Appendix A

Conservation Plans

Lamprey River Water Management Plan

August 2013

CONSERVATION PLAN

Epping Water Works (#20045)

Introduction

Conservation plans under the Instream Flow Program (Env-Wq 1900) require meeting the conservation measures and best management practices in the Department of Environmental Services (DES) Water Conservation Rules (Env-Wq 2101). Use of these measures and practices as a standard will provide a common level of effort by all water users.

Epping Water Works provides drinking water to the residents and businesses located in the Town of Epping, New Hampshire. The active sources for the Town's water supply are four ground water wells located within the drainage of the Lamprey Designated River.

As part of the permitting of a new water supply source, Epping Water Works prepared a proposed Water Conservation Plan (dated December 1, 2010) which was reviewed and was approved February 3, 2011 by the DES Drinking Water and Groundwater Bureau (see attachment). This Conservation Plan applies to the entire Epping Water Works service area.

Water Source and Uses

The Epping Water Works water supply has five registered water supply wells located in Epping; four that are currently in use (20045-S02; 20045-S03; 20045-S04 and 20045-S05) and one that has been abandoned (20045-S01) and is not expected to be reactivated for future use. The Hoar Pond Well 1 (20045-S02) and the Hoar Pond Well 2 (20045-S04) are active bedrock wells located north of Hoar Pond and east of Beniah Lane. The Fremont Road Well (20045-S03), an active bedrock well, and Well #1 (20045-S01), an inactive gravel packed well, are located south of Fremont Road (aka Jenness Road) near an unnamed tributary to the Piscassic River. Figure 1 depicts the locations of these withdrawals with respect to the Lamprey River (Note: 20045-S99 was the former designation for the combined S01 and S02 wells.) The fifth well, Hoar Pond Well No. 3 (20045-S05), was developed in bedrock in the vicinity of Hoar Pond. Well use was reported beginning March 2012. 20045-S05 is not yet included in the GIS coverages, but would be located on the map near 20045-S04 and 20045-S02.

The three active Hoar Pond wells are located in the watershed of a Lamprey tributary upstream of the Designated River; therefore the drainage area of the impact point of those wells on the Designated River is equal to the drainage area at the head of the Designated River, which is 152.5 sq. mi. The one active Fremont Road Well is located in the drainage of the Piscassic River; therefore the drainage area of the impact point of that well is equal to the drainage area at the confluence of the Piscassic River and the Designated River, which is 211.4 sq. mi.

The analysis of induced recharge for these three bedrock wells (DES 2009a) indicates that the Fremont Road well may induce recharge from surface water at average and maximum pumping rates. The analysis of the two older wells located near Hoar Pond, Hoar Pond Wells 1 and 2, did not indicate induced recharge from the Pond, although the pumping of these wells may intercept groundwater that would otherwise recharge Hoar Pond. The same conditions are expected to apply to the newer bedrock well – Hoar Pond Well 3. Note that the methods used to evaluate induced recharge apply to sand and gravel wells and are not ideal for evaluating wells in bedrock.

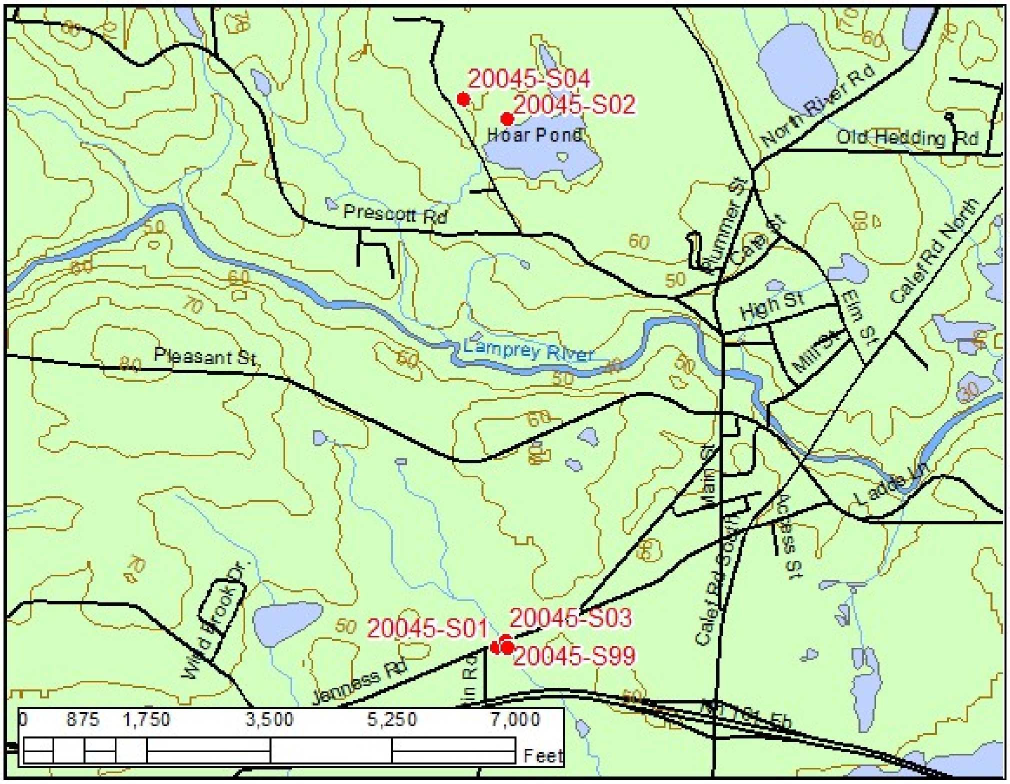

Figure 1 - Location map of Epping Water Works water supply wells.

Water Use Patterns

The groundwater withdrawn from the four active wells is the water supply for the residents and businesses in the Town of Epping. The well pumping rates of the wells are variable. The Hoar Pond wells are permitted for 185 gallons per minute (gpm). The pumping capacity of the Freemont Well is about 40 gpm. The pumping schedules and rates are set by the operators and the wells activate when they are needed to maintain the water levels in the two storage tanks that have a combined capacity of 500,000 gallons. The wells are metered and monthly water use is reported quarterly to DES.

Water use data for 1992 through 2012 are summarized in the tables and figures below. The Epping Water Works monthly water withdrawal data for the years of 1989 through 2013 were obtained from DES Water Use Reporting database. The water use records for 1989 through 1991, and for 2013, were incomplete so they were not included in the annual use summaries. Annual water use was converted from thousands of gallons to cubic feet per second (cfs) and cubic feet per square mile of drainage area (cfsm) to make comparisons with stream flow values in the Lamprey Designated River.

The system's highest annual use during the period 1992-2012 was 51.94 million gallons (1999); the lowest annual use was 32.45 million gallons (1992) (Figure 2 and Table 1). The average annual use was 41.06 million gallons. Between 1992 and 2012 annual water use increased by 18.73 million gallons or 37 percent. This represents an average increase of 0.937 million gallons per year for the 21 year period of record. Annual system water use increased from 1991 to 1999, then decreased and stabilized in the early 2000s, and has been on an increasing trend through 2012.

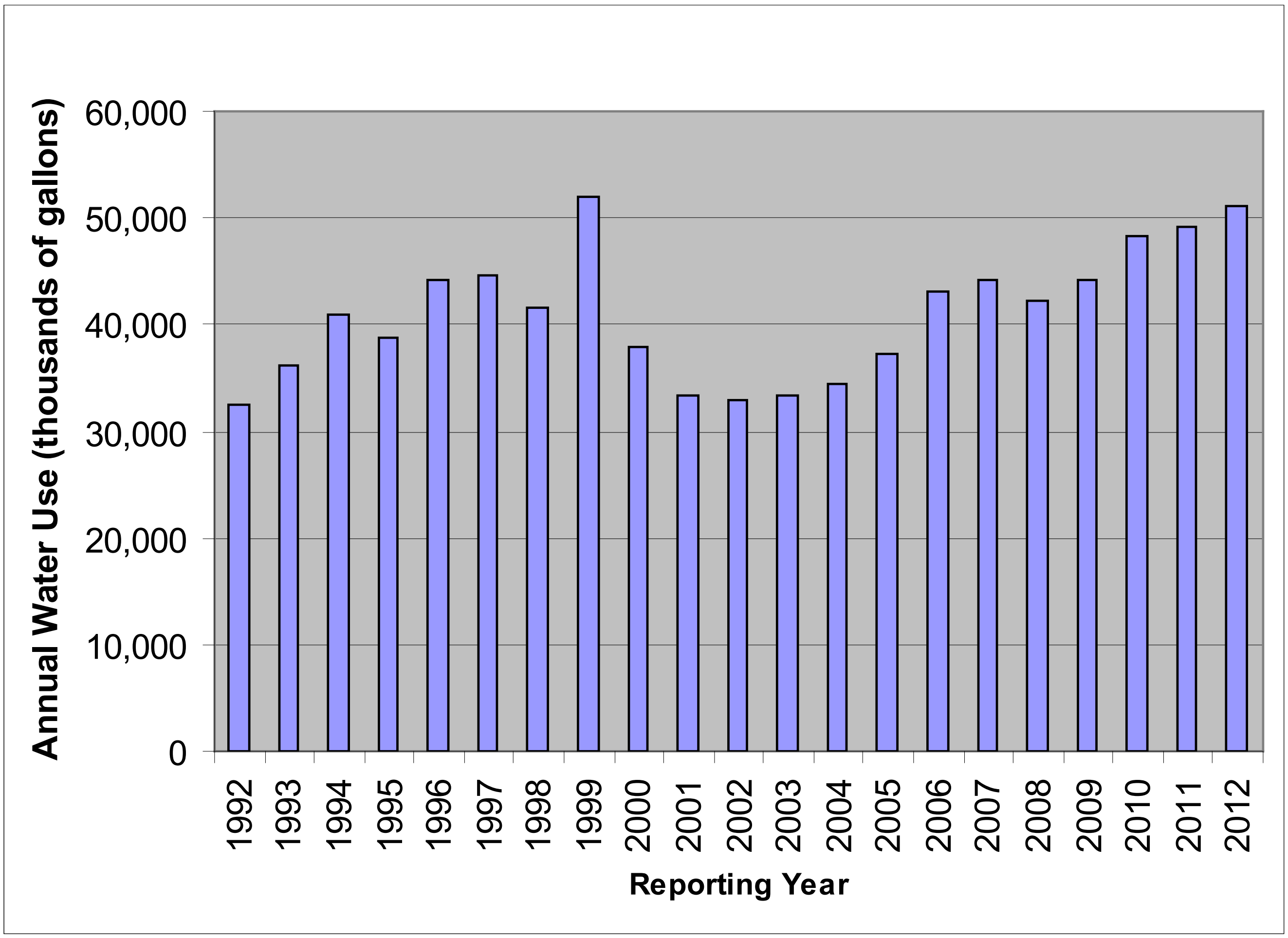

Figure 2 - Epping Water Works Annual Water Use

Table 1 - Epping Water Works Annual Water Use Statistics (1992 through 2012)

	Low	High	Average
Thousands of Gallons	32,452	51,937	41,060
cfs	0.1376	0.2202	0.1741
cfsm at Packers Falls Gage	0.00075	0.00120	0.00095

Of the annual water use at each of Epping's water sources, the greatest annual withdrawals were once from the Fremont Road Well, but since 1999 withdrawals from that well have decreased significantly and withdrawals have increased at the Hoar Pond wells (Figures 3 through 5). The transition to the Hoar Pond wells was due to decreased yield at the Fremont Road Well and better water quality in the Hoar Pond wells. During the transition, water withdrawals from Well #1 (20045-S01) were used beginning in June and July of 1997, followed by near continuous use during 1998 and 1999. Withdrawals from Well #1 stopped after July 2000.

