
12.	Provide stormwater programs, resources and/or support as resources allow to town departments, boards and commissions in the Sudbury watershed.	EQ	WR, IS	FY14-18
P. Emergency Response				
1.	Coordinate with MWRA and local officials to provide emergency response training and annual tabletop or field exercises.	CE	RD	FY14-18
2.	Continue to provide emergency response support services; maintain response supplies and up-to-date contact lists.	CE		FY14-18
3.	Continue to provide Incident Command System training to staff.	CE		FY14-18
4.	Construct additional structural controls to reduce likelihood of spills reaching the reservoir.	CE	EQ	FY14-18
5.	Evaluate, monitor, oversee, and help remediate spills that threaten water quality or DWSP property.	CE	EQ	FY14-18
6.	Ensure that DWSP and town emergency responders are aware of emergency protocols put in place by DWSP.	CE	RD	FY14-18
7.	Ensure that proper authorities are provided updated emergency contact list and phone numbers on a regular basis.	CE	RD	FY14-18
8.	Provide emergency response training for new DWSP employees and refresher training for veteran staff.	CE	RD	FY14-18

References

DCR Division of Water Supply Protection Publications, Reference Reports, and Other Documentation

Legal References

Session Laws

- Chapter 262, Acts of 1932. Rutland-Holden Trunk Sewer Legislation
- Chapters 460 and 501, Acts of 1938. Rutland-Holden Trunk Sewer Legislation
- Chapters 286 & 287, Acts of 1939. Rutland-Holden Trunk Sewer Legislation
- Chapter 737 of the Acts of 1972. Kelly-Whetmore Act
- Chapter 372 of the Acts of 1984. MWRA Enabling Act
- Chapter 36 of the Acts of 1992. Watershed Protection Act
- Chapter 15, Acts of 1996, § 2420-7961. Holden and West Boylston Sewer Construction/Expansion
- Chapter 26 of the Acts of 2003, § 290. Creation of Department of Conservation and Recreation
- Chapter 149 of the Acts of 2004, s. 27. Creation of Water Supply Protection Trust

Massachusetts General Laws

- MGL c. 10, § 73 . Water Supply Protection Trust General Law.
- MGL c. 92A½. DCR Watershed Management General Laws.

Code of Massachusetts Regulations

- 350 CMR 11.00. Watershed Protection Regulations.
- Other Environmental Regulations: www.mass.gov/eea/agencies/massdep/service/regulations/

Other Legal Documents

- DCR/MWRA Memorandum of Understanding
- Executive Order No. 484: Leading by Example – Clean Energy and Efficient Buildings

Documentation by Program

Unless otherwise noted, all publications by Department of Conservation and Recreation, Division of Water Supply Protection.

Watershed Preservation Restrictions (WPR):

- WPR Working Group worksheets
  - Baseline Documentation Procedure
  - Monitoring Procedure
  - Landowner Relations Procedure
  - Enforcement Procedure
  - Reserved Rights Procedure

- Baseline Documentation Reports
- Annual Monitoring Reports

Land Management

- Continuous Forestry Inventory (CFI) Data
- *From Here Forward: Proposed Changes to the Department of Conservation and Recreation Division of Water Supply Protection's Watershed Forest Management Program* (2013)
- *Terrestrial Invasive Species Management Strategy* (2011)
- *Quabbin Land Management Plan* (2007 – 2017)
- *Science and Technical Advisory Committee (STAC) Report* (2012)
- *Sudbury Land Management Plan* (2004 – 2013)
- *Wachusett Land Management Plan* (2001 – 2010)
- *Wachusett Land Management Plan (*Draft *2011 – 2020)*
- *Ware Land Management Plan* (2003-2013)

Wildlife Management

- Annual Aquatic Wildlife Pathogen Control Zone report
- Annual Canada Goose Population Control Program Report
- Annual Common Loon Summary report
- Long-term Wildlife Resource Monitoring Program Report (2005)
- Quabbin Gull Harassment Program Reports (2010-2013)
- *Regional Movements, Feeding Behavior, and Roosting Patterns of Ring-billed, Herring, and Great Black-back Gulls Utilizing Wachusett and Quabbin Reservoirs, Massachusetts* (2007)
- Ring-billed, Herring, and Great Black-back Gull Study: 2008-2010 Report and Proposed Management Recommendations (2010)
- Ring-billed, Herring, and Great Black-back Gull Study: Progress Report (2008, 2009)
- White-tailed Deer Control Program Report (2010)

Public Access Management

- *Quabbin Public Access Management Plan Evaluation* (2011)
- *Quabbin Public Access Management Plan Update* (2006)
- *Sudbury and Foss Reservoirs Public Access Plan Update* (2010)
- *Wachusett Public Access Plan Update* (2011)
- *Ware River Watershed Public Access Management Plan Evaluation* (2011)
- *Ware River Watershed Public Access Management Plan Update* (2010)

Watershed Security

- Hydraulic and Hydrology Study of Winsor Dam (2012)
- MWRA Vulnerability Assessment (2003)

