NHDES-R-WD-09-16

2005 Annual Report of Water Use versus Stream Flow on Designated Rivers

September 15, 2009

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Definitions and Acronyms

Affected Water User (or AWU) (Env-Wq 1902.03) means a water user required to be registered under Env-Wr 700, or successor rules Env-Wq 2102, and having a withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its tributary drainage area.

Aggregate Water Use (Env-Wq 1902.04) means the total water use by all Affected Water Users at, and upstream from, any location on a designated river, being the difference between the sum of water withdrawals and the sum of measured registered water returns. Aggregate Water Use is averaged for a month and may not represent withdrawal and return of water conditions during any one day.

cfs means cubic feet per second. One cfs is equal to 7.4814 gallons per second or 448.9 gallons per minute.

cfsm means cubic feet per second of flow per square mile of stream drainage area. This is a means of comparing stream flow per unit area (square miles).

7Q10 means the lowest average flow rate for a 7-day period on an annual basis with an expected recurrence interval of once in every 10 years, determined for a location on a river or stream, and expressed in terms of volume per time period, usually in cfs.

Designated River means a river or river segment that is designated under RSA 483:15.

Destination means:

(1) A location to which water is discharged;

(2) A facility to which water is transferred;

(3) Any water-containing product(s) created by a water user; or

(4) Evaporative losses occurring as a result of water use.

Discharge means a return of water to the environment usually to the subsurface like a septic field or directly to a surface water body by a registered water user. Discharges have WUSD_ID (Water User Source or Discharge Identification Number) like 20057 20057-D01, where the first number (20057) represents the water user's identification number and the second, hyphenated number (20057-D01) represents the water user's discharge location. In this case D01 indicates the first or only discharge location of this facility. Water users may have more than one registered discharge.

Gage means a stream flow measurement station on a river. Stream gages used in this report are operated and maintained by US Geological Survey.

General Standard is a set of quantitative values for assessing aggregate water use at any river location relative to stream flow at that location. The General Standard has four tiers of water use that reflect the assumption that more water is available for use when stream flow is greater. Rivers that are not in compliance are not necessarily impaired or threatened due to flow alteration, but there is sufficient withdrawal relative to monthly mean stream flow to warrant concern and further analysis.

Env-Wq 1903.02 Estimation and Report of Aggregate Water Use and Streamflow.

(c) A designated river shall be not in compliance with the general standard if:

(1) The average monthly aggregate water use exceeds 5 percent of 7Q10 when average monthly streamflow is less than or equal to 0.5 cfsm;

(2) The average monthly aggregate water use exceeds 0.02 cfsm when average monthly streamflow is greater than 0.5 cfsm and less than or equal to 1.0 cfsm;

(3) The average monthly aggregate water use exceeds 0.04 cfsm when average monthly streamflow is greater than 1.0 cfsm and less than or equal to 4 cfsm; or

(4) The average monthly aggregate water use exceeds 0.16 cfsm when average monthly streamflow is greater than 4 cfsm.

Impact Point Use means the incremental water use at a single point on a Designated River. An impact point may be a single surface water withdrawal from the Designated River, the point where groundwater would enter the Designated River if it had not been captured by a well, or the confluence of a tributary where water is being used with the Designated River. Impact Point Use where a tributary enters the Designated River may include water use from several water user sources or withdrawals, and is equal to the sum of these uses.

Protected Instream Flows means flow requirements for a Designated River established by the Commissioner of DES based on an Instream Flow Study conducted under Env-Wq1900 as required by RSA 483 and Laws of 2002, Chapter 278.

Registered water users are described under Env-Wr 700 or successor rules Env-Wq 2102 as water users using more than 140,000 gallons per week during any year. These water users are required to register with DES and to report monthly water use.

Return means the release of water to the environment, as defined in Env-Wq 2102.03. The Instream Flow Rules require that returns assessed in this report be registered (under Env-Wr 700 or successor rules Env-Wq 2102) and measured.

Source means a withdrawal location usually from a well or surface water body. Sources have WUSD_ID (Water User Source or Discharge Identification Number) like 20057 20057-S02, where the first number (20057) represents the water user's identification number and the second, hyphenated number (20057-S02) represents the water user's source of the withdrawal. In this case S02 indicates the second source of this facility. When the first and second numbers do not match, such as 20351 20061-S01, this indicates that water is transferred from the source of the water user identified by the second number to the water user identified by the first number as in the case of a municipal water system delivering water to an institution or factory. Water users may have more than one registered source.

Transfers occur when registered water users have sources or discharges that are controlled by other registered water users, such as a public water supply or waste water treatment facility. Facilities that transfer water from or to AWUs are also considered Affected Water Users. Because they may not have a physical location in the GIS coverage, some transfers may not be identified in this process.

WMPA means Water Management Planning Area, (Env-Wq 1902.16) or the tributary drainage area to a Designated River for which a Water Management Plan is required.

