NASHUA RIVER WATERSHED
SMART MONITORING PROGRAM 2005-2010

Technical Memorandum CN 429.0

The Nashua River, Pepperell

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Cover photo by Therese Beaudoin, MassDEP. August 17, 2005

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Latin Name	Common name	Latin Name	Common name
Agelaius phoeniceus	red-winged blackbird	*Ludwigia* sp.	water primrose
Anas platyrhynchos	mallard duck	*Lythrum salicaria*	purple loosestrife
Ardea herodias	great blue heron	*Myriophyllum* sp.	milfoil
Branta canadensis	Canada goose	*Neovison vison*	American mink
Brasenia schreberi	watershield	*Notemigonus crysoleucas*	golden shiner
Callitriche sp.	water starwort	*Odocoileus virginianus*	white-tailed deer
Cambaridae family	freshwater crayfishes	*Peltandra virginica*	arrow arum
Castor canadensis	North American beaver	*Perca* sp.	perch
Catostomus commersonii	white sucker	*Phalacrocorax* sp.	cormorant
Cephalanthus occidentalis	buttonbush	*Potamogeton crispus*	curly-leaf pondweed
Ceratophyllum demersum	coontail	*Potamogeton* sp.	pondweed
Elliptio complanata	Eastern elliptio (mussel)	*Procyon lotor*	raccoon
Elodea canadensis	waterweed	*Sagittaria* sp.	arrowhead
Gerridae family	water strider	*Trapa natans*	water chestnut
Gramineae family	true grasses	Tricoptera order	caddisflies
Icterus galbula	Baltimore oriole	*Vallisneria* sp.	American eelgrass
Lemna sp.	duckweed	*Wolffia* sp.	watermeal
Lithobates catesbeianus	American bullfrog	Zygoptera order	damselflies

All photos in document taken by Therese Beaudoin. MassDEP. CERO.
SMART monitoring logo designed by Robert Kimball and Barbara Kimball.

LIST OF ACRONYMS

% sat	percent oxygen saturation
305(b)	Section 305(b), Clean Water Act
7Q10	lowest 7-day average streamflow that occurs, on average, once every 10 years
BRP	Bureau of Resource Protection
BWR	Bureau of Water Resources
ºC	degree Celsius
CERO	CEntral Regional Office
CFR	Coldwater Fish Resource
cfs	cubic feet per second
CSO	Combined Sewer Overflow
DO	dissolved oxygen
DWM	Division of Watershed Management
ºF	degree Fahrenheit
GPD	gallons per day
HSPF	Hydrological Simulation Program - FORTRAN
in	inch
m	meter
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
µS/cm	microSiemen per centimeter
MDL	method detection limit
MGD	million gallons per day
mg/L	milligrams per liter
mi	mile
mi^2	square mile
NH	New Hampshire
NH_3-N	ammonia nitrogen
NO_3NO_2-N	nitrate-nitrite nitrogen
NPDES	National Pollutant Discharge Elimination System
NRWA	Nashua River Watershed Association
NTU	Nephelometric Turbidity Unit
NWR	National Wildlife Refuge
NWS	National Weather Service
POR	point of record
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RDL	reporting detection limit
RPD	relative percent difference
SMART	Strategic Monitoring and Assessment for River basin Teams
SOP	standard operating procedure
SR	State Road
SSolids	suspended solids
STP	sewage treatment plant
SU	Standard Unit
T	temperature
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TN	total nitrogen
TPhos	total phosphorus
Turb	turbidity
USGS	United States Geological Survey
WES	Wall Experiment Station
WPP	Watershed Planning Program
WWTF	wastewater treatment facility
WWTP	wastewater treatment plant

INTRODUCTION

The purpose of this technical memo is to present observations and data collected in the Strategic Monitoring and Assessment for River basin Teams (SMART) program in the Nashua watershed from 2005 through 2010, highlighting how the program supports and augments programs of the Massachusetts Department of Environmental Protection (MassDEP) Bureau of Resource Protection (BRP, now the Bureau of Water Resources, BWR) Central Regional Office (CERO) and the Division of Watershed Management (DWM).

Overview of Monitoring Plan

Limited SMART monitoring began in the watershed in 1998 as part of a cooperative effort between Mass DEP CERO and the DWM Watershed Planning Program (WPP), as well as the Nashua River Watershed Association (NRWA); regular bimonthly water quality monitoring began in March 1999. Data collected under these programs provided the basis for HSPF modeling and the draft 2007 Nashua Watershed Total Maximum Daily Load (TMDL). The sampling plan matrix for the SMART monitoring program Years 2005-2010 is presented in Table 1; the location of sampling stations is presented in Figure 1. Sampling components at all stations included:

- *in situ* measurements: dissolved oxygen (DO), percent oxygen saturation, pH, specific conductivity, temperature (T), depth and total dissolved solids (TDS);
- physical/chemical constituents: total alkalinity, chlorides, hardness, total suspended solids (TSS), turbidity;
- nutrients: ammonia-nitrogen (NH_3-N), nitrate-nitrite-nitrogen (NO_3–NO_2-N), total nitrogen (TN), and total phosphorus (TP);
- flow measurements (at existing USGS flow gaging stations); and
- general field observations.

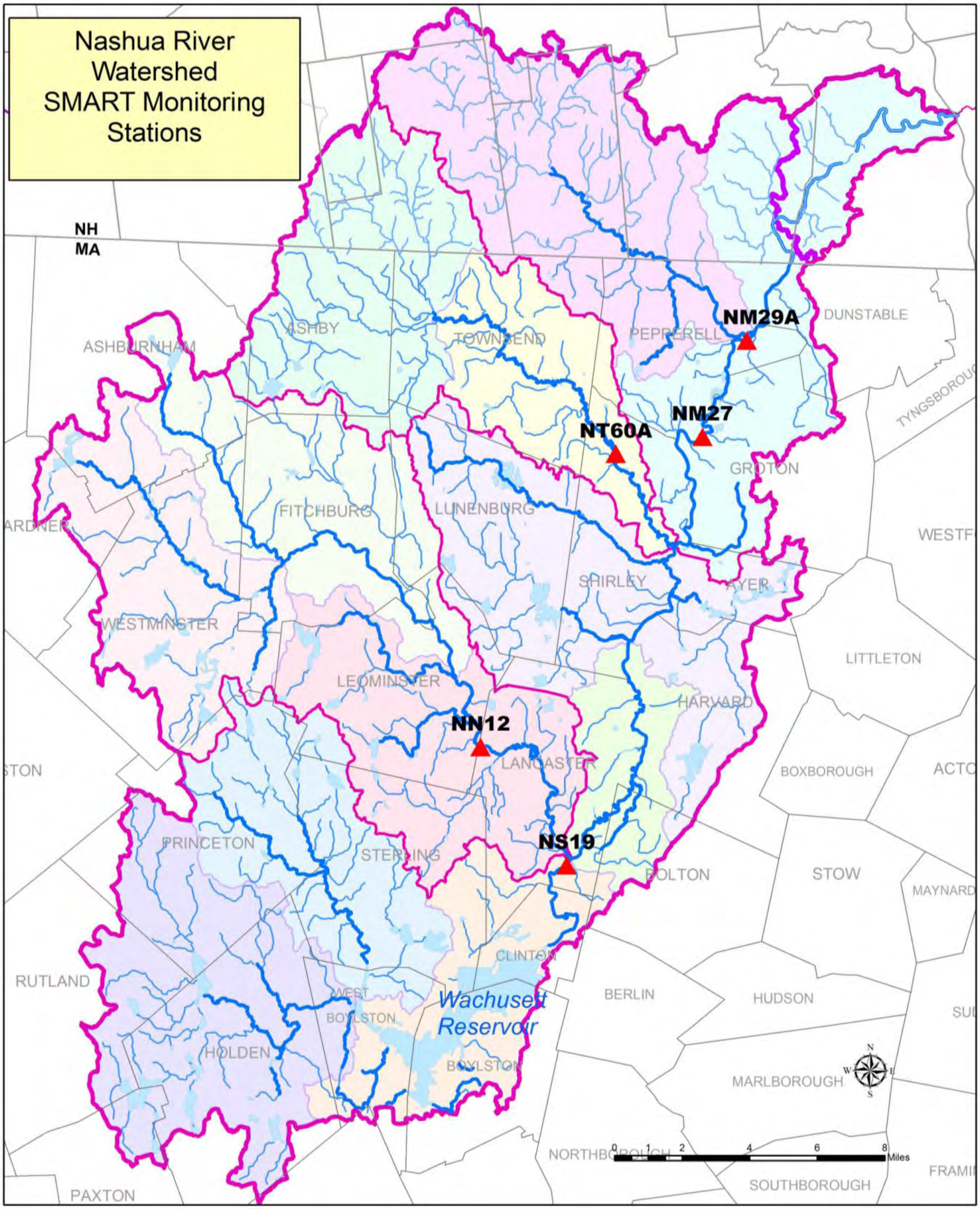
Table 1 Nashua Basin SMART Sampling Summary – 2005 through 2010

Location and Segment Numbers	Station Name	Station Type	Dates Sampled[1]
North Nashua River @ Old North Main Street, Lancaster MA81-04	NN12	Impact	2005: 2/9/05, 4/13/05, 6/8/05, 8/17/05, 10/13/05 2006: 1/11/06, 3/14/06, 5/10/06, 7/12/06, 9/13/06, 11/1/06 2007: 2/7/07, 4/11/07, 6/13/07, 8/22/07, 10/10/07 2008: 1/16/08, 3/19/08, 5/15/08, 6/12/08, 7/17/08, 8/14/08, 9/18/08, 11/12/08 2009: 2/18/09, 4/22/09, 6/17/09, 9/2/09, 10/21/09 2010: 2/4/10, 7/15/10, 9/22/10, 11/9/10 [1]The SMART Monitoring program began in the Nashua basin in May 1998.
Nashua River "South Branch" @ Atherton Bridge, Bolton Road, Lancaster MA81-09	NS19	Impact	
Nashua River at canoe launch, South Road State Road (SR) 119, Pepperell MA81-06	NM27/ INLTPEPPD	Impact	
Nashua River at former trestle site downstream of covered bridge, Mill Street, Pepperell MA81-07	NM29A	Boundary	
Squannacook River west of Candace Lane, Groton MA81-18	NT60A	Reference	

Hydrology

The Nashua River, a major tributary of the Merrimack River, flows approximately 41.6 miles (mi) from its beginning at the outlet of Lancaster Millpond in Clinton, Massachusetts (MA). Its watershed lies in both Massachusetts and New Hampshire (NH). Of the total drainage area of 530 square miles (mi^2), most lies within Massachusetts and encompasses all or part of 3 cities and 21 towns. For an in-depth description of the watershed, see Nashua River Watershed Water Quality Assessment Report 2003 (MassDEP 2008). The river is characterized by long runs and large impoundments on the mainstem, and upstream, on the North and South Branches. Four dams remain on the mainstem, including the Pepperell Paper Company Dam behind which lies

Figure 1 MassDEP SMART Nashua River Watershed Water Quality Station Locations



Pepperell Pond, a 296-acre eutrophic impoundment. In addition, the Ice House Dam in Ayer impounds 137 acres. Annual precipitation ranges from 48 to 50 inches (in) over most of the watershed, with a section in the northeast corner of the watershed averaging 46 to 48 in, and a smaller region around Mt. Wachusett receiving 50 to 52 in; more information can be found at Average Annual Precipitation For Massachusetts (Ostiguy et al 2014).

Major Massachusetts tributaries of the Nashua River include the North Nashua, Squannacook, and Nissitissit Rivers.

Quality Assurance/Quality Control

The quality assurance (QA) project plan (QAPP) for the SMART program is presented in CN 012.1*: Quality Assurance Project Plan Strategic Monitoring and Assessment for River basin Teams (SMART) (Blackstone, Chicopee, Concord, French/Quinebaug, Millers, and Nashua Watersheds) 2008-2012* (Beaudoin 2008). The QAPP presents data quality objectives, quality assurance procedures, and other program-specific information.

Aerial photos were obtained from Google Earth (2014a, 2014b, 2014c, 2014d, 2014e) at a height of approximately 4,000 feet (ft).

PROJECT OBJECTIVES

The primary water quality objectives of the SMART monitoring program are:

- Document baseline water quality by: providing information on low flow/event flow variation, seasonal variation and frequency of selected constituents; and establishing reference distributions of key constituents for ecoregion delineation and “clean water” sites;
- Estimate loads of detected water constituents at key locations by: quantifying nitrogen loadings to coastal waters; and calculating phosphorous loads upstream/downstream of representative land use areas;
- Define long term trends in water quality by: documenting improvements associated with major abatement projects; and identifying trends at least-impacted stations (that may result from factors such as acid precipitation and climate change);
- Assess attainment of water quality uses by: comparing existing water quality with water quality standards; and by assessing use support for the fishable/swimmable goal;
- Provide support for other programs by: determining reference distributions for ecoregion stations; conducting trend analysis for the 305(b) reports[1] and basin plans; quantifying nutrient loadings for load allocations (TMDLs); obtaining data on nonpoint source loadings for more intensive Year 2 sampling; providing guidance for volunteer monitoring; collecting data for development of statistically-based water quality standards and for improvement of Combined Sewer Overflow (CSO) and Stormwater policies; and developing a long-term database on conditions at key locations for the development of new programs and basic research.

As stated in the Introduction, this document presents observations and data collected in the Nashua Watershed under the SMART program from 2005-2010. An assessment of the data will be presented in future reports.

METHODS

Water quality sampling procedures are included in *Grab Collection Techniques for DWM Water Quality Sampling, Standard Operating Procedure* (MassDEP 1999b). Use of the *in situ* monitoring equipment followed procedures set forth in *CN 4.0 Water Quality Multi-probe Instrument Use, Standard Operating Procedure* (MassDEP 1999a). Physical/chemical and nutrient samples were analyzed at the Wall Experiment Station (WES), the MassDEP analytical laboratory located in Lawrence, Massachusetts. All samples were collected, transported, analyzed, and discarded according to chain-of-custody procedures.

In addition to the measurements and analytes noted above, field observations were recorded at each station on standardized field sheets, field notebooks, and as photographs. Field observations included date/time, location, crewmembers, snow cover, canopy cover, water odors, colors, sheens, foams, estimated river height and velocity, weather conditions, observed uses, wildlife, aquatic algae and macrophytes, potential pollution sources, and unusual conditions. Number and type of samples were recorded, as well as the last set of *in situ* data collected. An aerial view and a photo depicting the upstream environs accompany each station description; see Figure 2 through Figure 11. A summary of field observations by station collected during this sampling period are presented in Table 2 through Table 6 following the station descriptions.

Each station selected for the SMART Monitoring program is described according to key characteristics associated with water quality at that location, as follows:

- Reference: a reference station is located in a stream segment that is minimally influenced by anthropogenic activities;
- Impact: an impact station is located where several sources of pollution come together and can be used to calibrate a mass balance model, or where critical reactions take place such as at an oxygen sag point; and

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[1] The 305(b) reports are the biannual reports to the U. S. Congress on water quality that are required under Section 305(b) of the Clean Water Act.

- Boundary: a boundary station is located at a pour point i.e., where water leaves a designated river basin, or at a state line.

Field sheets, raw data files, chain of custody forms, lab reports, and other metadata used in this report are managed and maintained by the MassDEP DWM in the Water Quality Access Database in Worcester, MA. The validation of the water quality data included data entry into DWM databases, data entry quality control checks, analysis for outliers, blank contamination, duplicates, precision, and holding time violations, followed by project level review (MassDEP 2005). The project coordinator, as identified in the QAPP for the SMART program (CN 012.2), reviews the data for reasonableness, completeness and acceptability (Beaudoin 2008).

In September, 2006 samples were not collected for alkalinity, chlorides and hardness analyses due to resources issues at WES; turbidity samples were analyzed at DWM. In 2010, the WES lab was closed from March through June during the construction phase of new laboratory space; SMART monitoring was not conducted during this time.