Infrastructure

- Building Inspection Reports
- Dam and Facility Inspection Reports
- MWRA Emergency Action Plan for the Wachusett Reservoir Dam (2011)

- MWRA Vulnerability Assessment (2003)
- Quabbin Park Plan (2013)

Watershed Protection Act

- Guidance Document for Making Applications under the Watershed Protection Act
- Watershed Protection Act Brochures
  - Horses and the Watershed Protection Act
  - Landscaping and the Watershed Protection Act
  - Watershed Protection Act Fact Sheet

Interpretive Services

- *Downstream* newsletter (biannual, 2008-2012)
- *Quabbin Reservoir Interpretive Plan* (1988)
- *Stillwater Farm Operational Plan* (2008)
- *Wachusett Reservoir Interpretive Plan* (2009)

Water Quality and Quantity Monitoring

- *Aquatic Invasive Species Assessment and Management Plan* (2010)
- Field Guide to the Aquatic Macrophytes of the MWRA Reservoir System (ESS Group, Inc., 2011)
- MDC Water Quality Data, 1990-1999 (2000)
- *Nutrient and Plankton Dynamics in Quabbin Reservoir* (2000)
- *Nutrient and Plankton Dynamics in Wachusett Reservoir, 1998–2002* (2002)
- Quabbin Reservoir and Ware River Watersheds Ten Year Water Quality Data Review 2000-2009 (2011)
- Quabbin Reservoir Watershed and Ware River Watershed Annual Water Quality Reports (2006-2011)
- Quabbin Reservoir/Ware River Aquatic Macrophyte Assessment (2006, 2009, 2013)
- USGS stream gages, http://waterdata.usgs.gov/ma/nwis/current.
- Wachusett Reservoir and Watershed Annual Water Quality Reports (1988–2011)
- Wachusett Tributaries Ten Year Water Quality Summaries (1988–1997, 1998–2007)

Aquatic Invasive Species Management

- Aquatic Macrophytes of the MWRA Reservoir System (ESS, 2013, 2011, and 2009)
- *Aquatic Invasive Species Assessment and Management Plan* (2010)
- Zebra Mussel Tank Bioassays (Quabbin Reservoir and Laurel Lake MA);Subcontract: Sandra Nierzwicki-Bauer, Darrin Fresh Water Institute, Rensselaer Polytechnic Institute, Bolton Landing, NY. FINAL REPORT- July 16, 2010

Environmental Quality Assessments (EQA)

- Burnshirt, Canesto, and Natty Pond Sanitary District 2009-2010 (2010)
- Coldbrook and Longmeadow Sanitary District 2009 (2010)
- East Branch Ware River Sanitary District 2011-2012 (2012)
- Fever Brook Sanitary District 2007-2008 (2008)
- Quabbin Northwest Sanitary District 2012-2013 (underway)
- Quabbin Reservation Sanitary District 2010-2011 (2012)
- Quinapoxet District Environmental Quality Assessment Report (2009)
- Reservoir District Environmental Quality Assessment Report (2013)
- Stillwater District Environmental Quality Assessment Report (2010)
- Thomas Basin Environmental Quality Assessment Report (2008)
- West Branch Ware River Sanitary District 2010-2011 (2011)
- Worcester District Environmental Quality Assessment Report (2010)

Wastewater Management

- DWSP monthly Sewer Flow Reports to Communities and Upper Blackstone Water Pollution Control Facility

Stormwater Management

- Massachusetts Interstate, Merrimack and South Coastal Small MS4 General Permit (2010 Draft)
- Massachusetts Stormwater Handbook (DEP, 2008)
- Quabbin Reservation: Culvert Mapping Project (2008)
- Stormwater Report for Hangar Storm Drain Improvement Project, DCR Administrative Complex - Quabbin Reservoir (2012).
- Wachusett Reservoir Direct Discharge Phase II Study (CEI, 2012)
- Wachusett Reservoir Direct Discharge Report (2008)
- Wachusett Stormwater Management BMP database
- Wachusett Stormwater Study (Camp Dresser McKee, 1999)

Emergency Response

- *Emergency Response Handbook – Quabbin/Ware Region* (2010)
- *Using CE-Qual-W2 to Model a Contaminant Spill into the Wachusett Reservoir* (Lillian M. Clark (UMass), 2013)
- *Wachusett Reservoir and Watershed Emergency Spill Response and Prevention Plan* (2008)
- *Wachusett/Sudbury Comprehensive Emergency Management Plan* (2012)

Implementation

- *Division of Water Supply Protection, Office of Watershed Management Annual Work Plan* (2005-2014)
- *Division of Water Supply Protection, Office of Watershed Management Annual Work Plan Final Report* (2005-2012)
- *Quabbin Reservoir and Ware River Watershed Protection Plan* (1991, 2000, 2008)
- *Sudbury Reservoir Watershed Protection Plan* (1997, 2008)
- *Wachusett Reservoir Watershed Protection Plan* (1991, 1998, 2003, 2008)

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