WUSD_ID means Water User Source or Discharge Identification Number. The WUSD_ID is comprised of a paired set of numbers like 20057 20057-D01, where the first number (20057) represents the water user's identification number and the second, hyphenated number represents the water user's source or discharge location. A source identification number uses an "S"; a

discharge ID number uses a “D.” Water transferred to or from one registered user to another would use a different value from the WU ID for the SD ID representing the source (20509 20005-S01) or for a discharge to another registered user (20670 20081-D01).

Withdrawal means removal of water from the environment by means of a well or surface water intake. The Instream Flow Rules require assessment of registered (under Env-Wr 700 or successor rules Env-Wq 2102) withdrawals within 500 feet of a Designated River or on of its tributaries.

2005 Annual Report of Water Use versus Stream Flow on Designated Rivers

I. Introduction

Instream flow is one of the key protection measures provided under RSA 483 the Rivers Management and Protection Act. RSA 483 gives DES the authority and responsibility to maintain flow to support instream public uses in rivers that have been designated by the Legislature for special protection under the Act. In 2002, a broad coalition of New Hampshire business and conservation interests joined together to enact compromise legislation, which became Chapter 278, Laws of 2002 (from House Bill 1449-A) that calls for a pilot program for instream flow protection. With the advice and input of the statewide Rivers Management Advisory Committee (RMAC), DES adopted Env-Wq 1900 known as the Instream Flow Rules (ISFR) effective May 29, 2003. These rules were renamed Env-Wq 1900.

Env-Wq 1903.02 of the ISFR requires annual reporting of water use versus stream flow for the Designated Rivers. Please refer to http://des.nh.gov/organization/commissioner/legal/rules/index.htm to read a copy of these rules. The ISFR require the annual report to include:

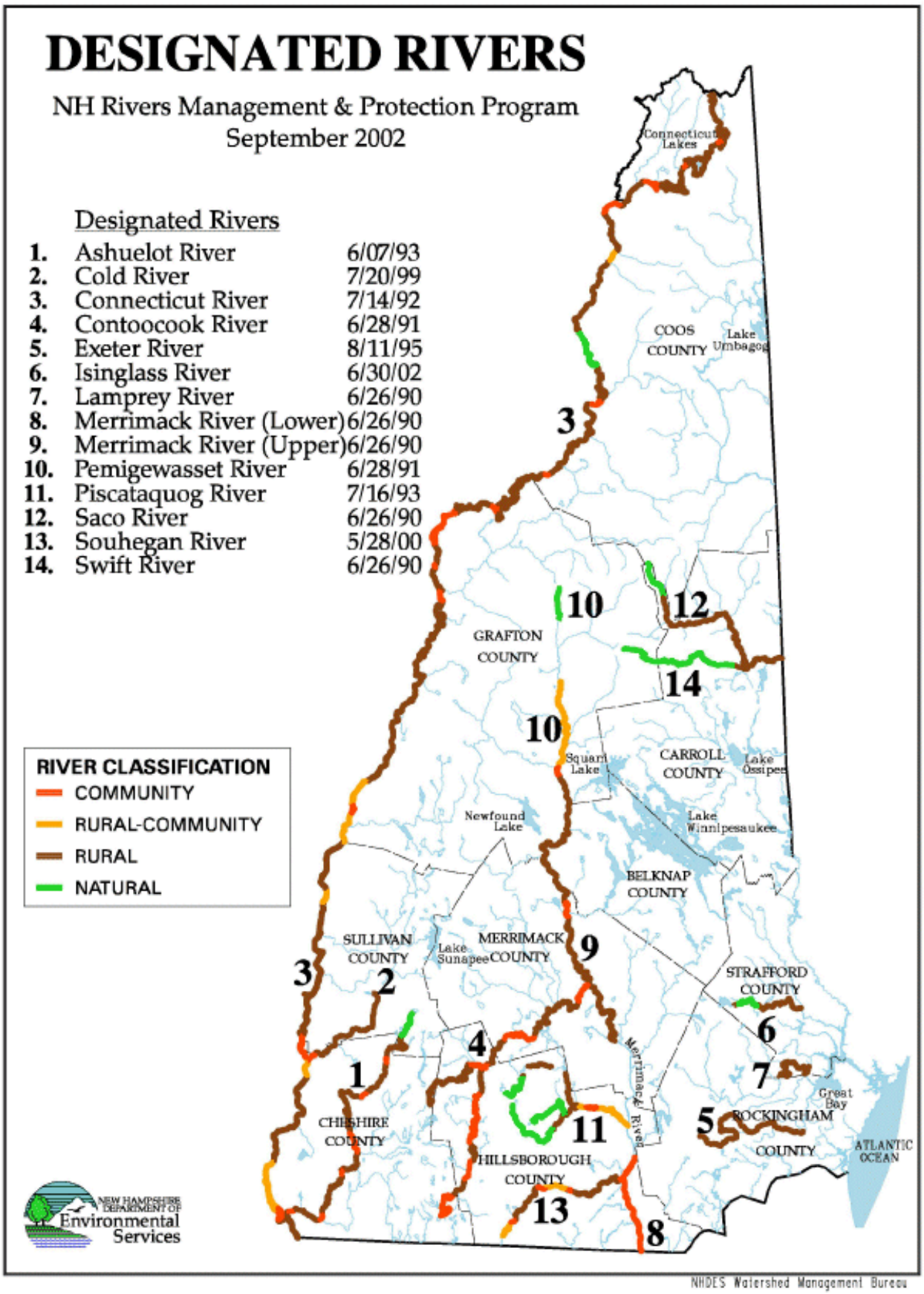
(1) An estimate of water use for each Affected Water User.
(2) An estimate of aggregate water use at each withdrawal or return location.
(3) An estimate of stream flow at each withdrawal or return location.
(4) A record of the month(s) and location(s) not in compliance with the General Standard for Designated Rivers without established Protected Instream Flows under Env-Wq 1905.
(5) A description of the WMPA [Water Management Planning Area] for Designated River(s) that are not in compliance with the General Standard.
(6) For each Designated River with protected instream flows established under Env-Wq 1905, a record of the date(s) and location(s) at which protected instream flows were not maintained.