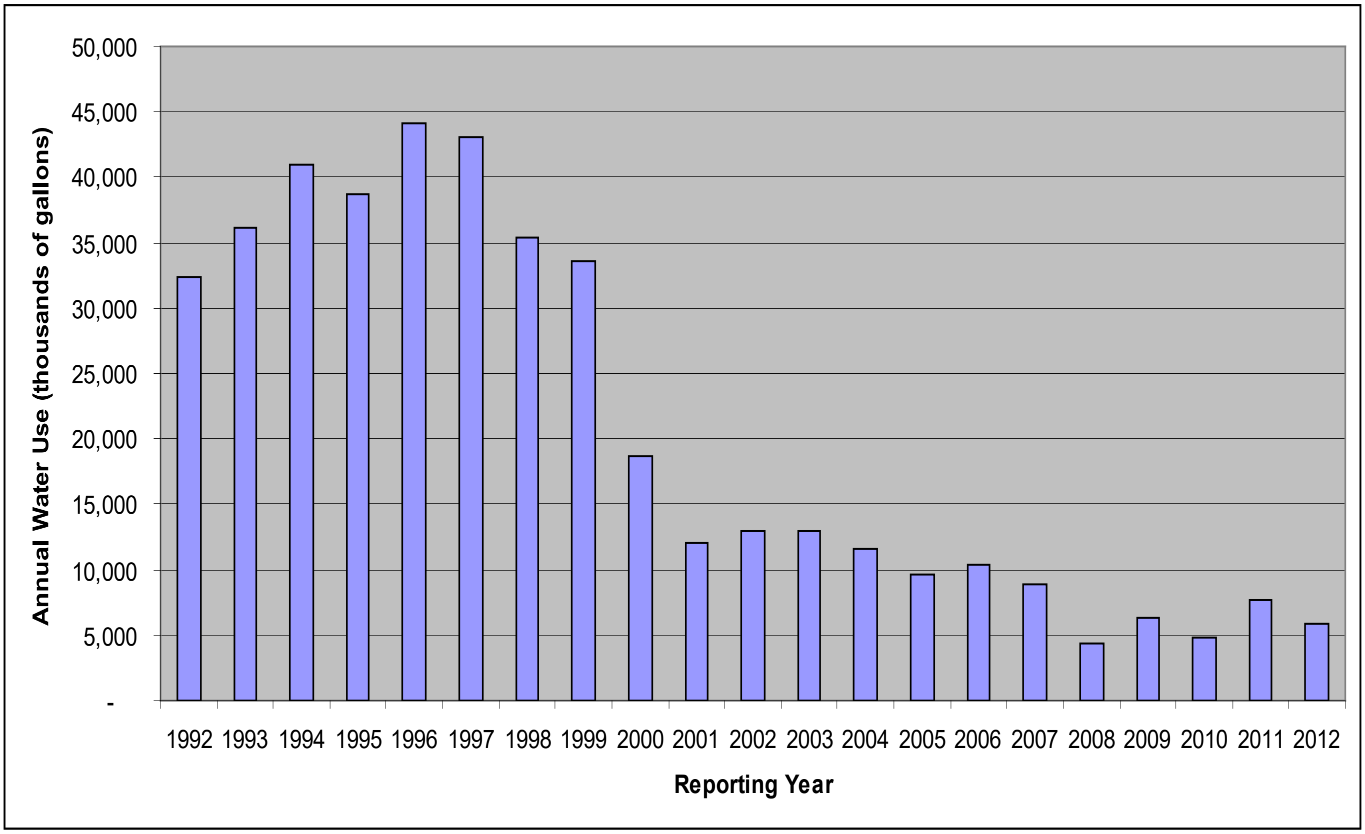

Figure 3 - EPPING WATER WORKS - FREMONT ROAD WELL (20045-S03) Annual Water Use

Table 2 - Epping Water Works - Fremont Road Well - Annual Water Use Statistics (1992 through 2012)

	Low	High	Average
Thousands of Gallons	4,394	44,135	20,501
cfs	0.0186	0.1871	0.0869
cfsm at Packers Falls Gage	0.00010	0.00102	0.00047

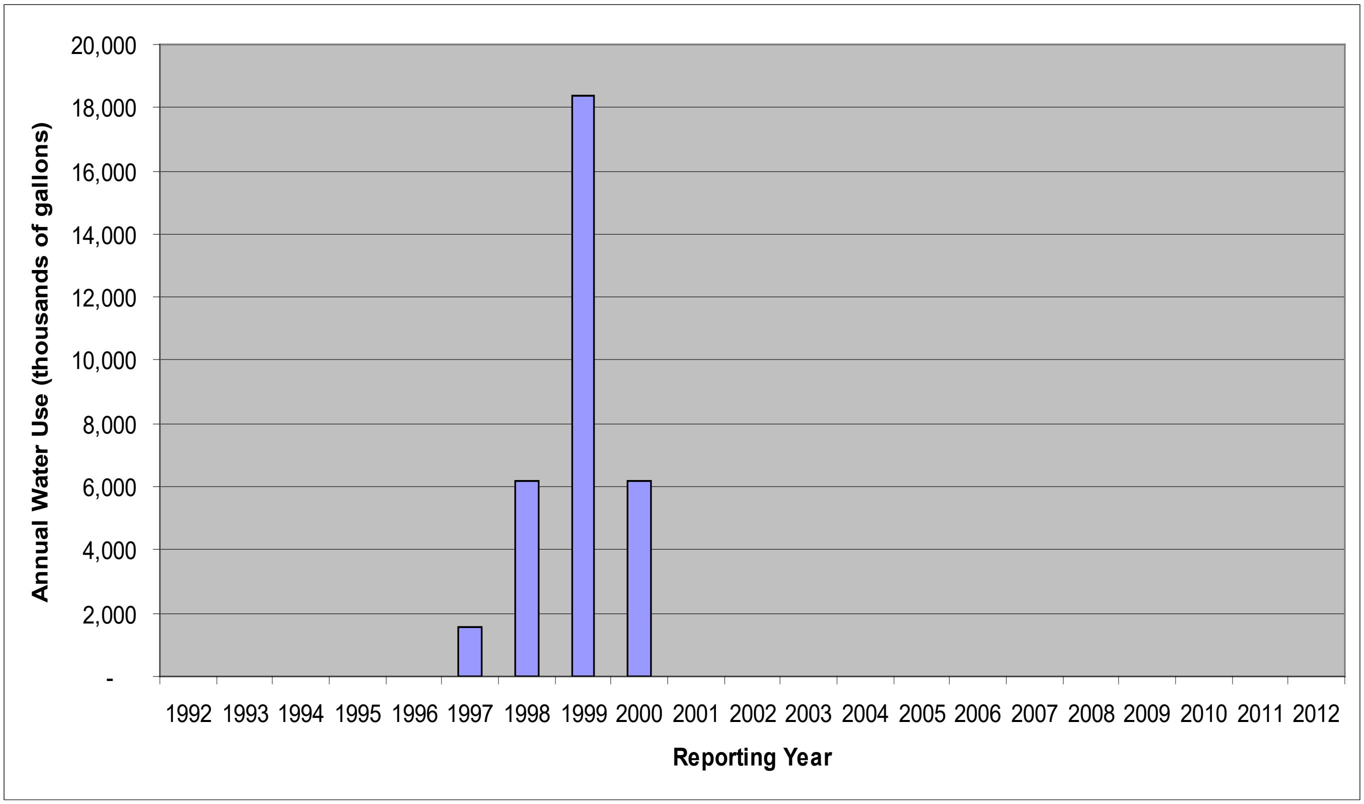

Figure 4 - EPPING WATER WORKS - WELL #1 (20045-S01) - Annual Water Use

Table 3 - Epping Water Works - Well #1 - Annual Water Use (1998-1999)

	Low	High	Average
Thousands of Gallons	6,175	18,359	12,267
cfs	0.0262	0.0778	0.0520
cfsm at Packers Falls Gage	0.00014	0.00043	0.00028

Hoar Pond Well 1 began reported water use in May 2000. Water use has been on a declining trend since that time (Figure 5 and Table 4). Hoar Pond Well 2 began reporting water use in June 2004. Water use increased annually from Hoar Pond Well 2 until 2011. Hoar Pond Well 3 (20045-S05) has been in use since March 2012 (Figure 6 and Table 5). There are insufficient data to describe annual water use at Hoar Pond Well 3. For the one year period from March 2012 through February 2013, total water use from this source was 18.170 million gallons.