STATION OBSERVATIONS

Station NN12 – North Nashua River at old North Main Street, Lancaster, MA (river mile 7.415)

Figure 2 Google Earth view of Station NN12 area

Figure 3 Station NN12 upstream – I-190 Bridges (6/17/2009)

Station NN12 is located on the North Nashua River in Lancaster, MA within the Southern New England Coastal Plains and Hills ecoregion. From 2005 through 2010, Station NN12 was sampled 33 times. The river was accessed from the southern shore downstream of the I-190 bridges. Samples were collected by wading to flowing water or by sampling pole. Station NN12 serves as an impact station as it is downstream of numerous point and nonpoint sources of pollution, as described below.

Land uses near this station included urban, forest, residential, and major roadways (Figure 2; Google Earth 2014a). Three major municipal National Pollutant Discharge Elimination System (NPDES) discharges are located upstream (design flow greater than 1 million gallons per day, or MGD), including the Fitchburg West (taken off-line in February 2010 but the permit is still active), Fitchburg East, and Leominster wastewater treatment plants (WWTP); Fitchburg East and Leominster wastewater treatment facilities (WWTF) are the largest and most complex facilities in the watershed. This segment of the river also contains numerous combined sewer overflows (CSO) which, with the WWTP discharges, define downstream water quality. Numerous large water withdrawals are located upstream (greater than 100,000 gallons per day, or GPD), including private and municipal drinking water supplies and industries.

The river is a run in this area, approximately 72 feet wide, and typically 3 to 5 feet deep (Figure 3). A midstream gravel bar was present from 2005 through mid-2007, extending approximately 70 feet from a point roughly 20 feet downstream of the I-190 Northbound Bridge. The gravel bar was typically covered with herbaceous vegetation during the growing season. At low flows, the stream south of this bar was a trickle or a series of stagnant pools, at which times monitoring was conducted in the northern channel. However, the mid-stream bar was mostly submerged after mid-2007, following scouring high flows. Deciduous and evergreen trees provided shade along the banks, but the canopy did not extend over the channel. The bottom was mostly gravel and sand, with bedrock, boulder, cobble and silt also present. Periodic high flows and channel scouring resulted in minimal habitat for rooted vegetation; aquatic macrophytes were rarely observed at Station NN12 and were limited to Gramineae family (grasses), *Myriophyllum* sp. (milfoil) and *Vallisneria* sp. (American eelgrass). Periphyton was observed on most sampling dates, and typically consisted of sparse to moderate filamentous algae, and moss.

Aquatic and semi-aquatic wildlife were reported at Station NN12. Three white suckers (*Catostomus commersonii*) approximately 7 to 12" in length were noted on 5/15/2008; small fish (1-3") of unknown species were seen, mostly during the summer months; and crayfish (family Cambaridae) were noted on several events. The tracks of a large beaver (*Castor canadensis*) and other evidence of beaver presence were observed frequently. A great blue heron (*Ardea herodias*) was seen feeding along the northern shore on 6/17/2009; and a pair of ducks, likely mallards (*Anas platyrhynchos)*, was observed downstream on 5/15/2008. An American bullfrog *(Lithobates catesbeianus)* was observed on 6/12/2008. Dense populations of mosquitoes were common after rain events. Raccoon (*Procyon lotor*) tracks were noted several times in the mud at the edge of the river. A water snake (species unknown) was observed on 6/8/05.

The water column in this reach was turbid on most events (82%), ranging from slightly to highly turbid/murky; clear conditions were only observed on 6 dates. Water color was typically light yellow/brown, with few observations of clear or grey. On approximately half of the sampling events, the water column lacked on odor; on the remainder, an effluent odor was typically noted. A single sheen was noted during this time period; on 7/20/2010, intermittent oily patches were recorded. Foam was present on approximately two-thirds of the sampling dates. Trash was noted in the stream bed on numerous events, usually minor in quantity. The type of trash observed included floatables, cigarette butts, tires (2), a pipe and a hay bale.

Station NS19 – Nashua River at Bolton Road, Lancaster, MA (river mile 27.201)

Figure 4 Google Earth view of Station NS19 area

Figure 5 Station NS19 upstream (6/17/2009)

Station NS19 is located on the Nashua River in Lancaster, MA within the Southern New England Coastal Plains and Hills ecoregion. From 2005 through 2010, Station NS19 was sampled 33 times. The river was accessed from two locations during this time frame, depending on riparian and flow conditions: the eastern shore downstream of the Bolton Road Bridge; and the western shore downstream of the sand bar between the Bolton Road and Atherton bridges. Both locations are considered to represent conditions in this area. Station NS19 serves as an impact station as it is downstream of numerous point and nonpoint sources of pollution, as described below.

Upstream land uses include agriculture, forest and residential, as well as a large surface water supply and an urbanized area (Figure 4; Google Earth 2014b). The 4,135-acre Wachusett Reservoir is part of the water supply for the Metropolitan Boston area; for more information on the management of Wachusett Reservoir, see Wachusett Watershed (MWRA 2014), MA DCR Annual Water Quality Reports (MA DCR 2014a) and Wachusett Tributaries Water Quality 1998-2007 for water quality information on the headwater streams of Wachusett Reservoir (MA DCR 2014b). At the base of the Reservoir lies Lancaster Millpond, whose outlet is the beginning of the Nashua River (also known as the Nashua River "South Branch"). Municipal NPDES discharges above Station NS19 include the Clinton WTP (minor) and the MWRA-Clinton STP (major).

The river at Station NS19 is a run, approximately 32 feet wide and shaded along its shores with deciduous trees and shrubs (Figure 5). The stream bottom consisted of a mixture of boulder, cobble, gravel and sand, with a large sand bar located along the western shore extending northward 60-70 feet from the Bolton Road Bridge. Periphyton was absent on 66% of events (22 of 33), with coverage by filamentous algae on 33%, ranging in density from sparse to very dense. Aquatic macrophytes observed were typically absent from the stream channel; occasionally, *Lythrum salicaria* (purple loosestrife) and *Myriophyllum* sp. (milfoil) were observed. Cambaridae (crayfish) and small fish (unknown species) were recorded. Wildlife noted here included the mallard duck (*Anas platyrhynchos),* great blue heron *(Ardea herodias),* Baltimore oriole *(Icterus galbula)* and raccoon (*Procyon lotor)***.** Mosquitoes were seasonally common.

The water column at Station NS19 was clear on approximately half of the sampling dates in this period; on a quarter of events, a slight turbidity was observed, with the remainder of events moderate to highly turbid. The water column was described as free of color on 64% of events; color, when observed, was usually light yellow/tan/brown. The river here typically lacked odor, with "effluent" noted twice and effluent once. Foam was also typically absent; when noted, it was typically very sparse/sparse in its coverage of the surface. Sheens were never observed; pollen/dust blankets were noted twice. Minor levels of trash were present on more than half of events; tires, metals, wooden planks, beer bottle, plastic bottles, broken glass and floatables were recorded.

Station NT60A – Squannacook River near Candice Lane, Groton, MA (river mile 4.708)

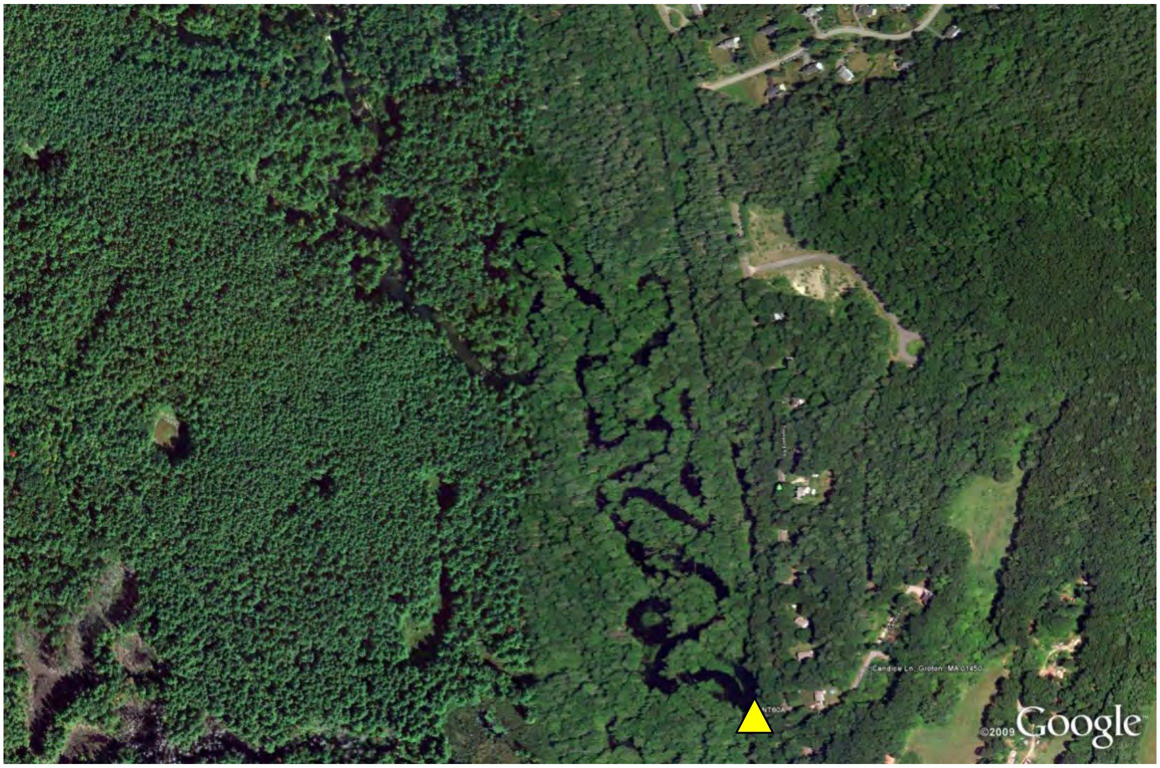

Figure 6 Google Earth view of Station NT60A area

Figure 7 Station NT60A upstream (6/8/2005)

Station NT60A is located on the Squannacook River in Groton, MA within the Southern New England Coastal Plains and Hills ecoregion. From 2005 through 2010, Station NT60A was sampled 30 times; on 3 sampling dates, the river was inaccessible due to bank-to-bank ice coverage (2/9/2005, 2/7/2007, 2/4/2010). The river was accessed from the eastern shore near Townsend Road, approximately opposite Candice Lane. Samples were collected by wading in or with a sampling pole. Station NT60A serves as a reference station, minimally impacted by anthropogenic activities.

Land uses near and upstream of this station include forest and sparse residential development; a downstream dam often impounds the river throughout this reach (Figure 6; Google Earth 2014c). The Squannacook River is a designated Coldwater Fish Resource (CFR; MassDFG 2015). There were no major municipal NPDES discharges (>1 MGD) or water withdrawals (>100,000 GPD) upstream of this station.

The river is a run near Station NT60A, approximately 60 to 75 feet wide, and the channel is typically too deep to wade (Figure 7). Trees provide shade along the stream corridor edges only; the channel is almost entirely open to the sun. Banks are undercut throughout the area. The bottom consisted mainly of gravel and sand (when visible), as well as occasional traces of silt. No aquatic macrophytes or periphyton were observed near the sampling point, with the absence of a single observation of *Brasenia schreberi* (watershield). Aquatic wildlife noted here included *Lithobates catesbeianus* (American bullfrog), unidentified mussels, and fish (unknown species). A brown leech (species unknown) was also noted (5/15/2008). Mosquitoes were seasonally common. Fishermen were infrequently observed, as well as canoers.

The water column noted at this station was clear on every sampling date in this time period. Water color was clear on half of dates; on most of the remaining events, the color was described as red. The station was characterized by a lack of water odors during this time period, with a single observation of “eutrophic”. A non-petroleum sheen was observed on 10/10/07; otherwise, foam, sheens and trash were absent.

Station NM27 – Nashua River at Nod Road, Groton, MA (river mile 7.426)

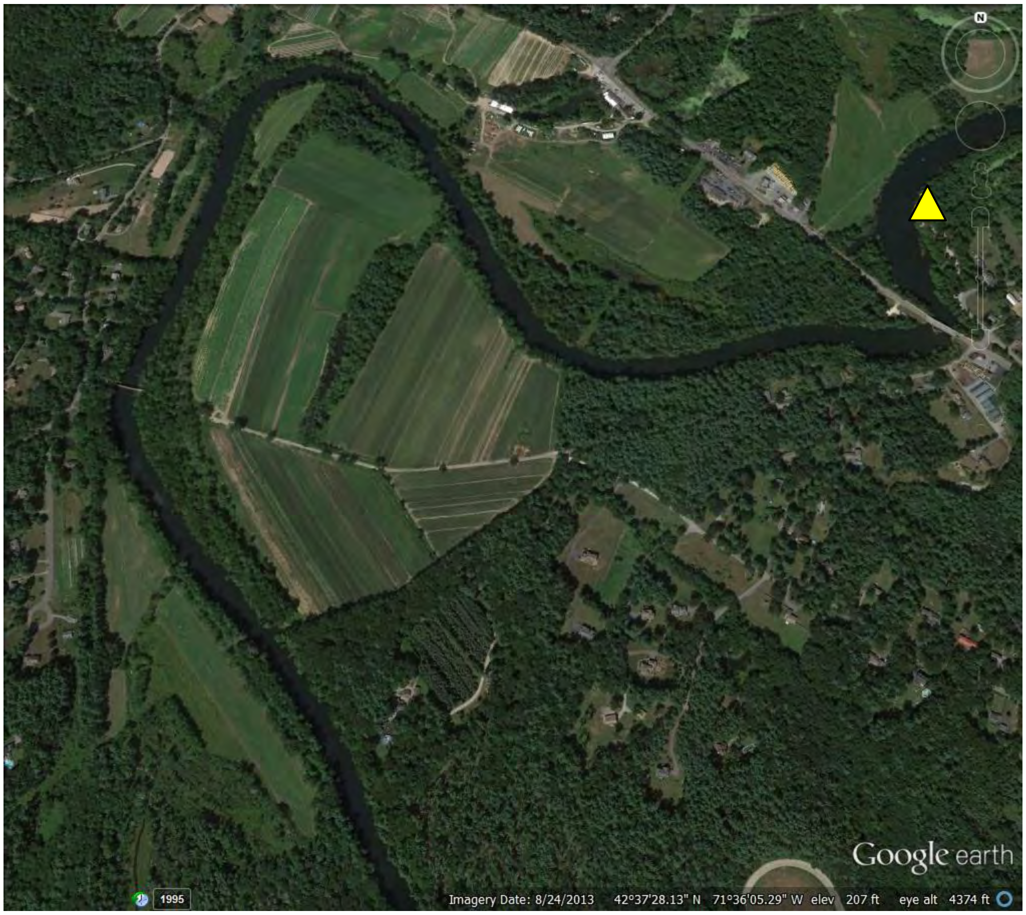

Figure 8 Google Earth view of Station NM27 area

Figure 9 Station NM27 upstream (6/12/2008)

Station NM27 (formerly INLTPEPPD) is located on the Nashua River in Groton, MA within the Southern New England Coastal Plains and Hills ecoregion. From 2005 through 2010, Station NM27 was sampled 30 times; on 3 sampling dates, the river was inaccessible due to bank-to-bank ice coverage (2/9/2005, 2/7/2007, 2/4/2010). The river was accessed from the eastern shore downstream (north) of the Rte 119 Bridge at the Groton boat launch. Samples were collected by wading in and/or with a sampling pole. Station NM27 serves as an impact station as it is located downstream of numerous point and nonpoint sources of pollution, as described below.

Land uses near and upstream of this station include agriculture, forest, and sparse residential (Figure 8; Google Earth 2014d). The Oxbow National Wildlife Refuge abuts an 8-mile stretch of the Nashua River above this sampling site; more information can be found at Oxbow National Wildlife Refuge (NWR; US F&WS 2014). Upstream municipal NPDES discharges (below Station NS19) include the Ayer WWTP and the Groton School (minor); a large groundwater discharge system is located near the Nashua River at Devens (design flow 3 MGD). There are no large water withdrawals (>100,000 GPD) near the river in this stretch.