Fourteen Designated Rivers were defined in the Rivers Management and Protection Act (RSA 483) in 2006 as shown in the map below. Of these 14 rivers, the Contoocook and the Piscataquog include branches that are also Designated River segments resulting in 17 Designated River segments. These branches require individual assessment that must be incorporated into the assessment of the main branch of the Designated River. There was no registered water use on the Middle Branch of the Piscataquog in 2006.

The ISFR require that "each designated river without established protected instream flows under Env-Wq 1905, estimate the month(s) and identify the location(s) not in compliance with the general standard." No protected instream flows were established by 2005, so assessments were made using the General Standard. The General Standard is a reference tool for comparatively evaluating water use on the Designated Rivers. A river is not in compliance with the General Standard, as defined in Env-Wq 1903.02(c), if:

(1) The average monthly aggregate water use exceeds 5 percent of 7Q10 when average monthly stream flow is less than or equal to 0.5 cfsm;

(2) The average monthly aggregate water use exceeds 0.02 cfsm when average monthly stream flow is greater than 0.5 cfsm and less than or equal to 1.0 cfsm;


DESIGNATED RIVERS
NH Rivers Management & Protection Program
September 2002
Designated Rivers
1. Ashuelot River 6/07/93
2. Cold River 7/20/99
3. Connecticut River 7/14/92
4. Contoocook River 6/28/91
5. Exeter River 8/11/95
6. Isinglass River 6/30/02
7. Lamprey River 6/26/90
8. Merrimack River (Lower) 6/26/90
9. Merrimack River (Upper) 6/26/90
10. Pemigewasset River 6/28/91
11. Piscataquog River 7/16/93
12. Saco River 6/26/90
13. Souhegan River 5/28/00
14. Swift River 6/26/90
RIVER CLASSIFICATION
COMMUNITY
RURAL-COMMUNITY
RURAL
NATURAL
Connecticut Lakes
COOS COUNTY
Lake Umbagog
GRAFTON COUNTY
Squam Lake
CARROLL COUNTY
Lake Ossipee
Newfound Lake
Lake Winnipesaukee
BELKNAP COUNTY
SULLIVAN COUNTY
Lake Sunapee
MERRIMACK COUNTY
STRAFFORD COUNTY
Great Bay
ROCKINGHAM COUNTY
ATLANTIC OCEAN
CHESHIRE COUNTY
HILLSBOROUGH COUNTY
Merrimack River
NEW HAMPSHIRE DEPARTMENT OF Environmental Services
NHDES Watershed Management Bureau

(3) The average monthly aggregate water use exceeds 0.04 cfsm when average monthly stream flow is greater than 1.0 cfsm and less than or equal to 4 cfsm; or

(4) The average monthly aggregate water use exceeds 0.16 cfsm when average monthly stream flow is greater than 4 cfsm.

This report includes individual Watershed Management Planning Area (WMPA) reports with the results of the assessment for each of the fourteen Designated Rivers. Each WMPA report identifies the gages used, water users in the WMPA, and includes a narrative description of the times and locations where the General Standard was not met. Each WMPA report includes the following information:

1) **DR WMPA map** showing the Watershed Management Planning Area for the Designated River with locations of stream flow gages and water use sources and discharges.

2) **Table of Water Use** - A listing of monthly water use in cfs by source and discharge for each reporting AWU in the WMPA. These sources and discharges are sorted by the drainage areas of their impact points on the Designated River beginning at the most upstream point.

3) **Table of Aggregate Water Use** - Aggregate water use is estimated by summing all registered upstream water withdrawals (+) and returns (-) at each impact point.