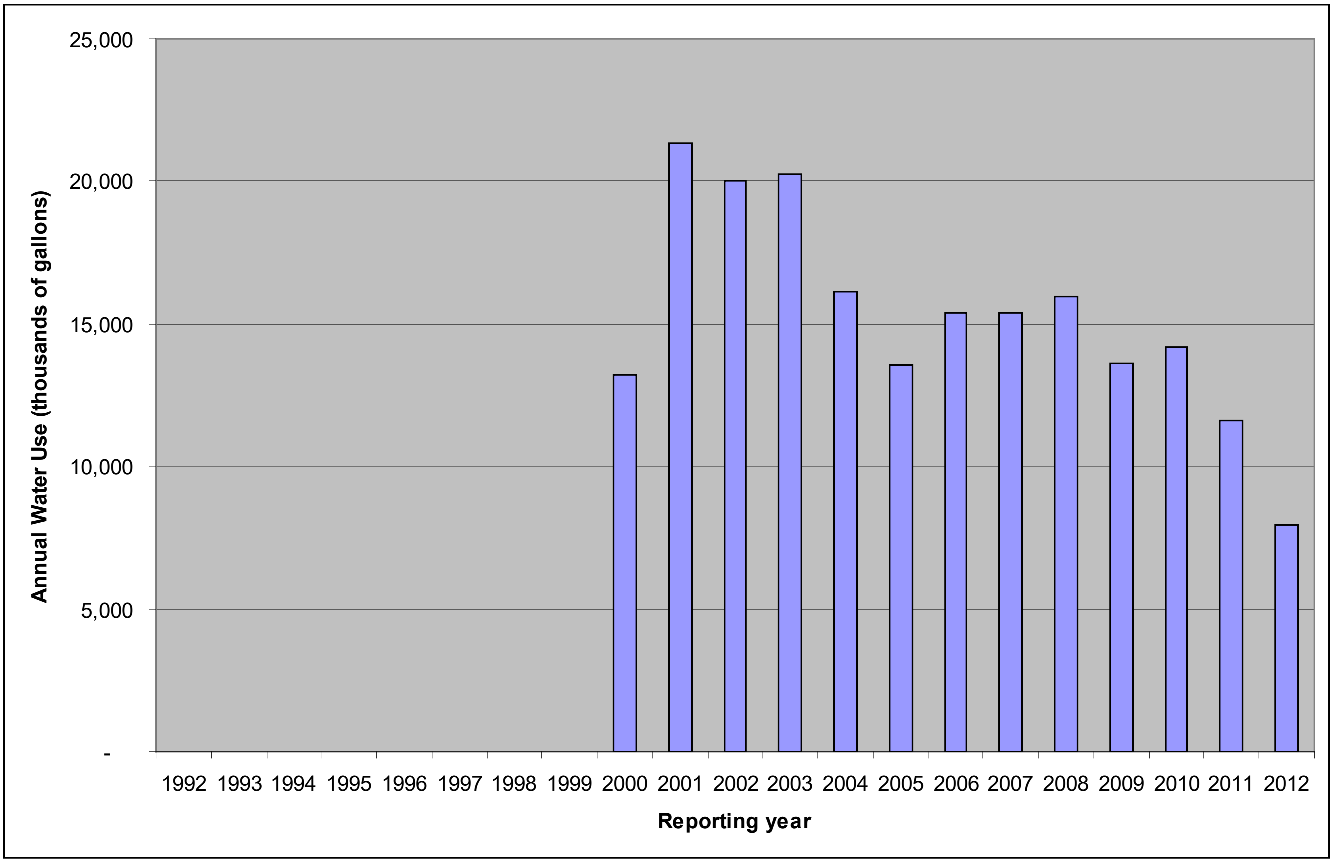

Figure 5 - EPPING WATER WORKS - HOAR POND WELL 1 - Annual Water Use (2000 includes only May through December use)

Table 4 - Epping Water Works - Hoar Pond Well 1 - Annual Water Use Statistics (2001 - 2012)

	Low	High	Average
Thousands of Gallons	7,965	21,342	15,461
cfs	0.0338	0.0905	0.0655
cfsm at Packers Falls Gage	0.00018	0.00049	0.00036

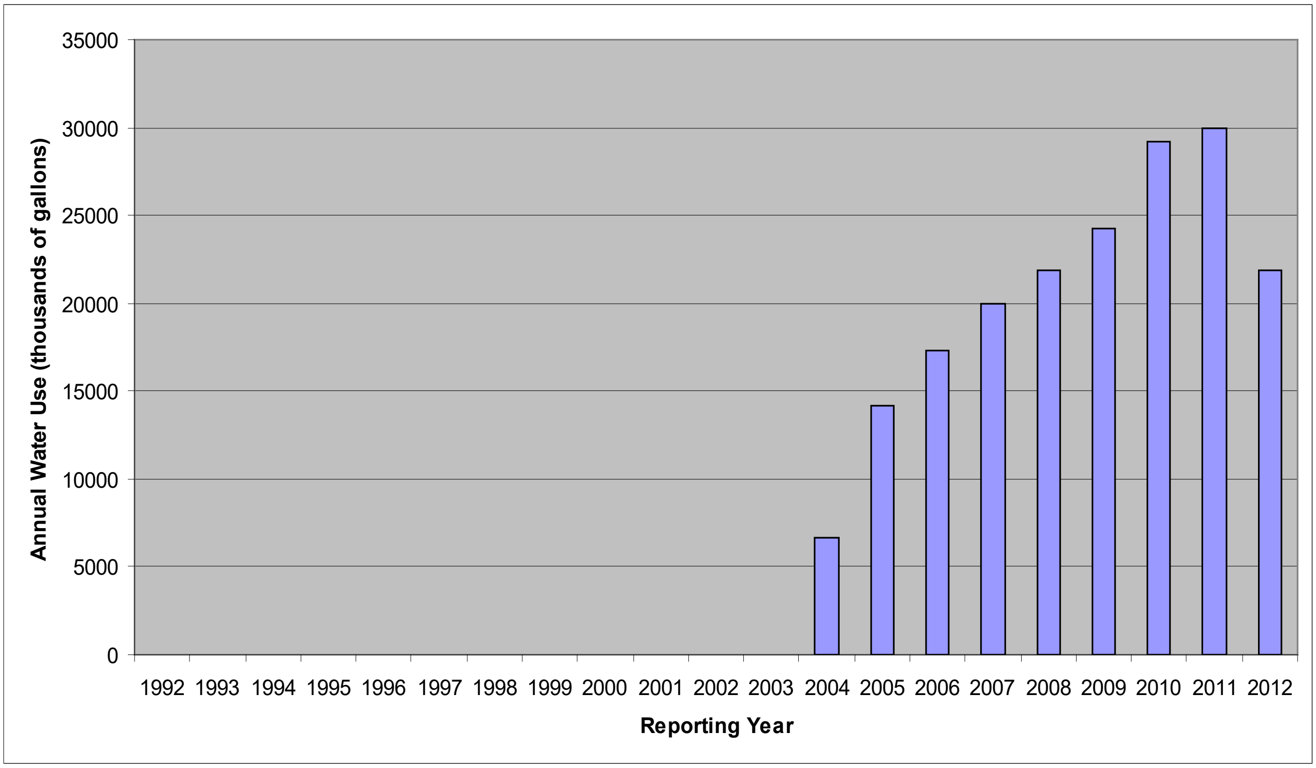

Figure 6 - EPPING WATER WORKS - HOAR POND WELL 2 (20045-S04) - Annual Water Use (2004 includes only June through December)

Table 5 - Epping Water Works - Hoar Pond Well 2 - Annual Water Use Statistics (2005 through 2012)

	Low	High	Average
Thousands of Gallons	14,177	29,958	22,334
cfs	0.0601	0.1270	0.0947
cfsm at Packers Falls Gage	0.00033	0.00069	0.00052

The monthly water use records for the Epping Water Works system begin in January 1989. Complete annual records are available from 1992. Monthly statistics were calculated for data from only complete years of record during periods of active use unless otherwise noted. The monthly water use data were converted to cubic feet per second by dividing the monthly values by days and multiplying them by a flow unit conversion factor. Based on these converted values, daily water use by the Epping Water Works has ranged from a minimum of 0.125 cfs (80,621 gallons per day, November 1989) to a maximum of 0.250 cfs (161,526 gallons per day), with an average use of 0.174 cfs (112,493 gallons per day) for the period of 1992 to 2012 (Figure 7 and Table 6).

Monthly water use varies in response to weather conditions and changes in seasonal demand. For the Epping system, the average monthly water usage was highest during summer and lowest during winter. This seasonal pattern reflects the general pattern of increased outdoor water usage (lawn irrigation, garden watering, vehicle washing, etc.) during the summer months, which declines during the fall, remains low during the winter, and begins to increase again in the spring. The highest monthly water use was 5.07 million gallons in July 2011, and the lowest total monthly use was 2.34 million gallons in February 1992. The average monthly use from 1992 through 2012 was 3.42 million gallons.

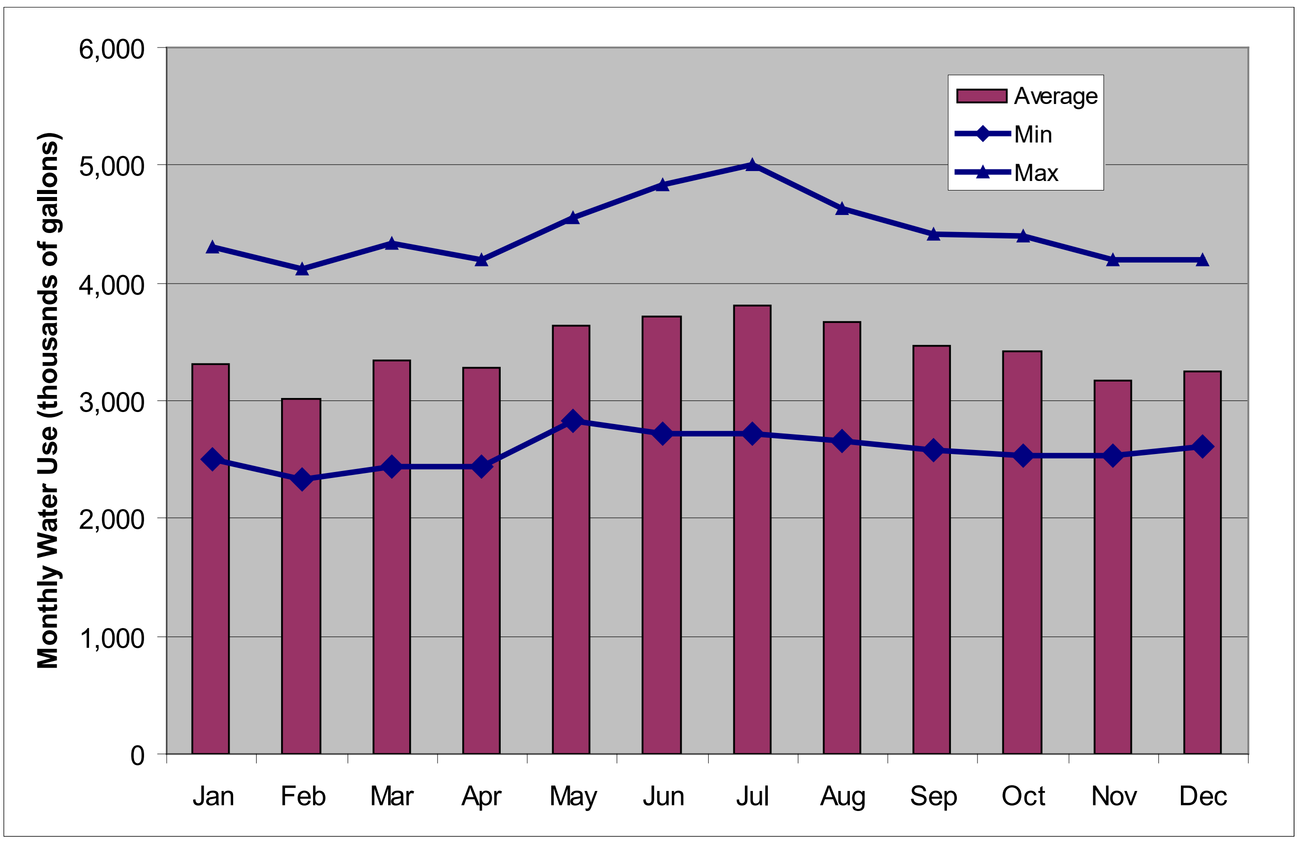

Figure 7 - EPPING WATER WORKS (20045) - Monthly Water Use (1992-2012)

Table 6 - Epping Water Works - Monthly Water Use Statistics (1992-2012)

	Low	High	Average
Thousands of Gallons	2,338	5,007	3,422
cfs	0.1189	0.2547	0.1741
cfsm at Packers Falls Gage	0.00065	0.00139	0.00095

Figures 8 through 10 and tables 7 through 9, below, show water use statistics (average, minimum and maximum) for the monthly water use from Epping Water Works individual sources. Well #1 is not presented because its record is short and inclusion would show little of interest. Hoar Pond Well 3, which began pumping March 2012, is shown despite its short record as an indication of possible rates of future water use.