The river is a run in this area, ranging from 110 to 200 feet wide and too deep to wade across (Figure 9). Trees provide shade along the stream corridor edges only; the channel is almost entirely open to the sun. Stream banks were undercut. The bottom mainly consisted of mud, gravel and sand; boulder and cobble were also present. Aquatic macrophyte growth was sparse, and included *Elodea canadensis* (waterweed), Gramineae family (grasses), *Lemna* sp.(duckweed), *Ludwigia* sp. (water primrose), *Myriophyllum* sp. (milfoil), *Peltandra virginica* (arrow arum), *Potamogeton crispus* (curly-leaf pondweed), *Potamogeton* sp. (pondweed), *Sagittaria* sp. (arrowhead), *Vallisneria* sp. (American eelgrass), and *Wolffia* sp.(watermeal). Periphytic growth ranging from sparse to very dense was noted on 13 events (n=30), and consisted either of a green or brown filamentous algae or algal film. Brown, loose floc was observed near shore on 7/20/2010; sparse moss was observed on 7/12/2006. Wildlife observed included red-winged blackbird (*Agelaius phoeniceus),* mallard duck (*Anas platyrhynchos*), great blue heron (*Ardea herodias*), Canada goose (*Branta canadensis),* crayfish (Cambaridae), North American beaver (*Castor canadensis*), white sucker (*Catostomus commersonii*), unspecified mussel (tentatively identified as *Elliptio complanata* or Eastern elliptio), perch (*Perca* sp.), cormorant (*Phalacrocorax* sp.), damselflies (Zygoptera) and unidentified song birds, freshwater clams and frogs.

Turbidity at Station NM27 was usually clear to slightly turbid (25, n=30). Water color was clear on half of all monitoring events (15), and light yellow on most of the rest (12). The station usually lacked odors, foams, sheens and trash. Canoers, kayakers and other boaters were infrequently observed, as well as fishermen.

Field blank samples were collected here throughout this monitoring period.

Station NM29A – Nashua River near Groton Street, Pepperell, MA (river mile 2.917)

Figure 10 Google Earth view of Station NM29A area

Figure 11 Station NM29A upstream (6/8/2005)

Station NM29A is located on the Nashua River in Pepperell, MA within the Southern New England Coastal Plains and Hills ecoregion. From 2005-2010, Station NM29A was sampled 33 times, and access was gained from the southern shore at the former railroad trestle, downstream of the Groton Street covered bridge. Samples were collected by wading in or with a sampling pole. Station NM29A serves as a boundary station, reflecting water quality in the Nashua River as it enters the state of New Hampshire approximately 3 miles downstream.

Land uses near and upstream of this station include agriculture, forest, and sparse residential, as well as the town center of Pepperell (Figure 10; Google Earth 2014e). Most of the river corridor between Station NM27 and NM29A lies within the Pepperell Pond impoundment, its length approximately 4.1 miles. A hydropower facility is located below Pepperell Pond. There are no NPDES municipal discharges or large water withdrawals (>100,000 GPD) near the river in this stretch (the Pepperell WWTF discharge is located downstream of this station).

The river is a run near Station NM29A, approximately 85 feet wide and typically too deep to wade across (Figure 11). Trees provide shade along the stream corridor edges only; the channel is almost entirely open to the sun. Stream banks were undercut. Numerous deadfall were noted in this segment. The water column and bottom were often unobservable due to solar reflection and turbulence, which minimized observations of substrate, trash, periphyton, macrophyton and turbidity. When visible, the bottom consisted of boulder, cobble, gravel, sand, silt and mud, and the wood and metal debris from the trestle that once spanned the river. Aquatic macrophyte growth included *Callitriche* sp. (water starwort), *Ceratophyllum demersum* (coontail), *Elodea canadensis* (waterweed), Gramineae family (grasses), *Lemna* sp. (duckweed), *Lythrum salicaria* (purple loosestrife), *Myriophyllum* sp. (milfoil), *Peltandra virginica* (arrow arum), *Potamogeton* sp. (pondweed), *Trapa natans* (water chestnut), *Vallisneria* sp. (American eelgrass), *Wolffia* sp. (watermeal) and an unknown submergent. Periphytic growth was present on most events (n=20, completely unobservable on 9), and the types of periphyton included moss, algal film, and filamentous algae, in densities ranging from sparse to very dense. Wildlife noted at the station included *Agelaius phoeniceus* (red-winged blackbird), *Anas platyrhynchos* (mallard duck), *Ardea herodias* (great blue heron) *Branta canadensis* (Canada goose), Gerridae (water striders), *Lithobates catesbeianus* (American bullfrog), adult Tricoptera (caddisflies), unidentified songbirds and fish. Occasional observations of unidentified species of hawk were noted, as well as a “large raptor carrying a large fish.” Deer tracks (*Odocoileus virginianus*) were noted at the river’s edge.

The water column was clear (16 events) or slightly turbid (2, n=26) when visible (unobservable on 5). The color was clear or light yellow on 30 of 33 events (red = 3). From 1998-2004, effluent odors were typical (20, n=27); from 2005-2010 the effluent odors were not noted at all. Typically, the water at this site lacked odor (24, n=33); “eutrophic pond” was noted 7 times, while fishy and rotting vegetables were each observed once. Very sparse to sparse foam was commonly observed (19, n=33), and absent on 10 dates. Sheens were typically absent (a pollen blanket was observed twice). Wood, steel ties, cables and other debris from the railroad trestle formerly located here were a constant presence. Other trash was described as consisting of floatables, broken glass and beer bottle caps

Table 2 MassDEP SMART 2005 - 2010. Station NN12. Summary of Observations.

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
2/9/2005	Boulder/cobble/gravel/sand/silt; highly embedded	Minor: floatables	Sparse, green filamentous	Light yellow	Effluent	Very sparse	None	Clear	Wet
4/13/2005	Boulder/cobble/gravel/sand/silt	Trash	Sparse, green filamentous	Light yellow	None	None	None	Slight	Dry
6/8/2005	Boulder/cobble/gravel/sand/silt; highly embedded	None	Moderate, brown film; sparse, moss	Brown	Effluent	Sparse	None	Slight	Wet
8/17/2005	Cobble/gravel/sand/silt/mud	Trash	Sparse, green filamentous	Grey	Musty	None	Sheen	Slight	Wet
10/13/2005	Unobservable	None	Unobservable	Brown	None	Sparse	None	Moderate	Wet
1/11/2006	Boulder/cobble/gravel/silt/mud	None	Sparse, bright green filamentous	Light yellow	Effluent	None	None	Clear	Wet
3/14/2006	Unobservable	Floatables	Unobservable	Brown	None	None	None	Highly turbid/murky	Wet
5/10/2006	Boulder/cobble/gravel/sand/silt	Minor: cigarette butts, miscellaneous	None	Clear	None	None	None	Slight	Wet
7/12/2006	Boulder/cobble/gravel/sand/silt	None	Moderate, green filamentous; very dense moss	Light yellow	Effluent	Very sparse	None	Slight	Dry
9/13/2006	Boulder/cobble/gravel/sand/silt/mud; highly embedded	Minor: tire	Dense moss	Light yellow	Effluent	None	None	Clear	Dry
11/1/2006	Boulder/cobble/sand/silt	Floatables	None	Clear	Effluent	Very sparse	None	Slight	Wet
2/7/2007	Boulder/cobble/gravel/sand/silt	None	None	Light yellow	None	None	None	Clear	Dry
4/11/2007	Boulder/cobble/gravel/sand/silt/mud	Trash: 2 tires, hay bale	None	Clear	None	Very sparse	None	Clear	Dry
6/13/2007	Bedrock/boulder/cobble/gravel/sand/silt	Minor: tire	Dense, green film	Light yellow	None	Sparse	None	Slight	Dry
8/22/2007	Bedrock/boulder/cobble/gravel/sand/silt	Pipe, tire	Very dense, brown filamentous	Grey/light yellow	Effluent, strong	Very sparse	None	Moderate	Dry
10/10/2007	Bedrock/boulder/cobble/gravel/sand/silt/mud	Tires, floatables	Very desne, green and red filamentous	Light yellow	Effluent	Foam	None	Moderate	Dry
1/16/2008	Unobservable	Unobservable	Unobservable	Light yellow	None	Very sparse	None	Clear	Wet
3/19/2008	Bedrock/boulder/cobble/gravel/sand/silt	Minor: tire, floatables	Sparse, green filamentous	Light yellow	None	None	None	Moderate	Wet
5/15/2008	Bedrock/cobble/gravel/sand/silt	Minor: tire, floatables	Sparse, green filamentous	Light yellow	None	Very sparse	None	Slight	Dry
6/11/2008	Bedrock/boulder/cobble/gravel/sand/silt	Tires, floatables	Moderate, filamentous	Clear	Effluent	Very sparse	Pollen	Moderate	Wet
7/17/2008	Bedrock/boulder/cobble/gravel/sand/silt	Tires	Very dense, green filamentous	Clear	Effluent, faint	Very sparse	None	Slight	Dry
8/14/2008	Unobservable	Minor: tires (2)	Unobservable; dense green filamentous in shallows	Brown	None	Moderate	None	Highly turbid/murky	Wet
9/18/2008	Bedrock/boulder/cobble/gravel/sand/silt	Minor: tires (2)	Dense, grey filamentous; sparse, moss	Light yellow	Effluent	Sparse	None	Slight	Dry
11/12/2008	Unobservable	Unobservable	Brown filamentous	Clear	None	Sparse	None	Unobservable	Dry
2/18/2009	Unobservable	Minor: tire	Very dense, green film	Light yellow	None	None	None	Slight	Dry
4/22/2009	Unobservable	Unobservable	Unobservable	Dark tan	None	None	None	Highly	Wet
6/17/2009	Unobservable	None	Sparse, dark green filamentous; sparse, moss	Clear	Effluent, slight	None	None	Moderate	Wet
9/2/2009	Boulder/cobble/gravel/sand/silt; embedded	None	Moderate, green filamentous; sparse, moss	Light yellow	None	Sparse	None	Slight	Wet
10/21/2009	Boulder/cobble/gravel/sand/silt	Minor: floatables, tire	Dense, silt-covered filamentous	Clear	None	Very sparse	None	Moderate	Wet
2/4/2010	Unobservable	Unobservable	None	Light yellow	None	None	None	Slight	Dry
7/20/2010	Unobservable	Unobservable; floatables at surface	Unobservable	Brown	Urine, strong	Very sparse	Intermittent oily patches	Highly turbid/murky	Wet
9/22/2010	Bedrock/cobble/gravel/sand/silt	None	Dense, brown filamentous; dense, moss	Light yellow	Effluent	Sparse to moderate	None	Slight	Dry
11/9/2010	Bedrock/gravel/sand/silt	Minor: floatables	None	Brown	Efluent, slight	None	None	Moderate	Wet
-- : Not noted									

Table 3 MassDEP SMART 2005 - 2010. Station NS19. Summary of Observations.

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
2/9/2005	Boulder/cobble/gravel/sand/silt	Minor, trash	None	Light yellow	None	None	None	Clear	Wet
4/13/2005	Cobble/sand	Trash	None	Light yellow	None	None	None	Slight	Dry
6/8/2005	Cobble/gravel/sand/silt/mud	None	None	Clear	None	Sparse	None	Clear	Wet
8/17/2005	Cobble/gravel/sand/silt/mud; highly embedded	Planks, floatables	Sparse, green filamentous	Clear	None	Very sparse	None	Clear	Wet
10/13/2005	Unobservable	Unobservable	Unobservable	Grey, brown	Musty, faint	None	None	Moderate	Wet
1/11/2006	Boulder/cobble/gravel/sand	Trash	None	Clear	None	None	None	Clear	Wet
3/14/2006	Unobservable	Unobservable	Unobservable	Brown	None	None	None	Highly turbid/murky	Wet
5/10/2006	Cobble/gravel/sand/silt	None	Unknown, very dense (caked with mud)	Light yellow	None	None	None	Moderate	Wet
7/12/2006	Cobble/gravel/sand/silt/mud	None	None	Light yellow	None	Very sparse	None	Clear	Dry
9/13/2006	Cobble/gravel/sand/silt	Trash	None	Clear	None	Sparse	None	Clear	Dry
11/1/2006	Boulder (rip rap from bridge abutments)	Trash	None	Clear	None	Very sparse	None	Slight	Wet
2/7/2007	Boulder/cobble/gravel/sand/silt	Minor, trash	None	Clear	None	None	None	Clear	Dry
4/11/2007	Cobble/gravel/sand/silt	None	None	Clear	None	None	None	Clear	Dry
6/13/2007	Boulder/cobble/sand/silt	Minor, beer bottle	Very dense, green/brown filamentous	Light yellow	None	Sparse to moderate	None	Slight	Dry
8/22/2007	Boulder/cobble/gravel/sand/silt	None	Sparse, brown filamentous	Clear	None	None	None	Clear	Dry
10/10/2007	Boulder/cobble/gravel/sand/silt	Minor, tire, floatables	Sparse, red/brown filamentous	Clear	Effluent	Sparse	None	Clear	Dry
1/16/2008	Unobservable	None	None	Light yellow	None	None	None	Clear	Wet
3/19/2008	Cobble/sand/silt	Minor, floatables	None	Clear	None	Very sparse	None	Moderate	Wet
5/15/2008	Boulder/cobble/gravel/sand/silt	Broken glass, timbers	Moderate, green filamentous	Light yellow	None	Sparse	None	Slight	Dry
6/11/2008	Boulder/cobble/gravel/sand/silt	Planks, metals	None	Clear	None	Moderate	Pollen	Moderate	Wet
7/17/2008	Boulder/cobble/gravel/sand	Minor, planks	None	Clear	None	None	None	Slight	Dry
8/14/2008	Cobble/gravel/sand/silt	Minor, planks, metals	Very dense, film	Clear	None	Sparse	None	Slight	Wet
9/18/2008	Boulder/cobble/gravel/sand	Minor, broken glass	Filamentous	Clear	Effluent	None	None	Clear	Dry
11/12/2008	Boulder/cobble/gravel/sand	None	Dense, brown filamentous	Clear	None	Moderate	None	Clear	Dry
2/18/2009	Boulder/cobble/gravel/sand/silt	None	None	Clear	None	None	None	Clear	Dry
4/22/2009	Unobservable	Unobservable	Unobservable	Dark tan	None	None	None	Highly turbid/murky	Wet
6/17/2009	Unobservable	None	None	Clear	None	None	None	Slight	Wet
9/2/2009	Unobservable	None	Moderate, green filamentous	Unobservable	None	Very sparse	None	Clear	Wet
10/21/2009	Unobservable	None	Sparse, brown filamentous	Clear	None	None	None	Slight	Wet
2/4/2010	Sand	Minor, trash	None	Clear	None	None	None	Clear	Dry
7/20/2010	Cobble/sand/silt	None	None	Clear	None	None	None	Clear	Wet
9/22/2010	Cobble/gravel/sand/silt	None	None	Clear	None	None	Sparse, pollen	Slight	Dry
11/9/2010	Unobservable	None	None	Brown	None	None	None	Moderate	Wet
-- : Not noted									

Table 4 MassDEP SMART 2005 - 2010. Station NT60A. Summary of Observations.