4) **Tables of Estimated Monthly Stream Flow** - Monthly values for stream flow are described as flow per unit of watershed area (cfsm) for the gages used in the assessment.

5) **Table of Estimated Monthly General Standard at Each Impact Point** - The monthly values for the General Standard in cfsm, cfs or both are calculated for each impact point.

6) **Table of Estimated Margin of Aggregate Water Use below the General Standard** - At each impact point and for each month, the difference between the aggregate water use and the General Standard is determined. A negative value indicates that water use exceeds the General Standard at the impact point.

8) **Graphs of incremental and aggregate water use versus the General Standard** - Monthly graphs show the General Standard compared to the water use and aggregate water use at each impact point.

II. Annual and Monthly Climatological Conditions

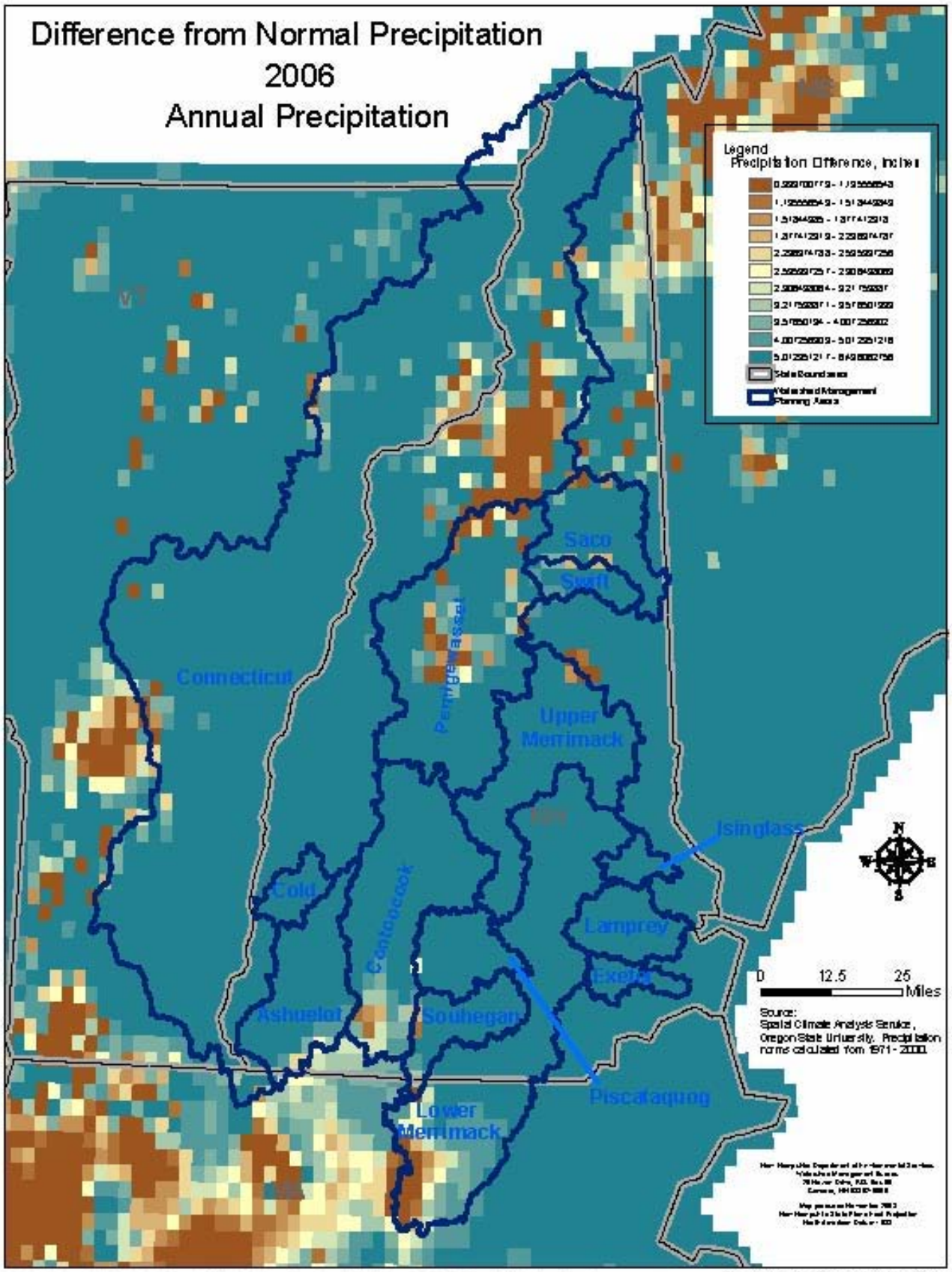
Stream flow and water use are strongly correlated with weather conditions. The table below identifies the deviation from the monthly normal precipitation for each month in 2005. A map of the 2005 departure from the annual average precipitation (1971-2000) is shown in the figure below. Maps of departures from monthly 1971-2000 average precipitation are illustrated in Appendix A. Also shown in the table below is the departure from the normal summer temperatures. This is shown by comparing the normal to the current year's Cooling Degree Days (CDD). A cooling degree day is a unit used to relate the day's temperature to the energy demands of air conditioning. Cooling degree days are calculated by subtracting 65 from a day's average temperature. For example, if the day's high is 90°F and the day's low is 70°F, the day's average is 80°F. Eighty minus 65 is 15 cooling degree days. Cooling degree days can be used to compare the current summer to past summers.