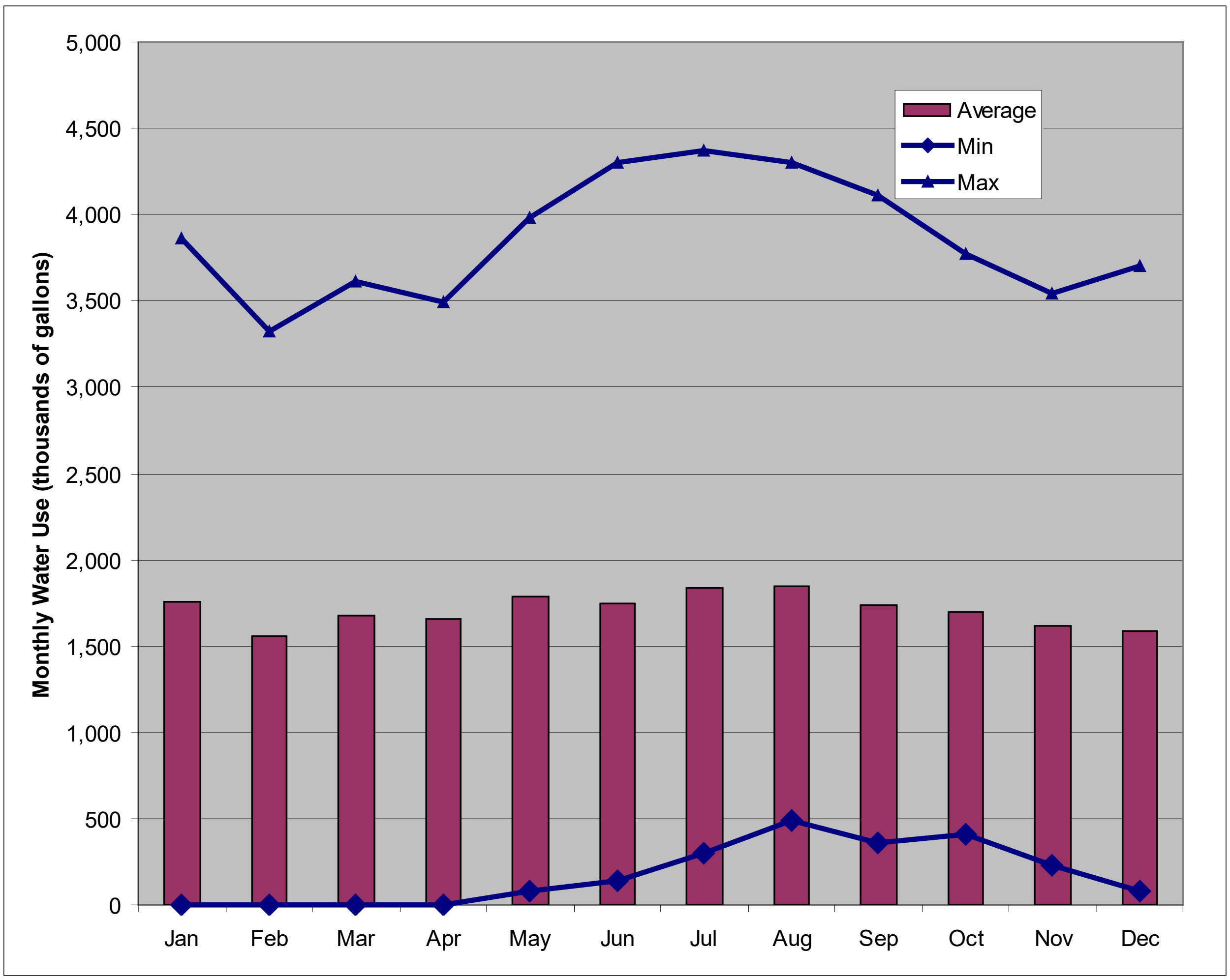

Figure 8 - EPPING WATER WORKS - FREMONT ROAD WELL - Monthly Water Use (1992-2012)

Table 7 – Epping WW - Fremont Road Well - Monthly Water Use Statistics (1992-2012)

	Low	High	Average
Thousands of Gallons	-	44,135	20,501
cfs	-	0.1871	0.0869
cfsm at Packers Falls Gage	0.00000	0.00102	0.00047

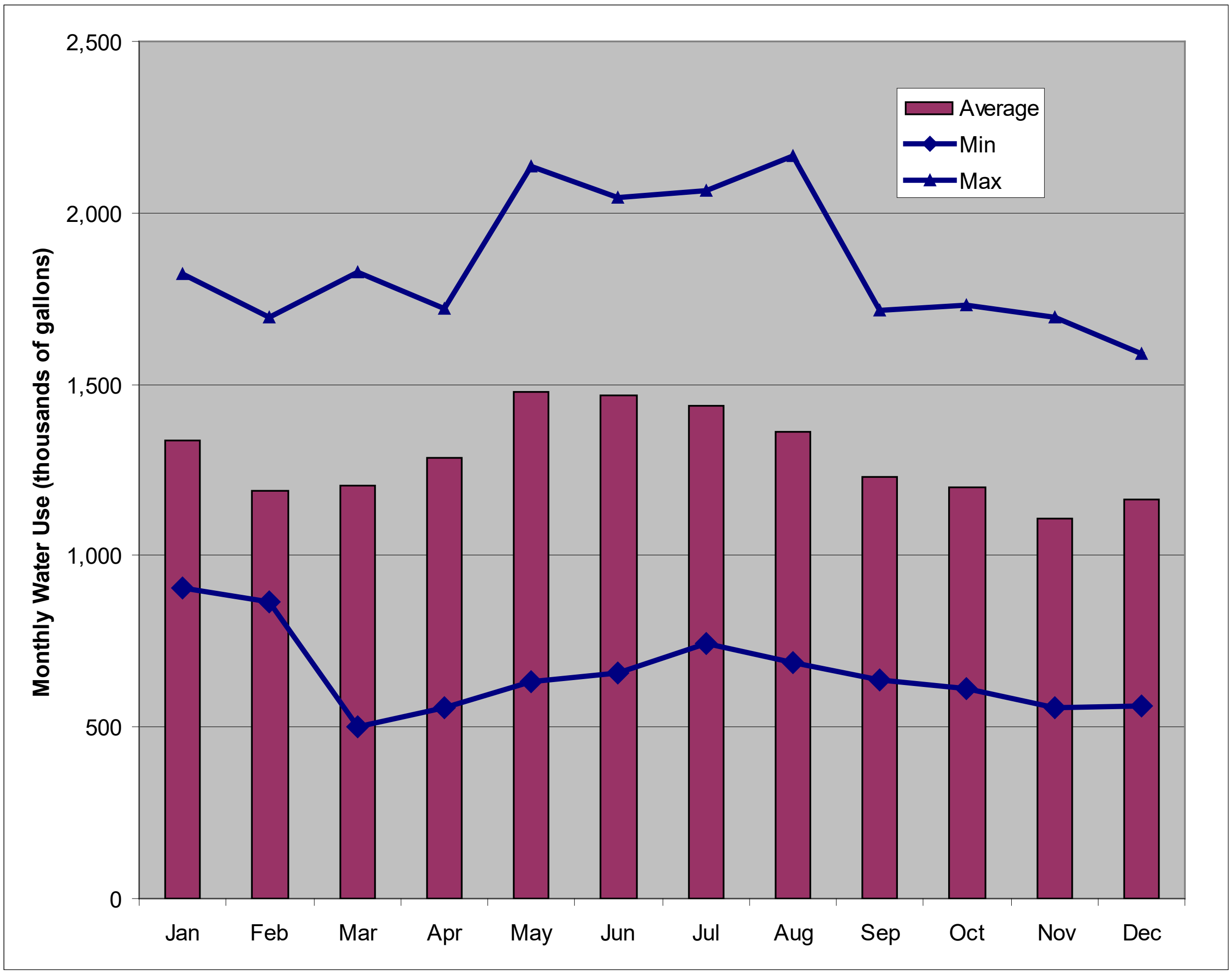

Figure 9 - EPPING WATER WORKS - HOAR POND WELL 1 (20045-S02) Monthly Water Use (2001-2012)

Table 8 - Epping WW - Hoar Pond Well 1 - Monthly Water Use Statistics (2001-2012)

	Low	High	Average
Thousands of Gallons	499	2,166	1,288
Cfs	0.0254	0.1102	0.0655
cfsm at Packers Falls Gage	0.00014	0.00060	0.00036