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
2/9/2005	Station not sampled on this date; not accessible due to snow/ice								
4/13/2005	Gravel/sand	None	None	Light yellow	None	None	None	Clear	Dry
6/8/2005	Gravel/sand/silt	None	None	Clear	None	None	None	Clear	Wet
8/17/2005	Gravel/sand/silt	None	None	Clear	None	None	None	Clear	Wet
10/13/2005	Gravel/sand	None	None	Clear	None	None	None	Clear	Wet
1/11/2006	Cobble/gravel	None	None	Clear	None	None	None	Clear	Wet
3/14/2006	Cobble/gravel/sand	None	None	Clear	None	None	None	Clear	Wet
5/10/2006	Gravel/sand	None	None	Clear	None	None	None	Clear	Wet
7/12/2006	Gravel/sand	None	None	Clear	None	None	None	Clear	Dry
9/13/2006	Gravel/sand/silt	None	None	Clear	None	None	None	Clear	Dry
11/1/2006	Gravel/sand/silt	None	None	Clear	None	None	None	Clear	Wet
2/7/2007	Station not sampled on this date; not accessible due to snow/ice								
4/11/2007	Cobble/gravel/sand/silt	None	None	Clear	None	None	None	Clear	Dry
6/13/2007	Gravel/sand/silt	None	None	Red/light yellow	None	None	None	Clear	Dry
8/22/2007	Gravel/sand/silt	None	None	Red	None	None	None	Clear	Dry
10/10/2007	Gravel/sand	None	None	Clear	None	None	Minor, not petroleum	Clear	Dry
1/16/2008	Gravel/sand	None	None	Clear	None	None	None	Clear	Wet
3/19/2008	Gravel/sand	None	None	Light yellow	None	None	None	Clear	Wet
5/15/2008	Gravel/sand	None	None	Clear	None	None	None	Clear	Dry
6/11/2008	Gravel/sand/silt	None	None	Red, slight	None	None	Pollen	Clear	Wet
7/17/2008	Gravel/sand/silt	None	None	Red, slight	None	None	None	Clear	Dry
8/14/2008	Gravel/sand/silt	None	None	Red	None	None	None	Clear	Wet
9/18/2008	Gravel/sand	None	None	Red	None	None	None	Clear	Dry
11/12/2008	Gravel/sand	None	None	Clear	None	None	None	Clear	Dry
2/18/2009	Gravel/sand	None	None	Red, slight	None	None	None	Clear	Dry
4/22/2009	Gravel/sand/silt	None	None	Red	None	None	None	Slight	Wet
6/17/2009	Gravel/sand	None	None	Red	None	None	None	Clear	Wet
9/2/2009	Gravel/sand	None	None	Red, slight	None	None	None	Clear	Wet
10/21/2009	Gravel/sand	None	None	Clear	None	None	None	Clear	Wet
2/4/2010	Station not sampled on this date; not accessible due to snow/ice								
7/20/2010	Gravel/sand	None	None	Red, slight	Eutrophic	None	None	Clear	Wet
9/22/2010	Gravel/sand	None	None	Red, very slight	None	None	None	Clear	Dry
11/9/2010	Gravel/sand/silt	None	None	Red, slight	None	None	Slight, pollen	Clear	Wet
-- : Not noted									

Table 5 MassDEP SMART 2005 - 2010. Station NM27. Summary of Observations.

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
2/9/2005	Station not sampled on this date; not accessible due to snow/ice								
4/13/2005	Cobble/gravel/sand/silt/mud	None	None	Unobservable	None	None	None	Slight	Dry
6/8/2005	Gravel/sand/silt/mud	None	None	Light yellow	None	None	Pollen	Clear	Wet
8/17/2005	Gravel/sand/silt/mud	None	None	Clear	None	None	Pollen	Clear	Wet
10/13/2005	Gravel/sand/silt/mud	None	None	Clear	Musty	None	None	Clear	Wet
1/11/2006	Gravel/sand/mud	None	None	Clear	None	None	None	Clear	Wet
3/14/2006	Gravel/sand/silt/mud	Minor, glass bottle	None	Clear	None	None	None	Clear	Wet
5/10/2006	Sand/silt	None	None	Light yellow	None	None	Oily sheen	Moderate	Wet
7/12/2006	Gravel/sand/silt/mud	None	Moderate, green filamentous; sparse, moss	Light yellow	None	None	None	Slight	Dry
9/13/2006	Sand/silt/mud	None	None	Clear	None	None	None	Clear	Dry
11/1/2006	Gravel/sand/silt	None	Sparse, green film	Light yellow	None	None	None	Clear	Wet
2/7/2007	Station not sampled on this date; not accessible due to snow/ice								
4/11/2007	Gravel/sand/silt	None	Sparse, green filamentous	Clear	None	None	None	Clear	Dry
6/13/2007	Gravel/sand/silt	None	None	Light yellow	None	None	Pollen	Slight	Dry
8/22/2007	Gravel/sand/silt/mud	None	Dense, green filamentous	Light yellow	None	None	Pollen	Moderate	Dry
10/10/2007	Gravel/sand/silt/mud	None	Sparse, green filamentous	Clear	None	None	None	Slight	Dry
1/16/2008	Gravel/sand/silt/mud	None	None	Light yellow	None	None	None	Clear	Wet
3/19/2008	Gravel/silt	None	Sparse, green filamentous	Clear	None	None	None	Clear	Wet
5/15/2008	Gravel/silt	None	None	Clear	None	None	None	Clear	Dry
6/11/2008	Gravel/sand	None	Dense, green filamentous	Clear	Eutrophic pond	None	Pollen	Slight	Wet
7/17/2008	Gravel/sand/silt	None	Very dense, brown filamentous	Clear	None	None	Manganous sheen	Slight	Dry
8/14/2008	Gravel/sand/silt	None	None	Red	None	None	None	Moderate	Wet
9/18/2008	Gravel/sand/silt	None	None	Light yellow	None	None	Pollen	Slight	Dry
11/12/2008	Unobservable	Unobservable	Brown filamentous on boat ramp	Light yellow	None	Very sparse	None	Unobservable	Dry
2/18/2009	Sand/silt/mud	None	Dense, light brown filamentous	Clear	None	None	None	Clear	Dry
4/22/2009	Sand/silt	None	None	Light yellow	None	None	None	Slight	Wet
6/17/2009	Gravel/sand/silt/mud	None	None	Light yellow	None	None	None	Slight	Wet
9/2/2009	Gravel/sand/silt	None	Moderate, dark green film	Light yellow	None	None	None	Clear	Wet
10/21/2009	Gravel/sand/silt/mud	None	Moderate, light brown film	Clear	None	None	Minor, pollen	Slight	Wet
2/4/2010	Station not sampled on this date; not accessible due to snow/ice								
7/20/2010	Gravel/sand/silt/mud	None	Sparse, green film on boat ramp; brown loos floc near shore	Clear	Eutrophic pond	None	Pollen; very sparse, oil-like sheen near boat ramp	Slight	Wet
9/22/2010	Gravel/sand	None	None	Clear	None	None	None	Slight	Dry
11/9/2010	Unobservable	Unobservable	Unobservable	Red, slight	None	None	None	Moderate	Wet
-- : Not noted									

Table 6 MassDEP SMART 2005 - 2010. Station NM29A. Summary of Observations.

Survey Dates	Substrate	Trash	Periphyton	Color	Odor	Foam	Sheen	Turbidity	Wet/Dry Conditions
2/9/2005	Boulder/cobble/gravel/sand/silt	Minor, trash	None	Clear	None	Sparse	None	Clear	Wet
4/13/2005	Boulder/cobble/gravel/sand/mud	Trash	Moss	Light yellow	None	Sparse	None	Slight	Dry
6/8/2005	Unobservable	Broken glass, trestle ties, steel rails	Dense, moss	Clear	None	Foam	None	Slight	Wet
8/17/2005	Boulder/cobble/gravel/sand/silt/mud; embedded	Broken glass, floatables	Very dense, moss	Clear	None	None	None	Clear	Wet
10/13/2005	Unobservable	Trash	Unobservable	Light yellow	None	Moderate	None	Slight	Wet
1/11/2006	Boulder/cobble/gravel/sand/silt	Old railroad ties, trestle stumps, cables, broken glass	Moss	Light yellow	None	Sparse	None	Clear	Wet
3/14/2006	Boulder/cobble/gravel/sand	Trestle supports, metals, floatables	Moderate, moss	Clear	None	Foam	None	Clear	Wet
5/10/2006	Unobservable	Broken glass, metals, wooden pole stumps	Unobservable	Light yellow	None	Very sparse	None	Slight	Wet
7/12/2006	Boulder/cobble/gravel/sand	Broken glass, stums of former trestle supports	Very dense, moss	Light yellow	None	Very sparse	None	Slight	Dry
9/13/2006	Cobble/gravel/sand/silt/mud	Metals, trestle debris	Dense, green filamentous; very dense, moss	Clear	None	Sparse	None	Clear	Dry
11/1/2006	Unobservable	Remains of former trestle bridge	Unobservable; dense, moss	Light yellow	None	Sparse	None	Unobservable	Wet
2/7/2007	Boulder/cobble/gravel/sand/silt	Debris from former railroad trestle	Sparse, green moss	Clear	None	None	None	Clear	Dry
4/11/2007	Unobservable	Metals, floatables	Unobservable	Clear	None	Sparse	None	Clear	Dry
6/13/2007	Boulder/cobble/gravel/sand/silt	Railroad trestle debris	Green filamentous	Light yellow	Fishy, slight	Sparse to moderate	None	Clear	Dry
8/22/2007	Cobble/gravel/sand/silt	Trestle parts, broken glass	Moderate, green filamentous; dense, moss	Very light yellow	Eutrophic pond	Sparse	None	Slight	Dry
10/10/2007	Unobservable	Trestle debris, floatables	Very dense, moss	Clear	None	None	Pollen	Clear	Dry
1/16/2008	Unobservable	Unobservable	Unobservable	Light yellow	None	None	None	Unobservable	Wet
3/19/2008	Unobservable	Trestle remnants, broken glass	Unobservable	Clear	None	Sparse	None	Slight	Wet
5/15/2008	Boulder/cobble/gravel/sand/silt	Trestle infrastructure remains	Dense, moss	Clear	None	Very sparse	None	Clear	Dry
6/11/2008	Cobble/gravel/sand/silt	Trestle remains	Dense, green filamentous	Clear	Eutrophic pond	Very sparse	None	Slight	Wet
7/17/2008	Cobble/gravel/sand/silt	Trestle remnants	Dense, filamentous	Light yellow	None	None	None	Slight	Dry
8/14/2008	Unobservable	Broken glass, beer bottle caps	Unobservable; dense, moss	Light yellow	None	Foam	None	Unobservable	Wet
9/18/2008	Unobservable	Trestle remains, tire, floatables	Very dense, moss	Light yellow	Rotting vegetables	Very sparse	None	Slight	Dry
11/12/2008	Unobservable	Trestle debris, broken glass	Unobservable	Clear	None	Sparse	None	Clear	Dry
2/18/2009	Unobservable	Trestle remnants, broken glass	None	Red, slight	None	Very sparse	None	Clear	Dry
4/22/2009	Unobservable	Unobservable	Unobservable	Clear	Eutrophic pond	Sparse	None	Clear	Wet
6/17/2009	Unobservable	Unobservable	Sparse, green film; sparse, moss	Light yellow	Eutrophic pond	Sparse	None	Slight	Wet
9/2/2009	Unobservable	Unobservable	Unobservable	Red	None	None	None	Unobservable	Wet
10/21/2009	Unobservable	Trestle remnants, broken glass	Unobservable	Light yellow	Eutrophic pond	None	None	Clear	Wet
2/4/2010	Unobservable	Trestle remnants	None	Clear	None	None	None	Clear	Dry
7/20/2010	Cobble/gravel/sand/silt/mud	Trestle remnants, broken glass, miscellaneous	Sparse, moss	Clear	Eutrophic pond	None	None	Clear	Wet
9/22/2010	Unobservable	Trestle remnants	Moderate, moss	Clear	Eutrophic pond, strong	None	Sparse, pollen	Slight	Dry
11/9/2010	Unobservable	Trestle remnants, floatables	Unobservable; dense, moss	Red, slight	None	Sparse	None	Unobservable	Wet
-- : Not noted									

SURVEY CONDITIONS

Stream discharge and precipitation data are used to determine hydrologic conditions and, consequently, if water quality surveys should be described as dry- or wet weather-influenced events. Precipitation data for each monitoring event were obtained from the National Oceanic and Atmospheric Administration (NOAA). The presence/absence of precipitation during the five days prior to each sampling event was based on the National Weather Service (NWS) data located on their website NOAA Climatological Data Publications (NOAA 2015). The weather station closest to the Nashua watershed sampling stations is located in Ashburnham, MA; data collected here were utilized in this report. Data collected at the station at Barre Falls Dam, Barre were used in the absence of data at the Ashburnham station; data from the Worcester weather station were also used for comparison purposes. Annual precipitation ranges from 46 to 48 inches (in) on the northeastern portion of the watershed, and 48 to 50 in on the rest; in a small area centered approximately on Mount Wachusett, annual precipitation ranges from 50 to 52 in (Ostiguy et al 2014).

During dry weather, trace amounts of precipitation may fall, but there is no measurable change in stream flow. The United States Geological Survey (USGS) operates four real time stream gaging stations in the Nashua River Watershed that are applicable to this water quality data set, as shown below:

- North Nashua River near Leominster, MA (USGS 2014a)
- Nashua River 0.4 mi Upstream Rte 110 at Clinton, MA (USGS 2014b)
- Squannacook River near West Groton, MA (USGS 2014c) and
- Nashua River at East Pepperell, MA (USGS 2014d).

Data from these stations can be accessed from Daily Data for Massachusetts: Stage and Streamflow (USGS 2014e).

The period of record (POR) mean streamflow values are the mean of daily mean values for each day for 63-64 years of record at the USGS Squannacook River gage at West Groton, MA (USGS station number 01096000), recorded in cubic feet per second (cfs). The daily mean data are reported at Daily mean data (USGS 2011f). The monthly and annual mean discharges are found at Monthly mean data (monthly, USGS 2014g) and Annual mean data (annual, USGS 2014h).

Wet weather is defined as precipitation within a five-day antecedent period that leads to more than a slight increase in stream discharge at the four stations listed above (i.e., streamflow). Under dry weather conditions, trace amounts of precipitation may fall, but no measurable change in stream flow occurs.

Table 13 (precipitation) and Table 14 (stream discharge) present information on survey conditions for each sampling event. Both the precipitation and the stream discharge data were used to estimate hydrological conditions during water quality sampling. Observations of discharge were based on flows at the USGS gaging station on the Squannacook River near West Groton, which is approximately 0.1 mi downstream of the SMART reference station on the Squannacook River (Station NT60A). Low flows were compared to the 7Q10 flow (the lowest 7-day average streamflow that occurs, on average, once every 10 years) at that location, which is 6.525 cfs (Ries 1999). When precipitation and discharge data were not sufficient to determine wet or dry conditions, additional data were utilized e.g., maximum daily temperature, snowfall, snow on the ground, specific conductivity, turbidity and bacteria.

February 9, 2005 – A storm on February 4, 2005 brought 5 in snow to the area (0.42 in as water); see Table 7 for local climate data. Maximum daily temperature ranged from 40 to 55 degrees Fahrenheit (°F) from February 4-9, while snow on the ground decreased from 13 to 7 in and discharge at the Squannacook River gage increased. Water quality data reflect wet weather/snowmelt conditions. Air temperature ranged from 40 to 50ºF under cloudy skies.

Table 7 Climate Conditions at the Barre Falls Dam, Barre, MA from February 4-9, 2005

Parameter	Feb 4	Feb 5	Feb 6	Feb 7	Feb 8	Feb 9
Max Temperature (ºF)	40	42	55	49	55	49
Precipitation (in, as water)	0.42	0	0	0	0	0
Snowfall (in)	5.0	0	0	0	0	0
Snow on the ground (in)	13	11	9	8	8	7
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

April 13, 2005 – Little precipitation fell in the 5 days prior to this spring survey (0.19 in); discharge at the Squannacook River gage decreased steadily in this period. Water quality data reflect dry conditions. Air temperature ranged from 43 to 46°F and cloud cover from 65% to 98%.