CDD definition source: **www.usatoday.com/weather/resources/askjack/waskdays.htm**

Table 1. Precipitation and temperature departures from normal conditions (1971-2000)

2005	2005 NH precip-itation (inches) *	Normal NH Precipitation (1971-2000) (inches)**	NH 2005 precipitation departure from Normal (inches)	Precip-itation as percent of Normal	2005 CDD Con-cord, NH ***	Concord NH CDD 1971-2000 norms!	2005 departure from 1971-2000 norms
January	2.88	3.42	(0.54)	84%	0	0	0
February	2.59	2.62	(0.03)	99%	0	0	0
March	3.93	3.37	0.56	117%	0	0	0
April	5.59	3.50	2.09	160%	2	2	0
May	5.19	3.76	1.43	138%	0	18	(18)
June	5.1	3.85	1.25	132%	172	82	90
July	4.08	3.94	0.14	104%	189	173	16
August	4.15	3.97	0.18	105%	200	133	67
September	3.63	3.66	(0.03)	99%	49	33	16
October	13.81	3.95	9.86	350%	7	1	6
November	5.55	3.92	1.63	142%	0	0	0
December	4.29	3.45	0.84	124%	0	0	0
Annual	60.79	43.41	17.38	140%	619	442	177

*** 2005 precipitation from National Climatic Data Center - www.ncdc.noaa.gov/oa/climate/research/cag3/nh.html**
**** Normal NH Precipitation (1971-2000) from NOAA's Climate Data Online - http://cdo.ncdc.noaa.gov/climatenormals/clim81/NHnorm.pdf**
***** Concord NH monthly Cooling Degree Days (CDD). Source is www.weather.gov/climate/index.php?wfo=gyx**
! Concord, NH 1971-2000 Normal CDD source: www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html


Difference from Normal Precipitation
2006
Annual Precipitation
Legend
Precipitation Difference, Inches
State Boundaries
Watershed Management Planning Areas
VT
ME
Saco
Swift
Connecticut
Pemigewasset
Upper Merrimack
Isinglass
Cold
Contoocook
Lamprey
Exeter
Ashuelot
Souhegan
Piscataquog
Lower Merrimack
0
12.5
25
Miles
Source:
Spatial Climate Analysis Service, Oregon State University. Precipitation norms calculated from 1971 - 2000.

III. Methods

This assessment compares water use to stream flow conditions. Registered users report water use data to DES on a regular basis. Stream flow data are available from USGS gages on most of the Designated Rivers. The assessment requires aggregating water use at stream locations. The result is a comparison between aggregate water use and some standards for water use, either PISF values or a set of placeholders for the PISF called General Standards.

A. Water Use Estimates

Water use data are available for registered water users from the DES Water Use database. Registration is required under the Water Use Registration and Reporting Rules for water users who use more than 140,000 gallons during a week (>=13.9 gpm on a continuous basis) in any year. Monthly water use data are self-reported by water users to DES either quarterly or annually depending on water use type. DES records these data in the Water Use Database and a data link to DES's GIS coverages is updated periodically. This annual report uses the monthly water use estimates from the database linked to the GIS coverage.

Every effort was made to use reported data including individual queries to the Water Use data base to retrieve late entries for this report however in a number of instances data was not reported for the calendar year. To complete the data set, missing water use data was populated by interpolation from the months before and after the missing point or by using trends or averaged data from previous years' water use reports as seemed most appropriate. The choice of method was based on the most reasonable expectation of water use given DES's understanding of the water use type.

Under the Instream Flow Rules, monthly aggregate water use must be assessed versus average monthly stream flow. Aggregate water use is defined as the total water use by all affected water users at and upstream from any location on a designated river, being the difference between the sum of water withdrawals and the sum of measured, registered water returns. Measured registered water returns exclude water uses such as irrigation, where the intent is for the water to be taken up and used by the plants. Also, excluded are uses where water losses or water return cannot be or is not measured. However, water returns were calculated as equal to the inflow where water use is a pass-through use without expectation of losses such as at a hydroelectric dam.

Water withdrawals and returns may occur directly on the Designated River or on a tributary. Effects of withdrawals and returns were assessed at every impact point on the Designated River. An impact point is where the water use affects the Designated River. A withdrawal or return directly at the Designated River has an impact point at that location. For groundwater withdrawals, the impact point is the point where a surficial flow line from the well meets the Designated River, which is topographically downhill to the stream. This is meant to represent the point where groundwater would enter the river if the well were not withdrawing water. The impact point for water use in a tributary watershed is the confluence of that stream with the Designated River. One or more water users may exist on a tributary resulting in a single impact point for all the upstream water use.