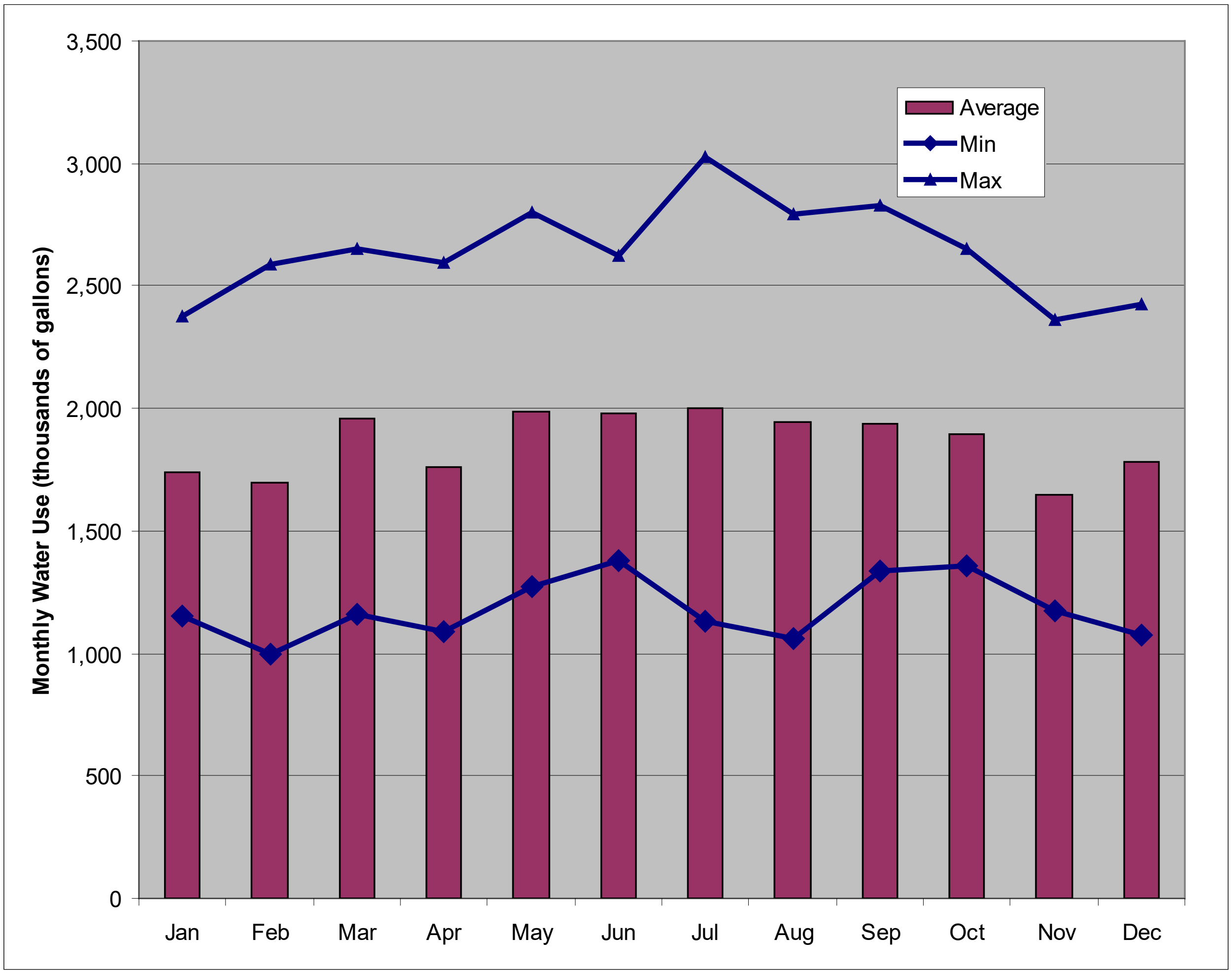

Figure 10 - EPPING WATER WORKS - HOAR POND WELL 2 (20045-S04) Monthly Water Use (2005-2012)

Table 9 - Epping WW - Hoar Pond Well 2 – Monthly Water Use Statistics (2005-2012)

	Low	High	Average
Thousands of Gallons	997	3,028	1,861
cfs	0.0507	0.1540	0.0947
cfsm at Packers Falls Gage	0.00028	0.00084	0.00052

Env-Wq 2101 Requirements for Water Conservation Plans

Development and approval of a water conservation plan that meets the Water Conservation Rules requirements will satisfy the Conservation Plan requirements under the Instream Flow Rules. The Conservation Rules require different activities depending on the type of water use. Conservation plans for public water supplies require inclusion of the following components:

- Installation, maintenance, and use of appropriately selected meters;

- Maintaining low levels of unaccounted-for water;
- Performing water audits to assess losses;
- A comprehensive plan for leak detection surveys of the distribution system;
- System pressure reduction where necessary;
- A water conservation educational outreach initiative;
- Adopting a rate structure that promotes water conservation; and,
- On-going water conservation compliance reporting.

So long as Epping Water Works is in compliance with their Water Conservation Plan through DES Groundwater and Drinking Water Bureau, they are meeting the water conservation plan requirements of the Instream Flow Program.

Existing Water Conservation Measures

Epping Water Works submitted a proposed Water Conservation Plan in 2010 to DES's Drinking Water and Groundwater Bureau in support of its permit application for the development of the new Hoar Pond Well No. 3. A revised version of the Water Conservation Plan (Geosphere Environmental Management, Inc. 2010) was approved by DES February 3, 2011 under Env-Wq-2101. The approved Water Conservation Plan meets the requirements for a water conservation plan under the Instream Flow Program.

The approved Water Conservation Plan documents the water conservation measures employed by Epping Water Works and how its operations meet the water conservation requirements for existing Large Community Water Systems pursuant to Env-Wq 2101. A copy of the revised Water Conservation Plan is included as an attachment to this document and some of the features of the approved Water Conservation Plan are described below.

All public sector water users, private water users and the water sources are metered. The meters are sized in accordance with the specifications of the manufacturer. The meters were selected, installed and are maintained in accordance with the procedures and protocols described in "Manual of Water Supply Practices Water Meters – Selection, Installation, Testing, and Maintenance" (AWWA 1999). The water meters at the Hoar Pond wells have been calibrated each year, while the commercial and residential water meters had not been tested or calibrated as of 2010. The public and private water user meters are read on a quarterly basis, while the water source meters are read on a daily basis.

A leak detection survey and water audit was performed in 2004 and no leaks were detected at that time. The water distribution system was also independently assessed for unaccounted losses by the Granite State Rural Water Association, that same year, and determined net losses to be less than five percent of total production. Epping estimated that in 2009 unaccounted-for water represented 9 percent of the water distributed (44 million gallons pumped versus 40 million gallons of metered water use). Beginning in 2011, Epping proposed to implement a program to check for leaks within the distribution system, which will involve a 20 percent system leak detection check per year. As a result, every five years the complete distribution system will have been surveyed for leaks. The first three year compliance report is due in 2014.

As noted in the Water Conservation Plan (Geosphere Environmental Management, Inc. 2010) the water system has pressures of 70 pounds per sq. inch (psi) and lower. The recommended working range for water pressure is 60 to 80 psi. A reduction in water pressure below the present values may reduce the ability to provide flow for fire suppression in certain areas of the system.

Epping Water Works charges its residential and commercial customers a flat rate for water use, with commercial customers paying a slightly higher rate. It also charges a quarterly fee, which is applied to every 50,000 gallons used. Water users consuming more than 50,000 gallons per quarter pay a higher total amount based on their water use. The Town of Epping also requires low flow fixtures for new homes and businesses, and it requires that any new irrigation systems be designed by a certified installer and approved by the Water and Sewer Commission.

The Epping Board of Water Commissioners actively performs public outreach to educate water users on water conservation issues. These efforts include discussion of water conservation issues at its meetings and the posting of notices in the local newspaper. Conservation issues are also discussed during the monthly televised water and sewer commission meeting. Water conservation educational materials are occasionally included in the bills sent to water users quarterly.

Water Conservation Alternatives and Costs

The approval of the attached Water Conservation Plan (Geosphere Environmental Management, Inc. 2010) by the DES Drinking Water and Groundwater Bureau meets the Instream Flow Program's Conservation Plan requirements. The Water Conservation Plan will be administered by the Drinking Water and Groundwater Bureau under its existing authority or the authority of the Instream Flow Program. A Water Conservation Plan was required for the development of a new water source and so there are no additional costs attributed to the Lamprey River Water Management Plan.

Conservation Implementation Schedule

The Town will continue to implement its Water Conservation Plan (Geosphere Environmental Management, Inc., February 3, 2011). The first three-year compliance report from Epping to the DES Drinking Water and Groundwater Bureau is due in 2014.

Water User Contact Information

Water User: Epping Water Works
Address: 157 Main Street, Epping, NH 03042
Contact: Dennis Koch, Water and Sewer Administrator
Phone: 679-5441 ext. 108
Email: waterandsewer@townofepping.com

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers.

Env-Wq 2101 Water Conservation Rules, adopted 5/12/05.

American Water Works Association. 1999. Water Meters – Selection, Installation, Testing and Maintenance. AWWA Manual M6, Fourth Edition.

Department of Environmental Services (DES) 2009a. Effects of Well Withdrawal Impacts on Lamprey Stream Flow. NHDES-R-WD-09-5. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire.

Department of Environmental Services (DES) 2009b. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Geosphere Environmental Management, Inc. 2010. Revised Water Conservation Plan for Town of Epping Water and Sewer Department. Dated December 1, 2010.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. completed by Dennis Koch, Epping Water Works.

Personal communication with Dennis Koch, Epping Water Works.

Personal communication with Norm Dionne, Epping Water Works.

Water use reports on file with the Department of Environmental Services (DES).

Attachment

Revised Water Conservation Plan
Town of Epping Water and Sewer Department

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Avenue, Exeter, NH 03833
tel: 603-773-0075 *fax*: 603-773-0077
www.geospherenh.com

MEMORANDUM OF TRANSMITTAL

DATE: 12/1/2010
PROJECT: 08204

TO: Mr. Derek Bennett
NHDES-DWGB
P.O. Box 95
Concord, NH 03302

RE: Town of Epping Water and Sewer Dept.
Revised Water Conservation Plan
Hoar Pond Well No. 3
Epping, NH

CC: Dennis Koch, Town of Epping Water and Sewer Dept., 157 Main St., Epping, NH 03042
Cliff Sinnott, Rockingham Planning Commission, 156 Water St., Exeter, NH 03833
Karen Falcone, Epping Board of Selectmen, Town Hall 157 Main St., Epping, NH 03042

ENCLOSED – THE FOLLOWING:

COPIES	DATE	DESCRIPTION
1	12/1/2010	Revised Proposed Water Conservation Plan Epping Water and Sewer Department

REMARKS:

Enclosed please find the Revised Proposed Water Conservation Plan for the Epping Water and Sewer Department. This enclosure has been sent to the Rockingham Planning Commission and the Epping Board of Selectmen via certified mail. Return receipts will be forward to you when returned. A copy was also sent to the Epping Water and Sewer Department. Please feel free to contact me with any questions.

Abigail Thompson
Submitted By

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.

December 1, 2010

Derek S. Bennett
Water Use and Conservation
Drinking Water and Groundwater Bureau
New Hampshire Department of Environmental Services
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Re: Revised Proposed Water Conservation Plan
Town of Epping Water and Sewer Department

Dear Mr. Bennett:

Geosphere Environmental Management, Inc. (GEOSPHERE) on behalf of the Epping Water and Sewer Department has prepared this Revised Proposed Water Conservation Plan for the proposed Large Groundwater Withdrawal identified as Hoar Pond Well No. 3 (*Attachment A*). A previous Proposed Water Conservation Plan was submitted to the New Hampshire Department of Environmental Services on November 7th, 2008. This submittal has been prepared to clarify actions currently taken or proposed to be implemented by the Epping Water and Sewer Department in accordance with the New Hampshire Department of Environmental Services (NHDES) Administrative Rules (rules) Env-Ws 390.05 and the subsequent Env-Wq 2101.05 Water Conservation Rules – Requirements for Existing Large Community Water Systems.