June 8, 2005 – Approximately one half inch of rain fell on June 7, 2005; discharge rose slightly at the Squannacook River gage. Data reflect wet weather/runoff weather conditions. Air temperature ranged from 77 to 82°F under sunny skies.

August 17, 2005 – Hurricane Irene struck New England on August 15, 2005, and dropped 2.1 in rain in the area. Flow at the Squannacook gage rose concurrently. Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 70 to 80°F under sunny skies.

October 13, 2005 – The remnants of Hurricane Tammy, along with Subtropical Depression 22 and other atmospheric factors, combined to drop over 7 in of rain on the area from October 8-12, 2005 (as measured at the Barre Falls Dam; the rain gage was not read at the Ashburnham station on October 8-9, 2005). Discharge rose dramatically at area gages from October 10-13. Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 55 to 57°F under overcast skies, with intermittent precipitation that ranged from sprinkles to rain.

January 11, 2006 – From January 6-11, 2006, 2.5 in snow was recorded at the Ashburnham weather station (0.21 in as water); see Table 8 for local climate data. Two inches of snow fell at the Barre Falls Dam, and the maximum daily temperature was above freezing on 4 of the 5 days prior to this survey; snow on the ground decreased from 6 to 3 in Discharge at the Squannacook and Nashua River gages decreased steadily over the week preceding this event. Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 34 to 44°F under cloudy skies.

Table 8 Climate Conditions at the Barre Falls Dam, Barre, MA from January 6-11, 2006

Parameter	Jan 6	Jan 7	Jan 8	Jan 9	Jan 10	Jan 11
Max Temperature (ºF)	35	35	29	35	41	42
Precipitation (in, as water)	0.10	0	0.07	0.02	0.01	0
Snowfall (in)	0.5	0	1.0	0.5	0	0
Snow on the ground (in)	6	5	6	6	5	3
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

March 14, 2006 – A storm that started the night before this monitoring event (March 13-14, 2006) brought a total of 0.59 in rain to the area. Discharge began to rise at area gages before midnight (3/13/06). Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 48 to 58°F and skies ranged from overcast to rain.

May 10, 2006 – This spring monitoring event took place within a storm that brought a total of 0.32 in of rain on this date. Discharge on the Squannacook River rose with precipitation (discharge at the Nashua River gage in East Pepperell indicated possible flow manipulation). Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 50 to 54ºF; precipitation progressed from drizzle to rain by the end of monitoring activities.

July 12, 2006 – Five days without precipitation preceded this summer monitoring survey; 0.46 in recorded at Ashburnham on this date fell after the survey. Discharge on the Squannacook River steadily decreased during the week before this event; discharge at the Nashua River gage in East Pepperell reflected possible flow manipulation activities. Based on precipitation and discharge, water quality data reflect dry conditions. Air temperature ranged from 72 to 80ºF under overcast skies that developed to drizzle by the conclusion of this monitoring survey.

September 13, 2006 – This late summer event was preceded by a storm that brought 0.30 in rain to the area on September 10, 2006; 3 days of dry weather followed. Field observations note "sprinkles" at the first station only. Discharge rose and fell quickly at the North Nashua River gage on September 10, 2006 then returned to pre-event levels; no rise in discharge was observed at the Nashua River gage in East Pepperell or the Squannacook River gage in Groton. Water quality data reflect dry conditions. Air temperature ranged from 50 to 62°F under cloudy skies.

November 1, 2006 – A strong storm front brought over 2 inches of rain to the area on October 28-29, 2006. Discharge rose rapidly at the North Nashua and Squannacook River gages concurrent with precipitation, and had not returned to pre-storm levels by the sampling date. Although the Nashua River gage in East Pepperell indicated possible man-made flow fluctuations, the overall discharge pattern was similar to that of other area gages. Water quality data reflect wet weather/runoff conditions. Air temperature ranged from 53 to 66°F under sunny skies.

February 7, 2007 – On February 3, 2007, 3 in snow fell in this area (0.25 in as water, at the Barre Falls Dam); see Table 9 for local climate data. The maximum daily temperature was below freezing from February 4-7, 2007. Ice affected some area gages, minimizing the availability of discharge data for the week preceding this winter survey. Although the Nashua River gage in East Pepperell indicated non-natural flow fluctuations, the general flow pattern over the previous week was a steady decrease. Water quality data reflect dry conditions. Air temperature ranged from 10 to 16ºF with 0 to 35% cloud cover.

Table 9 Climate Conditions at the Barre Falls Dam, Barre, MA from February 2-7, 2007

Parameter	Feb 2	Feb 3	Feb 4	Feb 5	Feb 6	Feb 7
Max Temperature (ºF)	32	34	26	19	13	21
Precipitation (in, as water)	0	0.25	0	0	0	0
Snowfall (in)	0	3.0	0	0	0	0
Snow on the ground (in)	0	3	2	2	2	2
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

April 11, 2007 – Spring sampling in the Nashua watershed fell within a dry period, with only trace precipitation recorded at the Ashburnham weather station in the five days prior to and including this date. Discharge at the Nashua and North Nashua River gages fell steadily from April 6-11, 2007 with non-natural flow fluctuations noted at the East Pepperell gage. Flow at the Squannacook River gage rose from midnight to midday on April 10, then fell through the sampling event, which may indicate man-made flow manipulation. Water quality data reflect dry conditions. Air temperature ranged from 41 to 48ºF with 0 to <30% cloud cover.

June 13, 2007 – This late spring survey occurred within a storm event in which about a half inch of rain was recorded at the Ashburnham weather station on June 12-13, 2007; 0.2 in fell on June 10. At the other end of the watershed, 0.38 in rain was noted at the Worcester weather station on June 10, with only trace precipitation measured on June 12-13, 2007. Streamflow at area gages reflected the precipitation pattern at the Worcester station, rather than the Ashburnham station. Water quality data reflect dry conditions. Air temperature ranged from 56 to 67ºF and skies from overcast to light rain.

August 22, 2007 – Less than one tenth of an inch of rain fell on the area during the 5 days prior to this summer sampling event. Discharge at the North Nashua and Squannacook River gages generally fell steadily during this time; discharge at the Nashua River gages (Clinton, East Pepperell) reflected non-natural flow fluctuations. Water quality data reflect dry conditions. Air temperature ranged from 58 to 69ºF under overcast skies.

October 10, 2007 – Rainfall at the Ashburnham station was nearly a half inch on October 8-10, 2007. Discharge at the Squannacook, North Nashua and Nashua (Clinton) River gages rose and fell sharply on October 8, 2007 then varied little through the monitoring date; the Nashua River gage at East Pepperell reflected rapid flow fluctuations. Data reflect dry conditions. Air temperature ranged from 54 to 58ºF under cloudy skies, with sporadic fog and drizzle.

January 16, 2008 – Over 8 in snow (0.49 in as water) was recorded at area climate stations on January 14-15, 2008; see Table 10 for local climate data. A storm on January 11-12 brought over an inch of rain. Discharge at area gages generally rose with these storms, and decreased through the monitoring date, but not to pre-storm flows (non-natural flow patterns were seen at the Nashua River gages in Clinton and East Pepperell). The maximum daily temperature was above freezing on 4 of the 5 days preceding this event; snow on the ground at the Barre Falls Dam decreased from Jan. 15-16, 2008. The water column was clear at all stations. Water quality data collected during this event reflect wet weather/runoff conditions. Air temperature ranged from 23 to 31ºF under sunny skies.

Table 10 Climate Conditions at the Barre Falls Dam, Barre, MA from January 11-16, 2008

Parameter	Jan 11	Jan 12	Jan 13	Jan 14	Jan 15	Jan 16
Max Temperature (ºF)	43	37	40	40	28	33
Precipitation (in, as water)	0.34	0.80	0	0.23	0.26	0
Snowfall (in)	0	0	0	6.0	2.0	0
Snow on the ground (in)	0	0	0	6	6	4
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

March 19, 2008 – A storm from on March 15-16 brought over half an inch of precipitation to the area before this late winter event. On the sampling date, 0.04 in precipitation (0.3 in as snow) was observed at Ashburnham; however, at the other end of the watershed, over half an inch of precipitation (trace as snow) was recorded in Worcester. Eight inches of snow remained on the ground at Ashburnham from March 17-19, while only traces were observed in Worcester. The water level at all stations indicated that streamflow was recently higher and, in particular, much higher at the North Nashua and Nashua Rivers. Moderate (visual) turbidity was observed at stations on the North Nashua and Nashua Rivers (at Lancaster), and slight at the Nashua River above Pepperell Pond. Streamflow decreased from a peak on March 15, and generally began to rise early morning to mid-day on the sampling date at the North Nashua and Nashua Rivers (Clinton), as well as on the Squannacook River. Data reflect wet weather/runoff conditions. Air temperature ranged from 36 to 39ºF. Precipitation fell throughout the survey (drizzle, light rain, rain, sleet and hail).

May 15, 2008 – Little precipitation was noted in the five days prior to this spring sampling event (0.09 inches at Ashburnham). Streamflow increased at the North Nashua River gage on May 13, in the absence of precipitation (none was recorded at any of the weather stations in Central Massachusetts on or around this date), then remained fairly steady through monitoring activities. A non-natural flow pattern was noted on May 13-14 at the Nashua River gage in East Pepperell. Flow at the Squannacook River gage decreased almost continually over the previous week. Field observations noted intermittent sprinkles at the first two stations (North Nashua River, Nashua River in Lancaster), and merely overcast skies after that. Low water levels were noted at stations on the Squannacook and Nashua (Lancaster) Rivers; at the other stations, water levels were typical. Data and observations collected on this date reflect dry weather conditions. Air temperature ranged from 54 to 60ºF; skies were overcast with intermittent sprinkles.

June 11, 2008 – This spring survey was preceded by a storm that brought 0.42 in rain to the area on June 11, 2008. Discharge rose mid-morning at two area gages, then decreased through June 12 (North Nashua River, Nashua River at Clinton). At the Squannacook River gage in West Groton, flow rose from mid-day, June 6 through mid-day June 7th, then fell through monitoring activities on June 12. Numerous daily flow fluctuations were observed throughout the previous week at the Nashua River gage in East Pepperell, independent of precipitation, indicating flow manipulation. Field observations noted relatively elevated water levels at the North Nashua and Squannacook Rivers; typical levels at the Nashua River above Pepperell Pond; and low to very low levels at the Nashua River in Lancaster and Pepperell. Visual turbidity was moderate at stations on the North Nashua River and the Nashua River at Lancaster; slight on the Nashua River in Groton and Pepperell; and clear on the Squannacook River. Based on precipitation, discharge and field observations, data reflect wet weather/runoff conditions. Air temperature ranged from 71 to 77ºF under sunny skies.

July 17, 2008 – Scant precipitation fell within the 5 days prior to this spring sampling event (0.07 in). Discharge fell steadily from July 10-17 at the Squannacook River at West Groton. At the North Nashua River in Leominster, flow rose on July 14, then decreased to pre-storm levels prior to this survey. Discharge patterns at the Nashua River gage in Clinton and in East Pepperell reflected non-natural flow fluctuations. Data collected on this survey reflect dry conditions. Air temperature ranged from 80 to 84ºF; cloud cover ranged from 35 to 90%.

August 14, 2008 – Over an inch and a half of rain fell on the area from August 11-13. Discharge at the Squannacook River, West Groton reflected this pattern, while discharge at other area gages exhibited evidence of flow manipulation. Data reflect wet weather/runoff conditions. Air temperature ranged from 66 to 80ºF; cloud cover ranged from <5% to 80%.

September 18, 2008 – Precipitation recorded at Ashburnham from September 13-15 totaled 0.81 inches; no precipitation fell from Sept. 16-18. Discharge generally rose at area gages on Sept. 14, and returned to pre-storm levels before the survey (evidence of flow manipulation was exhibited at the Nashua River, East Pepperell gage). Water quality data reflect dry conditions. Air temperature ranged from 60 to 67ºF under sunny skies.

November 12, 2008 – Approximately 0.64 inches of rain fell in the area from November 7-11. Discharge at the North Nashua and Squannacook River gages generally reflected this pattern, with flows returning to (or below) pre-storm levels prior to the survey (discharge at the Nashua River gage, East Pepperell reflected non-precipitation fluctuations). Field observations noted a clear water column at each station. Data reflect dry weather conditions. Air temperature ranged from 40 to 47ºF and cloud cover from 35 to 90% during this event.

February 18, 2009 – A trace of snow was the only precipitation recorded in the area in the five days before this winter monitoring event; see Table 11 for additional climate data. Although the daily maximum temperature was above freezing on 4 of the 5 days in this period, snow on the ground remained at 9 in from Feb. 13-18. Stream discharge rose on Feb. 12, then decreased through monitoring activities at the North Nashua and Squannacook Rivers (discharge at the Nashua River gages at Clinton and East Pepperell indicate non-natural flow fluctuations). Data collected during this event reflect dry conditions. Air temperature ranged from 24 to 46ºF; sunny skies became overcast during monitoring activities.

Table 11 Climate Conditions at Ashburnham, MA from February 13-18, 2009

Parameter	Feb 13	Feb 14	Feb 15	Feb 16	Feb 17	Feb 18
Max Temperature (ºF)	44	28	36	36	36	34
Precipitation (in, as water)	T	0	0	0	0	0
Snowfall (in)	T	0	0	0	0	0
Snow on the ground (in)	9	9	9	9	9	9
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

April 22, 2009 – This spring survey followed a storm that brought over an inch of rain to the area. Streamflow at area gages reflected this event, rising on April 21, 2009 then decreasing on April 22; discharge did not return to pre-event flows before monitoring activities. Water quality data collected on this event reflect wet weather/runoff conditions. Air temperature ranged from 58 to 62ºF and cloud cover from 40 to 100%.

June 17, 2009 – This late spring event followed a 5-day period with over 3 inches of rain recorded at the Ashburnham weather station. Discharge at area gages generally reflected the precipitation pattern (non-natural flow fluctuations were noted at the gages on the Nashua River at Clinton and East Pepperell). Data collected during this event reflect wet weather/runoff conditions. Air temperature ranged from 64 to 79ºF under sunny skies.

September 2, 2009 – Tropical Storm Danny brought 1.44 in rain to the area on August 29-30, 2009**.** Discharge at area gages generally reflected the precipitation pattern, and flows had not returned to pre-storm levels by this survey. Data collected on this date reflect wet weather/runoff conditions. Air temperature ranged from 61 to 79ºF under sunny skies.

October 21, 2009 – A half inch of rain fell in the area on October 19, 2009. In general, discharge at area gages reflected this precipitation pattern, and had not returned to pre-storm flows before the survey (non-natural flow fluctuations were noted at the Nashua River gages in Clinton and East Pepperell). Data collected on this event reflect wet weather/runoff conditions. Air temperature ranged from 49 to 64ºF, and cloud cover varied from <10 to 90%.

February 4, 2010 – Winter monitoring followed a dry period, with scant precipitation in the area (including 0.5 inches as snow) during the preceding 5 days; see Table 12 for local climate data. Daily maximum temperatures were below freezing, and snow on the ground remained at 8 in. In general, streamflow decreased at local gages (North Nashua River and Nashua River at East Pepperell); an unnatural flow pattern was observed at the Nashua River gage in Clinton, and discharge data were incomplete at the Squannacook River gage. Data collected on this event reflect dry conditions. Air temperature ranged from 24 to 28ºF under sunny skies. Ice covered most or all of the channel at Stations NM27 (Nashua River, Groton) and NT60A (Squannacook River, Groton), therefore monitoring was not conducted at those locations.

Table 12 Climate Conditions at Ashburnham, MA from January 30 - February 4, 2010

Parameter	Jan 30	Jan 31	Feb 1	Feb 2	Feb 3	Feb 4
Max Temperature (ºF)	13	16	23	28	28	28
Precipitation (in, as water)	0	0	0	0	0.03	T

Snowfall (in)	0	0	0	0	0.5	T
Snow on the ground (in)	8	8	8	8	8	8
Data obtained at NOAA Climatological Data Publications (NOAA 2015).						