B. Aggregate Water Use Estimates

Water use on the Designated River is aggregated at each impact point and also at each end of the Designated River by finding the difference between the sum of water withdrawals and the sum of measured registered water returns for all upstream sources and discharges. Water use by intermediate users, such as an industry receiving water from a municipal public water supply, are transfers of water. A transfer of water is not aggregated so as not to double count. Transferred water is part of the

withdrawal or return values reported for the source or discharge. The aggregate water use is reported in cfs.

C. Stream Flow Estimates

Monthly stream flows were estimated for the impact points on the Designated Rivers. Monthly stream flows are used to determine the General Standard criteria for each impact point. Stream flows were interpolated or extrapolated from USGS stream flow gages. Stream flow estimates in this report rely on the concept that stream flow will vary uniformly with drainage area. This is not always true especially as one goes to much larger or much smaller drainage areas than the reference data. Stream flow estimates will be most accurate at locations closest to the gage. Future reports are expected to measure stream flow using regression methods to define monthly stream flow at impact points.

Stream Flow Data Source

Monthly mean stream flow values were taken from the USGS website (http://waterdata.usgs.gov/nh/nwis/current/?type=flow). Monthly mean stream flow data in cfs were downloaded from the USGS gages' web pages then imported to Excel worksheets. Daily average flows are used to calculate monthly mean flows when monthly data have not been posted.

Gages are first selected from the active, total record stream gages on a Designated River. Partial record gages may be used where no total record gages are available. Partial record gages may not be well calibrated for measuring low flows because generally their main use is measurement of high flows. Where gages on the Designated River were not available, surrogate gages within the Water Management Planning Area were used, or as a final resort, gages in other similar watersheds were used where no gages were active in the Water Management Planning Area.

Where a surrogate gage was necessary, gages were identified that are within watersheds similar to the watersheds of the ungaged Water Management Planning Area. Drainage basin size, elevation, and location were used as the criteria to identify a set of possible surrogate gages. Surrogate gages were used in two ways. One way was to compare the surrogate gage's flow to a historically active gage in the WMPA using linear regression. The regression equation was then used to create data for the historical data location using this year's stream flow data from the surrogate gage. The second use was to use the surrogate gage directly with compensation for drainage basin size. The gages used for the 14 Designated Rivers are identified in Table 2 below.

In some cases, there is more than a single gage measuring the Designated River. Stream flow at each water user location between gages is prorated based on the proportion of watershed area so that the closest gage factors most heavily. On occasions, such as at the confluence of the Winnipesaukee River with the Upper Merrimack Designated River, data from gages on a tributary was used to assist in defining the stream flow assessment.

Table 2. Gages used for estimating stream flow for each Designated River

Ashuelot

01158000	ASHUELOT RIVER BELOW SURRY MT DAM, NEAR KEENE, NH
01160350	ASHUELOT RIVER AT WEST SWANZEY, NH
01161000	ASHUELOT RIVER AT HINSDALE, NH

Cold

Surrogate station at

01154000	SAXTONS RIVER AT SAXTONS RIVER, VT

Connecticut

01129200	CONNECTICUT R BELOW INDIAN STREAM NR PITTSBURG, NH
01129500	CONNECTICUT RIVER AT NORTH STRATFORD, NH
01131500	CONNECTICUT RIVER NEAR DALTON, NH
01138500	CONNECTICUT RIVER AT WELLS RIVER, VT
01144500	CONNECTICUT RIVER AT WEST LEBANON, NH
01154500	CONNECTICUT RIVER AT NORTH WALPOLE, NH

Contoocook

01085500	CONTOOCOOK R BL HOPKINTON DAM AT W HOPKINTON, NH
01086000	WARNER RIVER AT DAVISVILLE, NH
01087850	CONTOOCOOK RIVER AT RIVER HILL, NEAR PENACOOK, NH

Exeter

1073587	EXETER RIVER AT HAIGH ROAD, NEAR BRENTWOOD, NH

Isinglass

01072870	ISINGLASS R AT ROCHESTER NECK RD, NR DOVER, NH

Lamprey

01073500	LAMPREY RIVER NEAR NEWMARKET, NH

Merrimack (Lower)

01092000	MERRIMACK R NR GOFFS FALLS, BELOW MANCHESTER, NH

Merrimack (Upper)

01081500	MERRIMACK RIVER AT FRANKLIN JUNCTION, NH

Pemigewasset

01075000	PEMIGEWASSET RIVER AT WOODSTOCK, NH
01076500	PEMIGEWASSET RIVER AT PLYMOUTH, NH
01081000	WINNIPESAUKEE RIVER AT TILTON, NH