As required by Env-Wq 2101.11, a copy of the Revised Proposed Conservation Plan and the NH DES prepared summary of Env-Wq 2101 rules (*Attachment B*) has be sent via certified mail to the governing board of the Town of Epping and the Rockingham Regional Planning Commission for review and to promote water conservation practices within the service area and neighboring towns of the new water system.

Sincerely,
GEOSPHERE ENVIRONMENTAL MANAGEMENT, INC.

Raymond W. Talkington, Ph.D., P.G., LSP
Principal Hydrogeologist

Abigail Thompson
Project Hydrogeologist

Cc: Karen Falcone, Epping Board of Selectmen, Town Hall, Epping, NH 03042
Cliff Sinnott, RPC, 156 Water St., Exeter, NH 03833
Dennis Koch, Town of Epping Water and Sewer Dept., 157 Main St., Epping, NH 03042

51 PORTSMOUTH AVENUE, EXETER, NEW HAMPSHIRE 03833
Telephone: 603-773-0075 Fax: 603-773-0077
www.geospherenh.com

Attachment A

Revised Proposed Water Conservation Plan

SYSTEM DESCRIPTION/DESCRIPTION OF NEED

The Town of Epping Water and Sewer Department (EWSD) currently has 3 bedrock wells to supply water to its municipal water users; #503 Fremont Well, #504 Hoar Pond Well No. 1, and # 505 Hoar Pond Well No. 2. The system has 420 connections that supplies water to a population of 1,050 residents.

In recent years, rapid development has occurred in the town along the Routes 125 and 27 corridors. New development, coupled with population growth has led to increased demand on the system. They are unable to buy water from nearby towns of Brentwood and Exeter. It is anticipated that demand will continue to rise as the population in Epping increases. A new source will be needed to maintain supply to an increasing number of municipal water users. The average existing use is 0.110 mgd. During times of peak demand, water use goes up to 0.160 mgd. It is anticipated that in the next 10 years the average daily demand will be 0.220 mgd and during peak demand, the average withdrawal rate may be as high as 0.350 mgd. Typically the wells are pumped 13-15 hours per day however during peak demand in summer the wells may be pumped longer. The town reduces stress from peak demand by storing water in 2 elevated tanks. One tank has a 300,000 gallon storage capacity, the other tank has 200,000 gallon storage capacity.

This Water Conservation Plan is made in accordance with New Hampshire Department of Environmental Services (NHDES) Administrative Rules (rules) Env-Ws 390.05 and the subsequent Env-Wq 2101.05 Water Conservation Rules – Requirements for Existing Large Community Water Systems.

TOWN OF EPPING WATER AND SEWER DEPT. WATER CONSERVATION PLAN

Env-Wq 2101.05 Requirements for Existing Large Community Water Systems.

A. An existing large community water system shall implement the measures described in this section.

B. Each large community water system shall install water meters within 3 years of obtaining approval for a new source of water that is subject to RSA 485:3 for all of the following:

1. Public sector water users except firefighting;
2. Private water users; and
3. All sources of water.

Epping Water and Sewer Department currently meters all customers and all sources.

C. The water system shall size the water meters required by (**B**), above, in accordance with the specifications of the manufacturer.

All meters are sized in accordance with the specifications of the manufacturer

D. In selecting, installing, and maintaining water meters, the water system shall comply with procedures and protocols described in "Manual of Water Supply Practices, Water Meters-Selection, Installation, Testing, and Maintenance," document identification number AWWA M6, American Water Works Association, 1999.

All meters are selected, installed, and maintained with the procedures and protocols described in "Manual of Water Supply Practices, Water Meters- Selection, Installation, Testing, and Maintenance" document identification number AWWA M6 American Water Works Association, 1999. Epping Water and Sewer Department will test and calibrate all source meters on an annual basis. Epping Water and Sewer Department has implemented a replacement program for service meters, replacing 5-10% of service meters a year, as well as any others in need of replacement.

E. The water system shall read the water meters required by **(B)(1)** and **(2),** above, at least once every 90 days.

Epping Water and Sewer Department currently reads all private water user meters and all public sector meters on a quarterly basis and will continue to do so.

F. The water system shall read the water meters required by **(B)(3),** above, at least once every 30 days.

Epping Water and Sewer Department currently reads all water source meters on a daily basis and will continue to do so.

G. The water system shall implement a water audit and leak detection program in Accordance with "Manual of Water Supply Practices, Water Audits and Leak Detection" document identification number AWWA M36, American Water Works Association, 1999, within one year of obtaining approval for a new source of water.

Epping Water and Sewer Department will use a qualified subcontractor to conduct their water audit and leak detection program in accordance with the "Manual of Water Supply Practices, Water Audits and Leak Detection" document identification number AWWA M36, American Water Works Association, 1999. Beginning in 2011, Epping Water and Sewer Department will implement a program to check for leaks within the distribution system. This program will involve a 20% system leak detection check per year. Therefore, every five years the complete distribution system will have been surveyed for leaks.

H. The water system shall repair all leaks identified by the activities required by **(G)** within 60 days of discovery unless a waiver is obtained in accordance with **Env-Ws 390.09.**

Epping Water and Sewer Department will repair all leaks discovered during water audits and leak detection within 60 days.

I. The water system shall estimate the volume and percentage of unaccounted-for water in the water system once every year using protocols and procedures described in Manual of Water Supply Practices, Water Audits and Leak Detection" document identification number AWWA M36, American Water Works Association, 1999.

Epping Water and Sewer Department will continue to use a qualified subcontractor to estimate the volume and percentage of unaccounted-for water using protocols and procedures described in "Manual of Water Supply Practices, Water Audits and Leak Detection" document identification number AWWA M36, American Water Works Association, 1999. It is estimated that Epping Water and Sewer Department had approximately 9% of unaccounted for water in 2009. In 2009 the source meters registered approximately 44 million gallons of groundwater withdrawn, the net of all service meters registered approximately 40 million gallons of water used.

J. The water system shall prepare and submit a response plan to the department within 60 days if the percentage of unaccounted-for water in the water system calculated pursuant to **(I)**, above, exceeds 15% of the total volume of water introduced to the water system.

Epping Water and Sewer Department will submit a response plan to NH DES within 60 days if the percentage of unaccounted-for water in the system exceeds 15%.

K. The response plan prepared in accordance with **(J),** above, shall identify how the water system intends to reduce the percentage of unaccounted-for water to below 15% within 2 years, except for leaks that have been identified which must be repaired in accordance with paragraph **(H).**

The response plan will identify actions the Epping Water and Sewer Department will take to reduce the percentage of unaccounted-for water to below 15% within 2 years, excluding the repair of leaks identified during leak detection.

L. The department shall approve the response plan within 90 days if it contains recommended actions that comply with the requirements specified in **(K),** above.

M. The water system shall implement the response plan in accordance with the approved schedule upon receiving approval from the department.

Upon approval from the NH DES, Epping Water and Sewer Department will implement the response plan in accordance with the approved schedule.

N. The water system shall implement pressure reduction within one year of obtaining approval of a new source of water when:

1. Technically feasible;
2. Consistent with water system industry standards and regulations; and
3. Consistent with other public health and safety considerations.

At this time, the water system has pressures of 70 psi and lower. Reducing pressures even more may threaten fire flow in certain areas of the system. It is not technically feasible to reduce pressures anywhere in the system within one year of obtaining approval of a new source.

O. The water system shall adopt a rate structure that promotes water conservation within 5 years of obtaining approval for a new source of water, as described below:

1. The rate structure shall be based on:
   a. A unit price of water; and
   b. The amount of water used by each connection to the water system; and

2. The unit price of water for residential customers shall:
   a. Remain the same; or
   b. Increase with the volume of water consumed.

Currently, the Epping Water and Sewer Department's water rate structure is based on metered water consumption using inverted block rates. The Epping Water and Sewer Department will continue to evaluate rate structures for effectiveness in promoting water conservation.

P. The water system shall complete a water conservation educational outreach initiative using materials prepared by the department as follows:

1. The water system shall implement the applicable public notification and outreach requirements to municipal governments within its service area in accordance with **Env-Wq 2101.11**; and

Epping Water and Sewer Department will implement public notification and outreach to the Town of Epping municipal government within the Epping Water and Sewer Department service area in accordance with Env-Ws 390.11.

2. The water system shall implement an educational outreach initiative for its customers to promote water conservation immediately upon obtaining approval for the new source.

The Epping Water and Sewer Department currently implements a variety of water conservation efforts to reduce demand. On a yearly basis, Epping Water and Sewer Department includes the NH DES-prepared water conservation educational materials in water bills that are mailed to water users. In addition, the Epping Board of Water Commissioners regularly holds meetings with the public to educate water users on water conservation issues, particularly lawn watering. The Epping Water Commission also posts notices in the local newspaper that discuss water conservation. Conservation issues are also discussed during the monthly-televised water and sewer commission meeting. Water efficiency efforts are also being undertaken by other departments in the town to reduce consumption. The planning board is requiring all new construction utilize water-conserving low-flow fixtures, these fixtures are required to have an energy star rating for water consumption. All proposed irrigation systems must be designed by a certified installer. All irrigation plans are reviewed for uniformity and conservation (e.g. rain sensors are required) prior to being approved by the Epping Water Commission. The Epping Water and Sewer Department intends to continue these efforts to promote water conservation after obtaining approval for the new source.

Q. Activities completed in accordance with **(B)** through **(P),** above, shall be completed by water system personnel under the supervision of a certified operator pursuant to **Env-Ws 367.**

The water conservation activities described in **(B)** through **(P)** will be completed by water system personnel under the supervision of a certified operator pursuant to Env-Ws 367.

Attachment B

Summary of Env-Wq 2101

-Water Conservation Rules-
Env-Wq 2101 (formerly Env-Ws 390)

Applicants applying for permits to develop new sources of water need to be aware that they are subject to new water conservation requirements required by RSA 485.61 which became law in July 2002. The law requires that the Department of Environmental Services (Department) adopt and administer water conservation rules for applicants developing the following type of new water sources:

1. New sources of groundwater for community water systems subject to RSA 485:3;

2. New sources of groundwater for bottled and bulk water operations subject to RSA 485:3;

3. New sources of groundwater that exceed 57,600 gallons over any 24-hour period subject to RSA 485-C; and

4. New sources of surface water associated with projects that require a water quality certification pursuant to Section 401 of the Federal Clean Water Act.