July 15, 2010 – A storm brought over an inch of rain to the area in the 24 hour-period before this survey. Streamflow patterns at area gages generally reflected this precipitation (unnatural flow patterns were recorded at the Nashua River gages in Clinton and East Pepperell), and data collected on this event reflect wet weather/runoff conditions. Air temperature ranged from 71 to 81ºF, and cloud cover ranged from 55% to overcast.

September 22, 2010 – This early autumn monitoring event was preceded by 5 days with little precipitation (0.34 in on 9/17/2010). Streamflow generally reflected the precipitation pattern at area gages (a non-natural pattern was observed at the Nashua River gage in East Pepperell). Data collected on this event reflect dry conditions. Air temperature ranged from 62 to 73ºF under mostly cloudy skies.

November 9, 2010 – A wet period preceded this mid-fall survey, with 2.25 inches of precipitation recorded at the Ashburnham weather station from November 5-9, 2010. Streamflow at area gages generally reflected the precipitation pattern (unnatural fluctuations were observed at the Nashua River gage in East Pepperell), and data collected on this event reflect wet weather/runoff conditions. Air temperature ranged from 49 to 53ºF; skies were overcast throughout monitoring activities.

Table 13 Nashua Basin Precipitation Data Summary 2005-2010							
Survey Dates	**5 Days**	**4 Days**	**3 Days**	**2 Days**	**1 Day**	**Sample**	**Wet/Dry**
2/9/2005	0.41*	0	0	0	0	0	Wet**
4/13/2005	0.19	0	0	0	0	T	Dry
6/8/2005	0	0	0	T	0.47	0	Wet
8/17/2005	0	0.06	0	2.11	0	0	Wet
10/13/2005	N/A	N/A	4.91	0.85	0.20	0.02	Wet
1/11/2006	0.13	0	0.05	0.03	T	0	Wet
3/14/2006	0	0.02	0.02	0	T	0.59	Wet
5/10/2006	0	0	T	0	0	0.32	Wet
7/12/2006	0	0	0	0	0	0.46	Dry
9/13/2006	0	0	0.30	0	0	0	Dry
11/1/2006	0	0.55	1.50	T	0	0.06	Wet
2/7/2007	0	0	0.29	0	0	0	Dry
4/11/2007	T	T	0	T	0	T	Dry
6/13/2007	0	0	0.02	0	0.40	0.12	Dry
8/22/2007	0	0.08	0	0	0	0	Dry
10/10/2007	0	0	T	0.15	0.12	0.17	Dry
1/16/2008	0.20	0.60	0	0.37	0.35	T	Wet
3/19/2008	T	0.43	0.10	T	0	0.04	Wet
5/15/2008	0.09	0	0	0	0	0	Dry
6/11/2008	0.08	0.14	0	0	0.42	0	Wet
7/17/2008	T	0	T	0.07	0	0	Dry
8/14/2008	T	0	0.97	0.45	0.26	0	Wet
9/18/2008	0.17	0.45	0.19	0	0	0	Dry
11/12/2008	0.42	T	0.22	T	T	0	Dry
2/18/2009	T	0	0	0	0	0	Dry
4/22/2009	0	0	0.05	0	0.70	0.45	Wet
6/17/2009	1.38	0	1.90	0.23	0.07	0	Wet
9/2/2009	0	1.28	0.16	0	0	0	Wet
10/21/2009	0	0.02	0	0.50	0	0	Wet
2/4/2010	0	0	0	0	0.03	T	Dry
7/15/2010	0	0.48	0	0	0.06	0.98	Wet
9/22/2010	0.34	T	0	0	0	0	Dry
11/9/2010	0	1.39	0.22	0	0.35	0.29	Wet

*Data expressed as inches of precipitation (as water); official data from the National Weather Service station in Ashburnham, MA available at NOAA Climatological Data Publications (NOAA 2015)

**Based on precipitation, streamflow and other relevant data.

T = too small to measure

N/A = data not available; rain gage not read

Table 14 USGS Flow Data Summary Discharge 2005-2010 Squannacook River at West Groton, MA								
Survey Dates	**5 Days**	**4 days**	**3 Days**	**2 Days**	**1 Day**	**Sample***	**Monthly****	**Daily*****
2/9/2005	81	84	85	86	87	93	149.0	124
4/13/2005	324	304	249	216	192	178	363	256
6/8/2005	139	121	110	95	107	102	100.5	124
8/17/2005	19	19	24	59	70	52	31.6	28
10/13/2005	39	452	377	215	175	142	311.1	45
1/11/2006	178	167	152	145	140	136	278.1	126
3/14/2006	93	95	113	115	113	178	106.6	248
5/10/2006	148	111	95	84	77	92	367.8	153
7/12/2006	66	60	57	52	50	58	81.7	36
9/13/2006	39	35	30	26	24	22	33.1	42
11/1/2006	38	73	455	281	167	127	248.1	74
2/7/2007	59	62	59[e]	58[e]	54	52	50.1	123
4/11/2007	243	213	196	180	193	187	446.2	279
6/13/2007	101	95	105	87	70	67	67.5	85
8/22/2007	16	15	15	14	14	13	18.3	29
10/10/2007	8.7	9.0	8.9	11	11	11	19.9	48
1/16/2008	222	321	254	190	161	134	112.5	103
3/19/2008	285	314	380	332	291	281	384.0	258
5/15/2008	128	116	107	101	95	88	119.5	167
6/12/2008	57	53	45	39	35	33	46.4	85
7/17/2008	25	22	20	20	17	16	87.1	32
8/14/2008	150	108	190	223	184	132	79.0	35
9/18/2008	103	111	173	132	98	81	146.5	35
11/12/2008	102	121	109	96	84	76	124.4	107
2/18/2009	224	187	152	125	111	102	117.9	121
4/22/2009	141	130	125	120	196	418	224.6	203
6/17/2009	107	182	305	425	242	166	168.8	87
9/2/2009	48	76	165	113	75	57	31.4	26
10/21/2009	30	28	28	34	42	40	50.0	107
2/4/2010	165[e]	136[e]	119[e]	105[e]	100[e]	97	218.4	154
7/15/2010	17	20	17	15	23	33	18.1	39
9/22/2010	8.8	8.8	8.7	8.1	7.5	7.1	7.57	32
11/9/2010	28	66	99	74	63	66	89.3	99

*Gage # 01096500 data (cfs) found at Daily Data at Squannacook River near West Groton, MA (USGS 2014c)

**Mean of monthly mean discharge (cfs) based on data collected from 10/1/1949 to 9/30/2013 found at Monthly mean discharge at the Squannacook River near West Groton, MA (USGS 2014g)

***POR= Period of Record, mean of daily mean discharge based on data collected from 10/1/1949 to 9/30/2013, found at Point of Record discharge at the Squannacook River near West Groton, MA (USGS 2014f)

[e] = Value has been estimated

7Q10 = 6.525 cfs @ USGS gaging station, Squannacook River near West Groton, MA (Ries 1999)

RESULTS AND QUALITY ASSURANCE/QUALITY CONTROL

The results of SMART monitoring conducted in the Nashua watershed from 2005 through 2010 are included below. In situ multiprobe readings, including temperature, pH, dissolved oxygen, percent oxygen saturation, depth, specific conductivity, and total dissolved solids, are presented for each station in Table 15 through Table 19. Nutrient and chemistry data are presented in Table 20 through Table 24. Most results are expressed as milligrams per liter (mg/L). Exceptions include: depth in meters (m); temperature in degrees Celsius (ºC); pH in Standard Units (SU); conductivity in microsiemens per centimeter (µS/cm); dissolved oxygen saturation in percent (% sat); and turbidity, in Nephelometric Turbidity Units (NTU).

Field sheets, field notebooks, chain of custody forms, raw data files, lab reports and other metadata are maintained by the Massachusetts Department of Environmental Protection (MassDEP) Division of Watershed Management Watershed Planning Program in Worcester, MA and data are stored electronically in the Division of Watershed Management's (DWM) water quality database. Detailed information regarding the data validation process is explained in the separate document, *CN 56.2. Standard Operating Procedure. Data Validation and Usability* (MassDEP 2005). Specific validation criteria used for 2005-2010 data include, but are not limited to: conformance to the SMART Monitoring Quality Assurance Project Plan (Beaudoin 2008) and DWM standard operating procedures (SOPs), precision, accuracy, representativeness, holding times, sample preservation, frequency of field quality control (QC) samples, contamination of field blanks, stability of multiprobe readings and documentation. The following data qualifiers were applied as needed:

Multiprobe data qualifiers:
** = Missing data.
-- = No data.
##=Censored data (data that have been discarded for some reason).
c = Greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard.
i = Inaccurate readings from multiprobe likely.
m = Method not followed; one or more protocols contained in the DWM Multi-probe SOP not followed.
r = Data not representative of actual field conditions.
s = Field sheet recorded data were used to accept data, not data electronically recorded in the Multi-probe surveyor unit, due to operator error or equipment failure.
u = Unstable readings.

Laboratory sample data qualifiers:
** = Missing data.
-- = No data.
= Censored data (data that have been discarded for some reason).
[ ] = A result reported inside brackets has been censored, but is shown for informational purposes.
b = Blank contamination in lab reagent blanks and/or field blank samples.
d = Precision of field duplicates (as relative percent difference, RPD) did not meet project data quality objectives identified for program or in QAPP.
e = Not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for *E. coli* bacteria are greater than fecal coliform bacteria.
h = Holding time violation (usually indicating possible bias low).
j = 'Estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used to report sample data where the sample concentration is less than the reporting detection limit (RDL) and greater than the method detection limit (MDL) (RDL > x > MDL). Also used to note where values have been reported at levels less than the MDL.
m = Method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, and missing data.

Table 15 MassDEP SMART 2005-2010. Station NN12. *In Situ* Multiprobe Data.

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(us/cm)	(mg/l)	(mg/l)	(%)
2/9/2005	SM-6140	9:22	0.5	2.6	6.9	420	273	13.8	102
4/13/2005	SM-6182	9:12	0.7	7.0	6.5	330	215	11.8	97
6/8/2005	SM-1338	8:55	0.5	18.6	6.6	348	226	8.3	89
8/17/2005	SM-1430	8:47	0.3	21.2	6.9	381	248	7.9	89
10/13/2005	SM-1500	9:05	0.6	13.5	6.8	277	180	9.9	95
1/11/2006	SM-1570	9:10	0.6	2.6	6.8 u	329	214	13.6	100
3/14/2006	SM-1640	9:05	0.6	6.2	6.6	315	205	12.0	97
5/10/2006	SM-1710	9:15	0.4	12.3	6.7	315	205	10.0	94
7/12/2006	SM-1792	9:15	0.3	21.1	6.8	372	238	7.5	86
9/13/2006	SM-1850	8:49	0.3	14.8	6.8	437	280	8.7	86
11/1/2006	SM-1920	8:48	0.4	10.1	6.6	257	167	10.7	96
2/7/2007	SM-1990	8:46	0.2 i	-0.1 u	6.7 u	367 u	239 u	15.0 u	103 u
4/11/2007	SM-2060	8:51	0.7	4.4	6.6	283	184	12.7	98
6/13/2007	SM-2130	8:59	0.9	18.6	6.8	264	172	8.6	92
8/22/2007	SM-2200	8:55	0.5	16.4	7.1	516	336	8.6	88
10/10/2007	SM-2270	9:00	0.5	15.8	7.0	472	307	8.2	83
1/16/2008	SM-2340	8:50	1.0	1.0	6.7	350	228	14.2	100
3/19/2008	SM-2410	8:49	0.6	3.6	6.7	289	188	13.2	100
5/15/2008	SM-2480	8:55	0.5	13.4	6.9	358	233	9.4	90
6/12/2008	SM-2526	8:56	0.5	20.6	7.0	508	330	## i	## i
7/17/2008	SM-2586	8:59	0.5	21.5	7.0	522	339	7.2	82
8/14/2008	SM-2632	8:54	0.9	19.5	7.0	271	176	8.3	90
9/18/2008	SM-2692	8:48	0.8	16.4	7.0	320	208	9.0	92
11/12/2008	SM-2762	9:04	0.6	7.7	6.9	292	189	11.5	96
2/18/2009	SM-2832	8:43	0.2	0.5	6.8	367	238	14.4	100
4/22/2009	SM-2904	8:37	0.8	8.9	6.7	207	135	11.2	96
6/17/2009	SM-2976	8:46	0.9	15.2	6.8	248	161	9.7	96
9/2/2009	SM-3048	8:17	0.7	16.4	6.9	379	246	9.8	101
10/21/2009	SM-3120	8:22	0.6	10.0	6.9	368	239	9.8	86
2/4/2010	SM-3192	8:39	0.3	0.2	6.8	369	240	13.9	95
7/15/2010	SM-3264	8:59	0.6	22.4	7.1	373	239	7.3	85
9/22/2010	SM-3336	8:37	0.5	17.2	7.1	577	375	8.0	83
11/9/2010	SM-3408	8:37	1.0	7.6	6.8	292	190	11.4	95

Table 16 MassDEP SMART 2005-2010. Station NS19. *In Situ* Multiprobe Data.

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(us/cm)	(mg/l)	(mg/l)	(%)
2/9/2005	SM-6142	9:59	0.6	3.1	7.0	228	148	14.4	108
4/13/2005	SM-6184	9:51	0.9	5.0	6.6	181	118	12.7	100
6/8/2005	SM-1340	9:31	0.5	13.9	6.5	170	111	10.2	98
8/17/2005	SM-1432	9:30	0.4	20.3	7.2	273	177	7.9	87
10/13/2005	SM-1502	9:48	1.0	14.2	6.9	225	146	8.6	84
1/11/2006	SM-1572	9:58	0.9	2.9	6.6	172	112	13.6	101
3/14/2006	SM-1642	9:48	1.0	6.2	6.7	235	152	11.6	94
5/10/2006	SM-1712	9:52	0.7	11.7	6.8	210	137	9.9	91
7/12/2006	SM-1794	10:08	1.9	16.4	6.8	159	102	8.8	91
9/13/2006	SM-1852	9:29	1.2	13.8	6.7	133	85	9.3	91
11/1/2006	SM-1922	9:29	0.7	10.8	6.7	237	154	9.2	83
2/7/2007	SM-1992	9:25	0.4 i	0.1 u	7.0 u	254 u	165 u	14.6 u	100 u
4/11/2007	SM-2062	9:26	0.7	3.7	6.8	152	98	13.2	100
6/13/2007	SM-2132	9:38	0.9	17.0	6.8	245	159	8.0	83
8/22/2007	SM-2202	9:45	0.8	13.2	6.9	126	82	10.3	98
10/10/2007	SM-2272	9:40	0.4	14.7	7.0	265	172	8.2	81
1/16/2008	SM-2342	9:28	1.0	1.4	6.9	157	102	13.8	98
3/19/2008	SM-2412	9:36	0.9	2.7	6.7	147	96	13.4	99
5/15/2008	SM-2482	9:51	0.2	12.7	6.9	257	167	8.7	82
6/12/2008	SM-2528	9:41	0.5	19.4	7.1	315	205	## i	## i
7/17/2008	SM-2588	9:44	1.0	15.8	6.8	138	90	9.6	97
8/14/2008	SM-2634	9:37	0.9	14.4	6.8	142	92	9.5	93
9/18/2008	SM-2694	9:28	0.6	15.8	7.0	246	160	8.4	85
11/12/2008	SM-2764	9:43	0.7	7.9	7.0	228	148	10.9	92
2/18/2009	SM-2834	9:30	0.6	1.2	6.9	153	100	14.7	104
4/22/2009	SM-2906	9:13	0.9	9.3	6.9	221	144	10.2	89
6/17/2009	SM-2978	9:26	0.9	12.7	6.8	165	107	10.4	98
9/2/2009	SM-3050	9:03	1.2	15.7	6.7	144	93	10.4	105
10/21/2009	SM-3122	9:11	1.0	11.0	6.9	133	87	10.4	94
2/4/2010	SM-3194	9:22	0.5	1.3	6.9	250	163	12.9	92
7/15/2010	SM-3266	9:54	1.1	17.0	6.8	134	86	9.1	96
9/22/2010	SM-3338	9:20	0.6	15.7	7.1	340	221	8.3	83
11/9/2010	SM-3410	9:20	1.1	8.6	6.8	243	158	10.1	86

Table 17 MassDEP SMART 2005-2010. Station NT60A. *In Situ* Multiprobe Data.