Piscataquog
Surrogate stations at

01094000	SOUHEGAN RIVER AT MERRIMACK, NH
01082000	CONTOOCOOK RIVER AT PETERBOROUGH, NH
01085500	CONTOOCOOK R BL HOPKINTON DAM AT W HOPKINTON, NH

Saco

01064500	SACO RIVER NEAR CONWAY, NH

Souhegan

01094000	SOUHEGAN RIVER AT MERRIMACK, NH

Swift

1064500	SACO RIVER NEAR CONWAY, NH

Monthly Stream Flow Data Processing

Monthly mean stream flows were estimated using data obtained from the USGS web pages. Where no active gages were identified in the Water Management Planning Area, such as for the Cold River, surrogate data from other gages were used. The Cold River gage is inactive. A surrogate data set was created from a nearby gage on the Saxton River in Vermont. These gages have similar basin size, elevation, and location. They also have 38 years of contemporaneous data collection. Monthly average flows for each gage were paired for the period when both gages were active. A comparison of flows was then conducted by running a linear regression on monthly average flows for the gages' mutually active period to calculate slope and intercept values. Monthly average stream flows for the inactive gage on the Cold River were then estimated using the monthly averages from the surrogate gage calculated with the regression equation. Where no historical gage was available for regression, data from a surrogate gage was adopted from nearby watersheds. The surrogate stream flow was usually averaged from at least two gages, which was converted to a cfsm value and then applied to the target river.

Stream flow at each impact point is determined by areal transposition methods. Monthly average stream flows in cubic feet per second at a gage were converted to cfsm by dividing the monthly stream flow by the gage's drainage area in square miles. The drainage areas of each impact point can then be multiplied by this flow value to yield the average monthly stream flow at each location. Between two gages, where more than a single gage might apply to an impact point, interpolation of the stream flow at each gage is used. The watershed area between the two gages is measured and the ratio of that area above and below the impact point is used as the ratio of the monthly stream flow used from each gage.

$$AMS_{(ip)} = \left\{\left(\left[1-\left(\left[DA_{(ip)}-DA_{(ug)}\right] / \left[DA_{(dg)}-DA_{(ug)}\right]\right)\right]*AMS_{(ug)}\right) + \left(\left[1-\left(\left[DA(dg)-DA(ip)\right] / \left[DA(dg)-DA_{(ug)}\right]\right)\right]*AMS_{(dg)}\right)\right\}* DA_{(ip)}$$

Where:
$AMS_{(ip)}$ = average monthly stream flow at an impact point between gages
$DA_{(ip)}$ = drainage area of the impact point in square miles
$DA_{(ug)}$ = drainage area of the upstream gage in square miles
$DA_{(dg)}$ = drainage area of the downstream gage in square miles
$AMS_{(ug)}$ = average monthly stream flow of the upstream gage in cfsm;
$AMS_{(dg)}$ = average monthly stream flow of the downstream gage in cfsm

D. General Standard Determination

The General Standard is a quantitative way to evaluate water use among streams of different sizes and characteristics. After the rivers have protected flows established for them, water use will be assessed based on the protected flows instead of the General Standard. The General Standard is not a Protected Instream Flow, but instead is a set of standardized criteria for evaluating water use in watersheds where a protected flow has not yet been established. Monthly water use is compared to the General Standard. General Standard criteria are derived from monthly stream flow per unit area. When stream flow is high, the General Standard for water use is greater. The General Standard is reduced as stream flow declines. When aggregate water use exceeds the General Standard, the stream segment is not in compliance with the General Standard. The General Standard acts as a means of assessing water use versus stream flow that is comparable on all the Designated Rivers. Rivers that are not in compliance are the highest priorities for developing protected instream flows.

The four water use criteria in the General Standard are expressed as values in cfsm making these values drainage basin-size dependent. To calculate the General Standard for the impact points in the watershed, the monthly stream flow at a gage location is converted to cfsm by dividing the flow by the gage's drainage area. Stream flow in cfsm for each impact point is then compared to the four tiers of the General Standard as described in Env-Wq 1903.02 (c) of the Instream Flow Rules, which are listed above.

The General Standard usually increases linearly with increasing watershed area because of the linear interpolation/extrapolation method used to calculate stream flows. It is interesting to note that in rivers with more than one gage, the General Standard can decrease with increasing watershed area. This is the result of flows at a gage that do not increase proportionally relative to the size of the drainage basin during these months, that is, unit flows (cfsm) for this section of the river were lower than they were upstream.

The General Standard should not be interpolated between gages. This would result in hybridized General Standard values in those cases where the General Standard varied between the two gages. Instead stream flow must be interpolated for the impact point using the method above and the General Standard is then defined based on this value.