The Department met with an advisory committee consisting of representatives of municipalities, community water systems, environmental organizations, and business and industry to develop the water conservation rules. The rules were formally adopted by the Department in May 2005.

A general summary of the requirements of the water conservation rules is provided below.

Requirements for All Large Community Water Systems and All New Small Community Water Systems Developing New Sources of Water

1. Install and maintain meters for all water withdrawals and service connections.

2. Implement a water audit, leak detection and leak repair program in accordance with the "Manual of Water Supply Practices, Water Audits and Leak Detection", document identification number AWWA M36, American Water Works Association, 1999.

3. When applicable, development and implementation of response plans to reduce unaccounted for water to less than 15%.

4. Implement a rate structure that encourages efficient water use.

5. Implement a water conservation educational outreach initiative.

Requirements for Existing Small Community Water Systems Developing New Sources of Water

1. Either: a) Install source and service connection meters and implement a water audit, leak detection and leak repair program in accordance with the "Manual of Water Supply Practices, Water Audits and Leak Detection", document identification number AWWA M36, American Water Works Association, 1999; **or** b) Complete a system-wide leak detection once every two years.

2. Repair all leaks within 60 days of identification.

3. Implement a water conservation educational outreach initiative.

Requirements for Applicants Developing New Sources of Water for Industrial, Commercial, or Institutional Water Uses

1. Install water meters for all water sources.

2. Retrofit or replace single pass water-cooling systems when feasible based upon an economic analysis that includes a four-year payback period.

3. Install controls to stop the overflow or discharge of water to waste when feasible based upon an economic analysis that includes a four-year payback period.

4. Identify water conservation best management practices or best available technologies that may be applicable to the types of water-using processes at the subject facility, and implement these measures when feasible based upon an economic analysis that includes a four-year payback period.

5. For all new lawn areas, install six (6) inches of loam and devices to shut-off automatic irrigation systems when not needed.

For more information about the water conservation rules, contact Derek Bennett at 271-6685 or derek.bennett@des.nh.gov.

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
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- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Karen Falcone
Epping Board of Selectmen
157 Main Street
Epping, NH 03042

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Joyce A Blanchard ☐ Agent ☐ Addressee

B. Received by (Printed Name) Joyce A Blanchard
C. Date of Delivery 12-2-10

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If YES, enter delivery address below: ☒ No

3. Service Type
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☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

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City, State, ZIP+4: Exeter NH 03833

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Postage	$ 1.22
Certified Fee	2.80
Return Receipt Fee (Endorsement Required)	2.30
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 6.32

Postmark Here: EXETER NH 03833 DEC -1 2010

Sent To: Karen Falcone, Epping Board of Selectman
Street, Apt. No.; or PO Box No.: 157 Main Street
City, State, ZIP+4: Epping NH 03042

PS Form 3800, August 2006 See Reverse for Instructions

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- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Cliff Sinnott
Rockingham Planning Commission
156 Water Street
Exeter, NH 03833

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Roxanne McRines ☒ Agent ☐ Addressee

B. Received by (Printed Name) Roxanne McRines
C. Date of Delivery 12/2/10

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☒ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

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CONSERVATION PLAN

Raymond Water Department (#20061)

Introduction

Conservation plans under the Instream Flow Program require meeting the conservation measures and best management practices in the Department of Environmental Services (DES) Water Conservation Rules (Env-Wq 2101). Use of these measures and practices as a standard will provide a common level of effort by all water users.

The Raymond Water Department provides domestic water for the Town of Raymond, New Hampshire. The water supply is sourced from three overburden wells located in the Town of Raymond on town-owned property adjacent to the Lamprey River. This Conservation Plan applies to the entire Raymond Water Department service area.

Water Source and Uses

Although the Raymond Water Department has three active stratified drift wells as sources for its water supply, until September 2010, it reported its total water use to DES as a wellfield under a single registration number (20061-S01). A fourth well located in the center of town is no longer used. Each of the wells has been assigned an identification number by the United States Environmental Protection Agency (USEPA). Table 1 identifies the Raymond water sources by their EPA ID numbers and by their NH water user registration numbers.

Table 1 – Well Names and Identification Numbers

Well Name	EPA ID Number	NH Water User Registration Number
Well #1	1971010-002	20061-S02
Well #2	1971010-003	20061-S03
Well #3	1971010-004	20061-S04
unused well	1971010-001	--

Figure 1 depicts the locations of these wells designated by their EPA ID numbers. The three wells are located in a stratified drift formation near the Lamprey River. Well #1 is located 281 feet from the Lamprey River, Well #2 is located 231 feet from the river, and Well #3 is located 249 feet from the river (Figure 1). An analysis of these wells showed that they do not induce recharge from the Lamprey River at their average or maximum reported extraction rates (DES 2009a). However, these wells intercept water that would be flowing toward the Lamprey River. Water is used by the Raymond Water Department customers and then returned to the environment by way of individual septic systems in the town.

Usage of the wells alternates on a monthly basis. The Town’s water system includes 1.3 million gallons of storage in three surface tanks (one 110,000 gallon and two 600,000 gallon) to supplement the wells during periods of peak demand. The Raymond Water Department

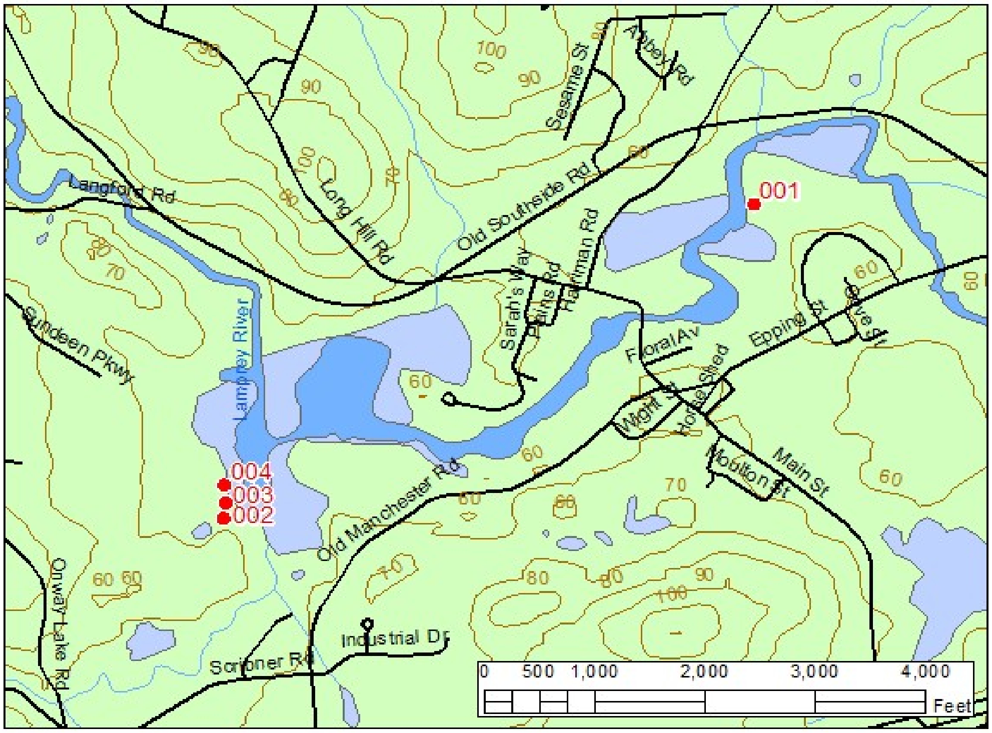

Figure 1 - Location of the Raymond Water Department water supply wells.

wells are located upstream of the Designated River; therefore the drainage area of the impact point of the withdrawal on the Designated River is equal to the drainage area at the head of the Designated River, which is 152.5 sq. mi.

Water Use Patterns

Water is withdrawn at rates occurring in a pattern common to municipal water supplies. Daily withdrawal rates are moderated by system storage. Water demand follows a typical diurnal pattern. The wells are pumped at an equal withdrawal rate. When pumping exceeds demand, excess water fills the distribution system storage, and, when pumping is less than demand, stored water makes up the difference. The pumping rates of the wells are variable and are set by the operators to operate approximately 20 hours per day. Depending on if the Town is operating one, two or all three wells at a time, the individual rates can range from 100 to 400 gallons per minute (gpm). Each well is metered and the total production is recorded daily. Monthly water use is reported quarterly to DES.

Water use data for the Raymond Water Department well field for the years of 1988 through 2013 are summarized in the figures and tables below. Complete years of monthly data from 1989 to 2012 were used to develop annual and monthly statistics. Individual well use information was not available until 2010, as the Town reported the three wells as a single wellfield until September 2010. Annual water use data were converted from thousands of gallons to cubic feet per second (cfs) and cubic feet per square mile of drainage area (cfsm) to make comparisons with stream flow values in the Lamprey Designated River.

Between 1989 and 2012 annual water use by the Raymond Water Department ranged from a high of 121.88 million gallons (2009) to a low of 76.04 million gallons (1990), with an average annual use of 99.78 million gallons (Figure 2 and Table 2). Overall, annual water use has increased over these 24 years (1989 to 2012), briefly reset by short periods of reduced water use after 1998, 2003 and 2010. During this period, annual water use increased by 26.10 million gallons or 33.25 percent. This represents an average increase of 1.087 million gallons per year or 1.4 percent per year for the 24 year period of record.