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(us/cm)	(mg/l)	(mg/l)	(%)
2/9/2005	**	**	**	**	**	**	**	**	**
4/13/2005	SM-6185	10:58	0.9	7.6	6.2	158	102	11.4	95
6/8/2005	SM-1342	10:45	1.1	19.7	6.4	168	109	7.8	86
8/17/2005	SM-1434	10:40	0.9	21.1	6.6	204	132	7.3	82
10/13/2005	SM-1504	11:15	1.2	12.6	6.1	136	89	9.2	86
1/11/2006	SM-1574	11:13	0.8	1.1	6.3	148	96	13.8	97
3/14/2006	SM-1644	11:00	0.8	4.5	6.4	143	93	12.7	98
5/10/2006	SM-1714	11:08	0.9	12.8	6.5	133	86	9.5	90
7/12/2006	SM-1796	11:15	0.8	21.3	6.4	178	114	5.8	67
9/13/2006	SM-1854	10:36	1.1	14.7	6.5	179	114	6.5	64
11/1/2006	SM-1924	10:50	0.8	8.1	6.1	103	67	10.8	92
2/7/2007	SM-1994	**	**	**	**	**	**	**	**
4/11/2007	SM-2064	10:36	0.8	4.3	6.5	116	75	12.7	98
6/13/2007	SM-2134	10:45	1.0	18.5	6.6	144	94	7.6	81
8/22/2007	SM-2204	10:58	1.0	16.4	6.6	217	141	7.1	73
10/10/2007	SM-2274	10:45	0.8	15.3	6.5	217	141	5.6	56
1/16/2008	SM-2344	10:39	1.0	0.0	6.5	136	88	14.2	97
3/19/2008	SM-2414	10:44	0.5	2.7	6.3	138	90	13.4	98
5/15/2008	SM-2484	11:00	0.7	14.0	6.6	156	101	9.3	90
6/12/2008	SM-2530	10:48	0.9	22.9	6.5	193	125	## i	## i
7/17/2008	SM-2590	10:52	0.7	22.2	6.5	200	130	6.4	74
8/14/2008	SM-2636	10:45	0.8	18.9	6.4	115 u	75 u	8.0	86
9/18/2008	SM-2696	10:39	0.9	16.5	6.5	134	87	8.3	85
11/12/2008	SM-2766	10:53	0.9	7.5	6.6	138	90	10.8	90
2/18/2009	SM-2836	10:42	0.5	0.0	6.5	155	100	14.3	98
4/22/2009	SM-2908	10:12	0.5	8.6	6.4	120	78	11.1	95
6/17/2009	SM-2980	10:33	0.9	15.5	6.3	110	72	9.2	92
9/2/2009	SM-3052	10:09	1.0	16.1	6.4	142	93	9.1	93
10/21/2009	SM-3124	10:18	0.9	7.1	6.6	187	122	10.3	85
2/4/2010	SM-3196	**	**	**	**	**	**	**	**
7/15/2010	SM-3268	10:59	0.9	23.7	6.5	210	135	5.4	65
9/22/2010	SM-3340	10:27	1.0	15.8	6.6	227	148	7.2	73
11/9/2010	SM-3412	10:31	1.0	6.5	6.4	172	112	10.7	87

Table 18 MassDEP SMART 2005-2010. Station NM27. *In Situ* Multiprobe Data.

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(us/cm)	(mg/l)	(mg/l)	(%)
2/9/2005	**	**	**	**	**	**	**	**	**
4/13/2005	SM-6187	12:04	1.0	8.4	6.6	232	151	11.1	95
6/8/2005	SM-1347	12:16	1.0	19.5	6.7	268	174	8.0	87
8/17/2005	SM-1439	11:51	0.8	23.6	7.0	346	225	7.6	90
10/13/2005	SM-1509	12:31	1.2	13.7	6.7	213	139	8.8	85
1/11/2006	SM-1579	12:22	0.9	1.8	6.7	253	164	13.5	97
3/14/2006	SM-1649	12:14	1.0	6.3	6.8	262	171	12.0	98
5/10/2006	SM-1719	12:22	1.1	14.2	6.9	263	171	9.4	92
7/12/2006	SM-1801	12:25	0.9	21.5	6.8	236	151	6.2	71
9/13/2006	SM-1859	11:37	0.9	15.8	7.0	220	140	6.6 u	67 u
11/1/2006	SM-1929	11:47	0.5	8.8	6.7	180	117	10.6	92
2/7/2007	SM-1999	**	**	**	**	**	**	**	**
4/11/2007	SM-2069	11:39	0.9	5.4	6.8	209	136	12.5	99
6/13/2007	SM-2139	11:54	1.0	19.6	6.8	221	144	7.6	83
8/22/2007	SM-2209	12:09	1.0	18.1	7.8	337	219	12.6	133
10/10/2007	SM-2279	11:52	0.9	16.0	7.0	346	225	6.4	65
1/16/2008	SM-2349	11:44	0.4	0.8	6.8	220	143	14.0	98
3/19/2008	SM-2419	11:49	0.6	3.5	6.7	212	138	13.4	100
5/15/2008	SM-2489	12:16	0.4	14.5	6.9	269	175	9.3	91
6/12/2008	SM-2535	12:00	0.7	24.4	7.0	326	212	## i	## i
7/17/2008	SM-2595	11:56	0.7	23.3	7.1	373	243	8.4	99
8/14/2008	SM-2641	11:55	0.8	19.4	6.8	180	117	7.9	86
9/18/2008	SM-2701	11:40	0.7	18.1	6.9	214	139	8.0	85
11/12/2008	SM-2771	12:03	0.8	9.4	7.0	227	148	10.4	91
2/18/2009	SM-2841	11:47	0.4	1.0	6.8	252	164	14.2	100
4/22/2009	SM-2913	11:11	0.4	9.6	6.9	238	154	10.7	94
6/17/2009	SM-2985	11:38	0.9	16.6	6.7	187	121	9.0	93
9/2/2009	SM-3057	11:14	0.9	17.8	6.9	214	139	9.4	99
10/21/2009	SM-3129	11:26	0.9	9.0	7.0	221	144	10.3	89
2/4/2010	SM-3201	**	**	**	**	**	**	**	**
7/15/2010	SM-3273	12:19	0.8	24.8	6.9	301	192	5.5	68
9/22/2010	SM-3345	11:40	0.9	17.0	7.1	435	283	8.7	90
11/9/2010	SM-3417	11:42	1.1	7.6	6.9	266	173	10.7	90

Table 19 MassDEP SMART 2005-2010. Station NM29A. *In Situ* Multiprobe Data.

Date	OWMID	Time	Depth	Temp	pH	Cond@ 25C	TDS	DO	SAT
		(24hr)	(m)	(C)	(SU)	(us/cm)	(mg/l)	(mg/l)	(%)
2/9/2005	SM-6144	11:28	0.7	0.4	7.0	378	246	15.1	104
4/13/2005	SM-6186	11:33	1.0	9.2	6.8	231	150	11.4	100
6/8/2005	SM-1344	11:44	0.7	20.2	6.7	248	161	8.0	88
8/17/2005	SM-1436	11:22	0.5	24.1	6.9	359	234	5.9	70
10/13/2005	SM-1506	11:59	0.9	13.8	6.7	204	132	9.1	88
1/11/2006	SM-1576	11:51	0.8	1.5	6.8	265	172	14.6	104
3/14/2006	SM-1646	11:42	0.7	6.0	6.9	269	175	13.2	106
5/10/2006	SM-1716	11:48	0.6	14.6	7.0	250	163	9.5	94
7/12/2006	SM-1798	11:52	0.7	22.6	6.8	232	148	6.6	77
9/13/2006	SM-1856	11:10	0.6	17.3	6.9	228	146	7.7	81
11/1/2006	SM-1926	11:21	0.7	8.4	6.6	169	110	10.7	91
2/7/2007	SM-1996	10:51	0.4 i	0.4 u	7.0 u	283 u	184 u	14.7 u	102 u
4/11/2007	SM-2066	11:07	0.8	5.4	6.8	206	134	12.6	100
6/13/2007	SM-2136	11:25	0.6	20.0	6.8	212	138	7.2	79
8/22/2007	SM-2206	11:34	0.5	19.1	7.2	277	180	8.7	94
10/10/2007	SM-2276	11:21	0.4	16.8	7.0	366	238	6.5	67
1/16/2008	SM-2346	11:15	0.6	0.5	6.8	231	150	13.7	95
3/19/2008	SM-2416	11:18	0.7	3.6	6.7	212	137	13.3	101
5/15/2008	SM-2486	11:39	0.5	15.0	6.9	255	166	9.7	96
6/12/2008	SM-2532	11:25	0.3	24.3	7.0	328	213	## i	## i
7/17/2008	SM-2592	11:29	0.4	24.6	7.0	314	204	7.2	87
8/14/2008	SM-2638	11:25	0.8	19.5	6.8	186	121	7.4	81
9/18/2008	SM-2698	11:12	0.5	18.7	6.9	207	135	7.7	82
11/12/2008	SM-2768	11:29	0.5	9.8	7.0	222	144	10.0	88
2/18/2009	SM-2838	11:17	0.7	0.8	6.8	252	164	14.3	100
4/22/2009	SM-2910	10:47	0.7	10.5	6.9	252	164	10.4	93
6/17/2009	SM-2982	11:08	0.9	16.7	6.7	180	117	8.5	87
9/2/2009	SM-3054	10:42	0.5	18.5	6.9	211	137	9.2	98
10/21/2009	SM-3126	10:57	0.6	9.0	7.0	219	142	10.4	90
2/4/2010	SM-3198	10:54	0.5	0.2	6.8	257	167	13.1	90
7/15/2010	SM-3270	11:43	0.5	26.0	7.1	354	227	6.4	81
9/22/2010	SM-3342	11:08	0.4	17.8	7.1	339	220	7.9	83
11/9/2010	SM-3414	11:11	0.5	7.4	7.0	253	164	10.6	89

Table 20 MassDEP SMART 2005-2010. Station NN12. Chemistry Data.

Date	OWMID	Time	Alkalinity	Hardness	Chloride	E_coli	Ssolids	Turb	TN	NH3-N	NO3-NO2-N	TPhos
		(24hr)	(mg/l)	(mg/l)	(mg/l)	(MPN/100ml)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/9/2005	SM-1140	9:00	16	40	96	a	2.3	2.0	1.9h	0.66	0.90h	0.055
4/13/2005	SM-1182	9:00	15	32	74	**	2.9	2.1	2.1	0.82	0.39	0.22
6/8/2005	SM-1336	8:45	19	37	77	**	5.1	1.7d	1.6	0.28	0.99	0.064
8/17/2005	SM-1428	8:40	18j	40	82j	**	6.0	3.1	2.3	0.16j	1.7	0.084
10/13/2005	SM-1498	8:50	16	31	60	**	3.8	2.5	1.3	0.05	0.82	0.063
1/11/2006	SM-1568	8:50	15	34	76	**	2.1	1.8h	1.6	0.17	1.1	0.083d
3/14/2006	SM-1638	8:55	13	30	83	**	43	31.0	2.0	0.16	1.0	0.17
5/10/2006	SM-1708	8:55	21d	38	76	**	5.2	3.0h	1.9	0.18	1.3	0.16
7/12/2006	SM-1790	9:00	21	42	77	**	3.8	2.3	2.1	0.07	1.5	0.070
9/13/2006	SM-1848	8:35	**	**	**	**	**	2.2	3.3	0.12	2.8	0.073
11/1/2006	SM-1918	8:45	15	28	55	**	2.6	2.0h	1.3	0.06	0.88	0.055
2/7/2007	SM-1988	8:35	**	41	75	**	2.1	1.1d,h	3.1	1.2	1.7	0.086
4/11/2007	SM-2058	8:35	14	31	64	**	1.9	1.1h	1.3	0.56	0.59	0.030
6/13/2007	SM-2128	8:40	18	30	53	**	4.7	2.3	1.5	0.13	1.1	0.075
8/22/2007	SM-2198	8:40	36	65	99	201	3.8d	2.3	5.4	0.10	4.6	0.31
10/10/2007	SM-2268	8:46	34	59	81	2420	3.9	2.2	5.1	0.11	4.4	0.22
1/16/2008	SM-2338	8:35	13	35	81	299	2.7	1.5h	1.5	0.21	1.0	0.044
3/19/2008	SM-2408	8:35	10	30	67	1050	3.6	1.5	1.1	0.15	0.77	0.051
5/15/2008	SM-2478	8:40	22	38	75	866	4.5	1.5	2.4	1.1	0.97	0.12
6/12/2008	SM-2524	8:35	42	60	95	132d	6.5	2.7	3.8	1.5	1.7	0.48
7/17/2008	SM-2584	8:45	36	67	99	1300	5.5	3.0	4.7	0.12	3.3	0.57
8/14/2008	SM-2630	8:45	**	33	53	1120	11d	4.4d	1.4	0.05	0.90	0.051
9/18/2008	SM-2690	8:35	23	41	61	1410	4.1	2.5	1.8	0.24	1.3a	0.065
11/12/2008	SM-2760	8:45	16	37	58	308	2.3d	1.2	1.8	0.05	1.4	0.068
2/18/2009	SM-2830	8:25	15	41	84	816	5.8	1.5	1.6	0.08	1.2	0.067
4/22/2009	SM-2902	8:25	8	24	46	345	10	2.4	0.71	0.05	0.36	0.056
6/17/2009	SM-2974	8:35	15	28	54	613	6.1	2.4d	1.2	0.08	0.82	0.070
9/2/2009	SM-3046	8:10	24	47	78	387	3.3	2.0	2.4	0.09	1.7	0.060
10/21/2009	SM-3118	8:15	26	45	79	866	3.2	1.9	2.8	0.72	1.6	0.10
2/4/2010	SM-3190	8:20	13	##h	88	461	##d	1.9b,j	1.6	0.09	1.3	0.035
7/15/2010	SM-3262	8:45	31	52	74	816	20	5.5	2.9	0.14	2.1	0.17
9/22/2010	SM-3334	8:25	45	77	110	326	4.0	##d	8.2	0.10	7.4	0.17
11/9/2010	SM-3406	8:18	17	35	57	816d	3.7d	1.4	1.4	0.04	1.1	0.045

Table 21 MassDEP SMART 2005-2010. Station NS19. Chemistry Data.