The General Standard includes a reference to 7Q10 in the lowest of the water availability criteria. The stream flow statistic known as 7Q10 represents the flow that is the lowest 7-day average flow with a statistical recurrence interval of 10 years. Values for each gage were usually taken from values derived by USGS for gages with sufficient periods of record. These data and the USGS methods can be found at http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/studies.htm. Additional values were taken from USGS WRI 02-4298, "Development of Regression Equations to Estimate Flow Durations and Low-Flow-Frequency Statistics in New Hampshire Streams." In some cases, a value for 7Q10 was averaged from nearby gages.

E. Comparison of Aggregate Water Use with the General Standard

The Aggregate Water Use and the General Standard criteria are determined at each impact point on the Designated River. At the locations and months that the Aggregate Water Use exceeds the General Standard criteria, the river is not in compliance with the General Standard. These locations and times are identified in the individual river reports for each WMPA. Graphs for each month show the General Standard with the impact point water use and with the aggregate water use for all water users upstream of

the impact point. The General Standard criteria increase with increasing stream flow, therefore the graph shows the General Standard criteria increasing in the downstream direction as estimated stream flow increases.

IV. Summary of Results

Summary of 2005 Water Use versus General Standard for NH Designated Rivers

The 2005 assessment is the third annual assessment of water use versus stream flow under New Hampshire's Instream Flow Program. For 2005, DES identified 490 registered sources and 153 registered, measured discharges that were included in this report (totals do not include water transfers). Highlighted values in the table below are the totals for the entire WMPA including other Designated Rivers as tributaries. A total of 56 sources and two discharges were not part of the assessment.

Table 3. Designated River WMPA summary of water users for 2005

WMPA	Drainage Area (square miles)	AWU Registered Sources in the WMPA	AWU Registered Measured Returns in the WMPA	Hydropower facilities registered as AWUs in the WMPA
Ashuelot	422	27	12	4
Cold	102	1	0	0
Connecticut (other than Ashuelot+Cold)		125	51	21
Connecticut (with Ashuelot+Cold)	6740	153	63	25
Pemigewasset	1023	51	16	8
Contoocook (North Branch)	121	3	2	2
Contoocook (Main stem)	764	63	24	16
Contoocook	764	66	26	18
Upper Merrimack (other than Pemigewasset + Contoocook)	643	62	16	6
Upper Merrimack (with Pemigewasset + Contoocook)	2430	179	58	32
Piscataquog (South Br. with Middle Br.)	180	2	0	0
Piscataquog (North Br.)	76	1	0	0
Piscataquog (main stem without branches)	39	5	3	3
Piscataquog (main stem and branches)	218	8	3	3
Souhegan	220	21	7	4
Lower Merrimack (other than DR tribs.)	1178	75	19	7
Lower Merrimack (with Souhegan, Piscataquog, upper Merrimack and Pemigewasset)	4046	283	87	46
Swift	114	5	0	0
Saco (other than Swift)	311	20	2	0
Saco	425	25	2	0
Exeter	88	8	0	0
Isinglass	74	4	0	0
Lamprey	212	16	1	0
Totals		489	153	71

Future annual assessments for the Designated Rivers will use the rivers' Protected Instream Flow values when they are established. For 2005, no Protected Instream Flow values had been established so all assessments were done using the General Standard. The Contoocook and Piscataquog Designated Rivers include separate branches, which were assessed individually. The fourteen Designated Rivers have seventeen segments because of these branches. Eight of the seventeen Designated River segments were in compliance with the General Standard for the entire year. Aggregate Water Use exceeded the

General Standard criteria in the remaining nine Designated River segments. August and September were the months most commonly exceeded (8 times each). The Isinglass River was not in compliance during any month in 2005. The Contoocook (mainstem) was not in compliance for ten months in 2005.

Table 4. Non-Compliance with the General Standard in 2005

Designated River Name	River Mile-Months not in Compliance with the General Standard*	Months Not In Compliance with the General Standard
Isinglass	134.4	All months
Contoocook (mainstem)	81.1	All months except April and October
Exeter	57.6	August, September
Souhegan	48.2	July, August, September
Lamprey	21.2	August, September
Piscataquog (SB and main stem)	19.6	August, September
Ashuelot	17.4	August, September
Contoocook (North Branch)	1.4	September
Piscataquog (NB)	0.1	August
Cold	0	None
Connecticut	0	None
Merrimack (Lower)	0	None
Merrimack (Upper)	0	None
Pemigewasset	0	None
Piscataquog (Middle Branch)	0	None
Swift	0	None
Saco	0	None
* The sum of the products of the river miles not in compliance with the General Standard and the number of months those miles were not in compliance.		

The General Standard is an assessment and illustration tool to compare basins of different sizes using normalizing criteria. It is not considered to be a protected flow for the river. Lack of compliance with the General Standard is not a violation. Monthly stream flow and water use used in these assessments may not illustrate acute impacts occurring for shorter durations. Because of the averaging affect of assessing water use and stream flows with monthly values, conditions resulting from shorter duration low flows or high intensity water use may not be observable.