Date	OWMID	Time	Alkalinity	Hardness	Chloride	E_coli	Ssolids	Turb	TN	NH3-N	NO3-NO2-N	TPhos
		(24hr)	(mg/l)	(mg/l)	(mg/l)	(MPN/100ml)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/9/2005	SM-1142	9:50	19	41	38	**	8.1	2.2	2.4h	0.08	2.0h	0.23
4/13/2005	SM-1184	9:45	9	25	37	**	3.1	1.2	0.92	<0.02	0.57	0.072
6/8/2005	SM-1339	9:25	9	23	34	**	5.0	1.3	0.82	<0.02	0.58	0.039
8/17/2005	SM-1431	9:25	34	40	41	**	3.4	1.6	2.5	0.05	2.1	0.072
10/13/2005	SM-1501	9:35	28	41	37	**	4.1	4.3	2.0	0.16	1.4	0.068
1/11/2006	SM-1571	9:45	10	26	32	**	1.9	0.9h	1.2	0.04	0.97	0.087
3/14/2006	SM-1641	9:42	19	34	44	**	9.2	4.3	2.3	0.08	1.7	0.18
5/10/2006	SM-1711	9:42	21	36	36	**	5.0	2.5h	1.8	0.03	1.4	0.088
7/12/2006	SM-1793	9:55	9	22	32	**	3.5	0.6	0.78	<0.02	0.52	0.040
9/13/2006	SM-1851	9:20	**	**	**	**	**	1.9	0.76	0.02	0.60	0.018
11/1/2006	SM-1921	9:22	24	42	38	**	1.6	1.8h	2.6	0.09	2.2	0.077
2/7/2007	SM-1991	9:15	28	42	38	**	3.6	1.2h	3.2	0.04	2.9	0.30
4/11/2007	SM-2061	9:18	11	21	29	**	2.3	0.7h	0.67	<0.02	0.53	0.050
6/13/2007	SM-2131	9:30	23	48	39	**	2.5	1.6	2.9	0.20	2.4	0.054
8/22/2007	SM-2201	9:30	8	17	22	57	3.5	0.8	0.57	<0.02	0.40	0.018
10/10/2007	SM-2271	9:31	31	40	34	365	1.2	1.3	4.1	0.03	3.8	0.053
1/16/2008	SM-2341	9:20	14	23	29	49	3.2	1.0h	0.87	0.04	0.60	0.077
3/19/2008	SM-2411	9:25	8	21	29	202	1.3	0.8	0.61	0.03	0.42	0.032
5/15/2008	SM-2481	9:35	22	44	47	260	3.0	1.6	2.3	0.27	1.9	0.079
6/12/2008	SM-2527	9:25	42	42	45	260	5.2	2.4	2.8	0.21	2.2	0.092
7/17/2008	SM-2587	9:35	6	19	24	104	7.7	1.5	0.79	0.02	0.54	0.033
8/14/2008	SM-2633	9:25	**	21	24	162	6.6	1.9	0.53	0.02	0.38	0.024
9/18/2008	SM-2693	9:20	27	44	40	155	1.7	1.5	1.5	0.04	1.3a	0.046
11/12/2008	SM-2763	9:35	28	41	38	96	1.7	1.4	2.0	0.04	1.7	0.13
2/18/2009	SM-2833	9:20	9	22	29	14	1.6	0.7	0.73	0.02	0.57	0.051
4/22/2009	SM-2905	9:03	20	38	39	128	3.9	1.7	1.6	0.03	1.3	0.080
6/17/2009	SM-2977	9:15	9	23	32	152	3.9	0.8	0.74	0.02	0.56	0.029
9/2/2009	SM-3049	8:51	8	21	26	129	3.9	0.9	0.61	<0.02	0.39	0.021
10/21/2009	SM-3121	9:00	7	20	26	23	1.9	0.6	0.63	0.02	0.44	0.012
2/4/2010	SM-3193	9:15	19	##h	47	86	2.9d	1.6b,j	2.4	0.10	1.9	0.16
7/15/2010	SM-3265	9:40	7	21	24	387	4.8	1.0	0.87	0.03	0.65	0.029
9/22/2010	SM-3337	9:10	34	52	49	397	1.6	1.5d	6.3	0.03	5.9	0.040
11/9/2010	SM-3409	9:12	25	45	37	291d	1.5	1.5	2.2	0.07	1.8	0.042

Table 22 MassDEP SMART 2005-2010. Station NT60A. Chemistry Data.

Date	OWMID	Time	Alkalinity	Hardness	Chloride	E_coli	Ssolids	Turb	TN	NH3-N	NO3-NO2-N	TPhos
		(24hr)	(mg/l)	(mg/l)	(mg/l)	(MPN/100ml)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/9/2005	**	**	**	**	**	**	**	**	**	**	**	**
4/13/2005	SM-1185	10:50	6	14	36	**	<1.0	0.9	0.54	<0.02	0.30	0.015
6/8/2005	SM-1341	10:34	8	16	37	**	3.0	1.8	0.70	0.03	0.37	0.025
8/17/2005	SM-1433	10:35	9	19	45	**	1.1	1.3	0.67	<0.02	0.41	0.020
10/13/2005	SM-1503	11:05	7	14	29	**	1.3	1.3	0.53	0.03	0.14	0.033
1/11/2006	SM-1573	11:00	7	15	31	**	<1.0	0.7	0.59	0.04	0.49	0.011
3/14/2006	SM-1643	12:45	6	13	31	**	1.7	1.6	0.66	0.05	0.50	0.014
5/10/2006	SM-1713	10:55	6	15	34	**	2.1	1.5	0.58	0.02	0.36	0.018
7/12/2006	SM-1795	11:03	10	19	41	**	3.6	1.8	1.1	<0.02	0.48	0.086
9/13/2006	SM-1853	10:30	**	**	**	**	**	1.8	0.70	0.03	0.47	0.015
11/1/2006	SM-1923	10:36	5	11	21	**	1.3	1.8h	0.43	<0.02	0.14	0.023
2/7/2007	**	**	**	**	**	**	**	**	**	**	**	**
4/11/2007	SM-2063	10:22	5	12	25	**	1.3	0.7h	0.38	<0.02	0.23	0.010
6/13/2007	SM-2133	10:35	10	16	29	**	2.0	1.4	0.64	0.07	0.39	0.023
8/22/2007	SM-2203	10:50	11	22	50	33	1.4	1.2	0.69	0.02	0.41	0.022
10/10/2007	SM-2273	10:35	12	24	47	39	4.5	1.4	0.66	0.03	0.41	0.016
1/16/2008	SM-2343	10:31	5	14	30	10	<1.0	0.6h	0.46	0.03	0.27	0.010
3/19/2008	SM-2413	10:35	8	13	31	3	<1.0	0.5	0.45	0.02	0.35	0.008
5/15/2008	SM-2483	10:50	9	16	34	25	2.0	1.4	0.60	0.03	0.37	0.017
6/12/2008	SM-2529	10:35	8	20	42	55	1.6	1.3	0.68	0.04	0.42	0.020
7/17/2008	SM-2589	10:40	10	22	43	72	1.4	1.3	0.69	0.03	0.37	0.016
8/14/2008	SM-2635	10:33	**	13	22	68	2.8	1.7	0.45	0.02	0.13	0.031
9/18/2008	SM-2695	10:30	7	15	27	86	1.0	1.3	0.53	0.03	0.27a	0.019
11/12/2008	SM-2765	10:35	6	15	30	24	<1.0	1.2	0.46	0.03	0.23	0.015
2/18/2009	SM-2835	10:30	4	16	33	14	<1.0	0.6	0.53	0.04	0.40	0.008
4/22/2009	SM-2907	10:03	3	12	26	108	3.8	1.5	0.36	<0.02	0.12	0.021
6/17/2009	SM-2979	10:25	7	12	23	96	2.0	1.4	0.46	<0.02	0.13	0.025
9/2/2009	SM-3051	10:00	8	16	31	107	1.1	1.6	0.51	<0.02	0.22	0.022
10/21/2009	SM-3123	10:10	8	20	44	16	1.5	1.2	0.60	0.02	0.42	0.012
2/4/2010	SM-3195	**	**	**	**	**	**	**	**	**	**	**
7/15/2010	SM-3267	10:50	12	25	46	37	1.3	1.3	0.54	0.05	0.28	0.016
9/22/2010	SM-3339	10:19	11	24	53	<1	1.9	0.9d	0.57	0.03	0.36	0.011
11/9/2010	SM-3411	10:20	6	20	33	30d	1.0	1.4	0.40	0.02	0.15	0.014

Table 23 MassDEP SMART 2005-2010. Station NM27. Chemistry Data.

Date	OWMID	Time	Alkalinity	Hardness	Chloride	E_coli	Ssolids	Turb	TN	NH3-N	NO3-NO2-N	TPhos
		(24hr)	(mg/l)	(mg/l)	(mg/l)	(MPN/100ml)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/9/2005	SM-1145	**	69	77	44	**	<1.0	<0.10	0.29h	0.14	0.14h	0.051
4/13/2005	SM-1187	11:50	12	29	52	**	1.2	1.7	0.91	0.20	0.37	0.038
6/8/2005	SM-1345	12:08	16	34	57	**	2.5	2.0	1.1	0.09	0.68	0.047
8/17/2005	SM-1437	11:45	21	43	66	**	2.3	1.5	2.0	0.12	1.6	0.060
10/13/2005	SM-1507	12:25	16	29	44	**	2.9	1.8	0.78	0.05	0.37	0.054
1/11/2006	SM-1577	12:15	14	31	52	**	7.7	1.2	1.0	0.09	0.75	0.032
3/14/2006	SM-1647	12:05	17	34	54	**	2.7	1.3	1.2	0.05	0.94	0.043
5/10/2006	SM-1717	12:05	18	37	53	**	2.1	1.7	1.3	0.09	0.82	0.057
7/12/2006	SM-1799	12:10	17	33	44	**	9.5	1.7	1.1	0.05	0.78	0.051
9/13/2006	SM-1857	11:28	**	**	**	**	**	2.0	##r	0.04	0.71	##r
11/1/2006	SM-1927	11:43	14	25	35	**	2.0	2.1	0.86	0.10	0.42	0.038
2/7/2007	**	**	**	**	**	**	**	**	**	**	**	**
4/11/2007	SM-2067	11:25	13	26	45	**	1.4	1.0h	0.88	0.20	0.46	0.030
6/13/2007	SM-2137	11:48	19	34	42	**	1.8	1.7	1.1	0.08	0.63	0.047
8/22/2007	SM-2207	12:01	32	50	63	43	6.7	2.1	1.9	<0.02	1.3	0.038
10/10/2007	SM-2277	11:43	34	50	64	111	<1.0	1.4	1.8	0.08	1.4	0.042
1/16/2008	SM-2347	11:40	12	30	57	88	2.2	1.5h	0.91	0.09	0.58	0.032
3/19/2008	SM-2417	11:40	11	27	50	91	1.5	1.1	0.70	0.05	0.49	0.022
5/15/2008	SM-2487	12:08	19	39	55	30	2.1	1.4	1.1	0.13	0.72	0.043
6/12/2008	SM-2533	11:48	27	45	64	34	1.5	1.4	1.3	0.10	0.89	0.073
7/17/2008	SM-2593	11:50	29	53	74	34	1.4	1.6	1.9	0.04	1.4	0.068
8/14/2008	SM-2639	11:45	**	26	33	397	3.7	2.0	0.76	0.06	0.37	0.047
9/18/2008	SM-2699	11:25	17	33	40	75	1.9	1.4	0.90	0.06	0.61a	0.037
11/12/2008	SM-2769	11:52	18	34	41	55	2.3	1.9	1.1	0.04	0.70	0.043
2/18/2009	SM-2839	11:35	13	33	57	17	1.5	1.1	0.91	0.05	0.70	0.027
4/22/2009	SM-2911	11:01	13	31	52	613	3.9	2.1	0.89	0.07	0.57	0.040
6/17/2009	SM-2983	11:32	13	25	39	172	4.7	2.1	0.74	0.05	0.34	0.058
9/2/2009	SM-3055	11:02	17	31	44	96	1.6	1.6	0.82	0.04	0.52	0.040
10/21/2009	SM-3127	11:17	17	34	46	1410	1.4	1.7	1.1	0.08	0.74	0.029
2/4/2010	SM-3199	**	**	**	**	**	**	**	**	**	**	**
7/15/2010	SM-3271	12:10	24	50	58	56	5.8	2.0	1.8	0.14	1.2	0.074
9/22/2010	SM-3343	11:32	35	66	79	20	<1.0	1.5d	4.8	0.03	4.3	0.035
11/9/2010	SM-3415	11:33	20	38	48	187d	1.7	1.4	1.1	0.04	0.81	0.032

Table 24 MassDEP SMART 2005-2010. Station NM29A. Chemistry Data.

Date	OWMID	Time	Alkalinity	Hardness	Chloride	E_coli	Ssolids	Turb	TN	NH3-N	NO3-NO2-N	TPhos
		(24hr)	(mg/l)	(mg/l)	(mg/l)	(MPN/100ml)	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
2/9/2005	SM-1144	11:25	17	43	80	**	1.6	1.4	1.5h	0.34	0.87h	0.046
4/13/2005	SM-1186	11:30	14	27	51	**	1.7	1.6	0.85	0.15	0.37	0.036
6/8/2005	SM-1343	11:36	19	33	51	**	4.7	1.8	1.0	0.08	0.60	0.051
8/17/2005	SM-1435	11:15	27	47	69	**	1.5	1.2	1.6	0.05	1.2	0.047
10/13/2005	SM-1505	11:50	14	28	40	**	2.4	1.6	0.78	0.06	0.32	0.051
1/11/2006	SM-1575	11:40	13	31	56	**	<1.0	1.1	1.0	0.10	0.74	0.030
3/14/2006	SM-1645	11:30	17	35	55	**	2.4	1.1	1.3	0.04	0.92	0.046
5/10/2006	SM-1715	11:35	17	35	52	**	2.9	1.7	1.1	0.07	0.73	0.057
7/12/2006	SM-1797	11:40	17	32	46	**	2.3	1.6	1.1	0.04	0.70	0.053
9/13/2006	SM-1855	11:00	**	**	**	**	**	1.1	0.93	0.03	0.71	0.032
11/1/2006	SM-1925	11:15	13	22	33	**	2.4	2.3	0.75	0.04	0.34	0.043
2/7/2007	SM-1995	10:40	21	40	54	**	1.4	1.4h	1.6	0.30	1.1	0.048
4/11/2007	SM-2065	11:00	11	27	45	**	1.5	1.1h	0.77	0.12	0.45	0.030
6/13/2007	SM-2135	11:15	19	32	39	**	2.0	1.5	0.97	0.12	0.54	0.051
8/22/2007	SM-2205	11:27	27	42	52	155	4.5	1.7	1.1	<0.02	0.68	0.043
10/10/2007	SM-2275	11:13	35	54	69	72	3.6	1.3	1.9	0.06	1.4	0.048
1/16/2008	SM-2345	11:10	13	28	49	49	1.4	1.4h	0.84	0.07	0.54	0.030
3/19/2008	SM-2415	11:10	11	26	45	21	1.5	1.0	0.71	0.06	0.51	0.019
5/15/2008	SM-2485	11:30	18	37	52	12	1.2	1.4	1.0	0.12	0.59	0.047
6/12/2008	SM-2531	11:20	26	44	65	21	1.9	1.5	1.3	0.08	0.83	0.054
7/17/2008	SM-2591	11:20	27	45	61	32	1.9	1.2	1.1	0.03	0.68	0.048
8/14/2008	SM-2637	11:15	**	27	34	87	3.0	2.8	0.70	0.04	0.34	0.044
9/18/2008	SM-2697	11:05	17	31	39	43	1.4	1.2	0.85	0.06	0.53a	0.039
11/12/2008	SM-2767	11:15	20	34	43	20	2.3	1.6	0.96	0.04	0.65	0.040
2/18/2009	SM-2837	11:05	12	32	55	5	1.8	1.1	0.89	0.06	0.67	0.025
4/22/2009	SM-2909	10:33	16	35	54	167	2.0	1.6	0.86	0.07	0.56	0.039
6/17/2009	SM-2981	11:00	12	24	38	166	3.1	2.1	0.69	0.05	0.31	0.051
9/2/2009	SM-3053	10:33	17	31	43	44	1.2	1.5	0.71	0.04	0.42	0.037
10/21/2009	SM-3125	10:50	16	33	44	45	1.4	1.9	0.97	0.05	0.67	0.030
2/4/2010	SM-3197	10:50	15	##h	55	18	1.0d	1.6b,j	1.1	0.10	0.83	0.027
7/15/2010	SM-3269	11:35	34	55	68	34	1.8	1.2	1.5	0.07	1.0	0.034
9/22/2010	SM-3341	10:57	30	53	62	34	<1.0	0.8d	2.1	0.02	1.6	0.020
11/9/2010	SM-3413	11:03	20	37	46	613d	1.7	1.5	1.2	0.04	0.86	0.032

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