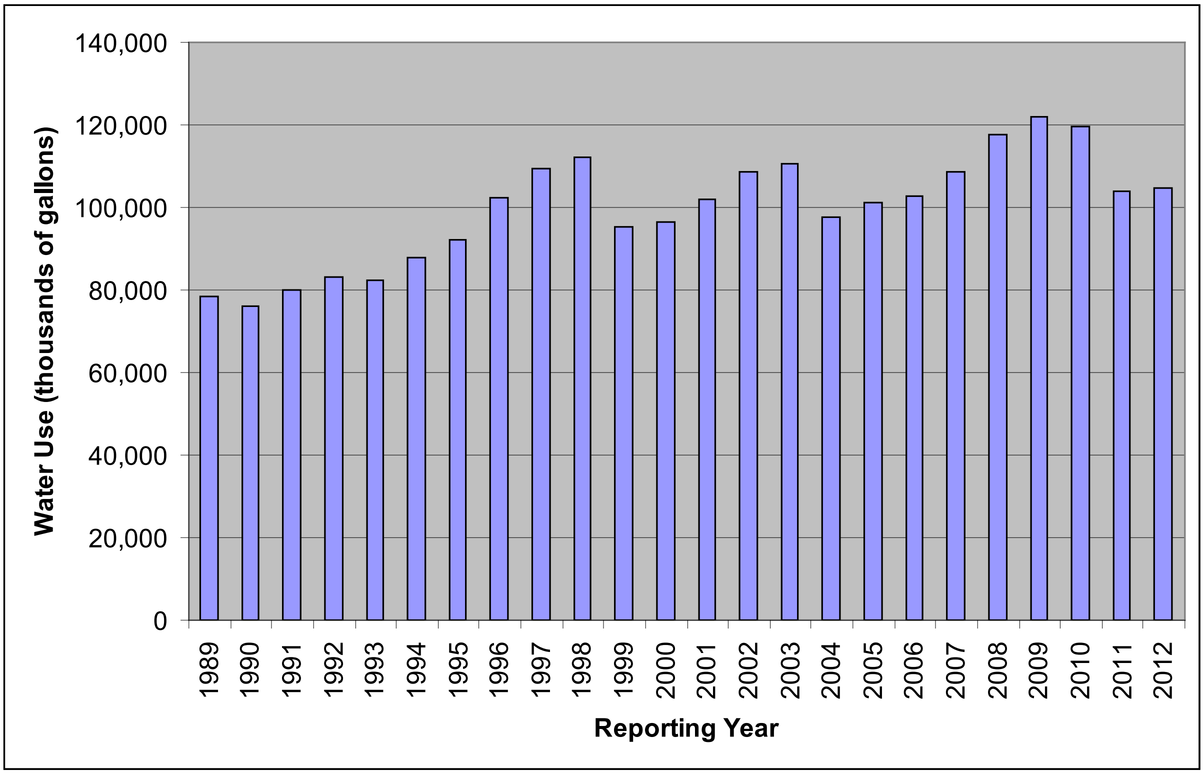

Figure 2 – RAYMOND WATER DEPARTMENT (20061) - Annual Water Use

Table 2 – Raymond Water Department - Annual Water Use Statistics (1989 - 2012)

	Low	High	Average
Thousands of Gallons	76,039	121,884	99,784
cfs	0.3224	0.5167	0.4230
cfsm at Packers Falls Gage	0.00176	0.00282	0.00231

Monthly water use varies in response to weather conditions and changes in seasonal demand. The average monthly water usage was highest during summer and lowest during winter (Figure 3). This seasonal pattern reflects increased outdoor water usage (lawn irrigation, garden watering, vehicle washing, etc.) during the summer months, which then declines during the fall, remains low during the winter and begins to increase again in the spring. The highest total monthly water usage was 12.48 million gallons (July 1997). The lowest total monthly water usage was 4.23 million gallons (November 1989), while the average monthly water use was 8.315 million gallons (Table 3).

The monthly use data were converted to cubic feet per second (cfs) by dividing the monthly values by days per month and multiplying them by a flow unit conversion factor. Daily water use by the Raymond Water Department ranged from a minimum of 0.218 cfs (0.141 million gallons per day, November 1989) to a maximum of 0.623 cfs (0.403 million gallons per day, July 1997), with an average use of 0.423 cfs (0.273 million gallons per day) for the period of 1989 to 2012 (Table 3).

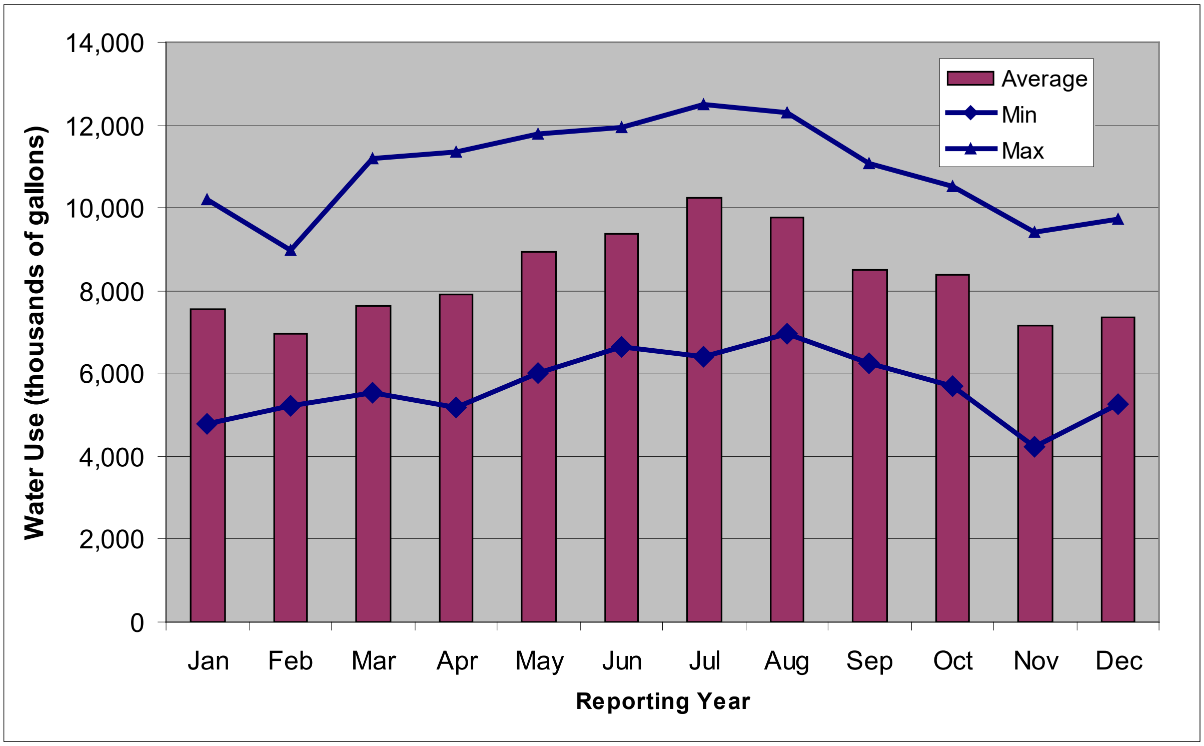

Figure 3 – RAYMOND WATER DEPARTMENT - Monthly Water Use Statistics (1989-2012)

Table 3 -Raymond Water Department - Monthly Water Use Statistics (1989 through 2012).

	Low	High	Average
Thousands of Gallons	4,232	12,483	8,315
cfs	0.2153	0.6350	0.4230
cfsm at Packers Falls Gage	0.00118	0.00347	0.00231

Env-Wq 2101 Requirements for Water Conservation Plan

Development and approval of a water conservation plan that meets the Water Conservation Rules requirements will satisfy the Conservation Plan requirements under the Instream Flow

Rules. The Water Conservation Rules require different activities depending on the type of water use. Conservation plans for public water supplies require inclusion of the following components:

- Installation, maintenance, and use of appropriately selected meters;
- Maintaining low levels of unaccounted-for water;
- Performing water audits to assess losses;
- A comprehensive plan for leak detection surveys of the distribution system;
- System pressure reduction where necessary;
- A water conservation educational outreach initiative;
- Adopting a rate structure that promotes water conservation; and,
- On-going water conservation compliance reporting.

The Raymond Water Department will be in compliance with the water conservation plan requirements of the Instream Flow Program by completing and obtaining approval of a Water Conservation Plan through DES Groundwater and Drinking Water Bureau.

Existing Water Conservation Measures

The Town of Raymond's Water Department has implemented most of the water conservation measures recommended by DES for water utilities (DES 1998) and as required in the state's Water Conservation Rules (Env-Wq 2101) for large community water systems. All water sources and users are metered. The production well meters are tested and calibrated every two years. System water meters are read monthly and water bills are mailed out quarterly. Water use is billed based on consumption, with the rate increasing with increasing use.

The Raymond Water Department continually looks for leaks, and monitors system records to identify anomalous water use. Leaks are repaired as soon as they are detected or reported. A leak detection survey in 2008 identified a 20 gallon per minute leak and another performed in 2013 identified two leaks with a combined rate of 18 gallons per minute. The Water Department also compiles a yearly pumped versus billed report to monitor unaccounted-for water. Based on the results of a recent assessment, unaccounted-for water was 19 percent, which is higher than the recommended maximum of 15 percent. In response, a leak detection study will performed in 2014.

The Raymond Water Department has several water conservation outreach initiatives. These include discussions and information dissemination with local groups (Boy and Girl Scouts, Planning Board and Board of Selectmen), bill stuffers, and through the Town's newsletter.

Water Conservation Alternatives and Costs

The Town of Raymond will document its existing water conservation activities and include a schedule for ongoing leak detection going forward from 2010 and a plan for responding to unaccounted-for water greater than 15%. Completion of this plan by the Town and approval by DES Drinking Water and Groundwater Bureau will meet the Instream Flow Program's

Conservation Plan requirements. The Water Conservation Plan will be administered by the Drinking Water and Groundwater Bureau under the authority of the Instream Flow Program.

The costs for the water conservation plan are to document the water conservation plan. Activities expected under the plan are currently ongoing in the service area.

If the Town needs to implement or maintain more restrictive water conservation measures due to diminished supply from its source(s) or storage, then those actions take precedent over this Conservation Plan. Nothing in this plan precludes the Town from further conservation actions on its own initiative.

Conservation Implementation Schedule

By June 1, 2014, the Town of Raymond will finalize a Water Conservation Plan as required by Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers. The water conservation plan will be in accordance with Env-Wq 2101 and will describe its existing water conservation activities and further include scheduling for its ongoing leak detection studies and a plan to repair leaks to maintain unaccounted-for water use to below 15 percent.

Water User Contact Information

Water User: Raymond Water Department
Address: 4 Epping Street, Raymond, NH 03077
Contact: Steve Brewer, Public Works Director
Phone: 895-4735 ext. 108
Email: sbrewer@raymondnh.gov

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 2101 Water Conservation Rules, adopted 5/12/05.

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers.

Department of Environmental Services (DES) 2009a. Effects of Well Withdrawal Impacts on Lamprey Stream Flow. NHDES-R-WD-09-5. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire.

Department of Environmental Services (DES) 2009b. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. completed by Dennis McCarthy, Town of Raymond.

Personal communications with Dennis McCarthy, Town of Raymond.

Personal communication with Denise O'Grady, Town of Raymond.

Water use reports on file with the Department of Environmental Services (DES).

CONSERVATION PLAN

Scenic Nursery & Landscaping (#20747)

Introduction

Conservation plans under the Instream Flow Program require meeting the conservation measures and best management practices in the Department of Environmental Services (DES) Water Conservation Rules (Env-Wq 2101). Use of these measures and practices as a standard will provide a common level of effort by all water users.

Scenic Nursery & Landscaping (Scenic Nursery) is located off Dudley Road, near the intersection of Route 27 and Route 107 in the northwest part of Raymond, New Hampshire. Scenic Nursery is a full service garden center and nursery, which also provides landscape design services. The business has been in operation at this location since 1997. The north and west portions of the property are located along the Lamprey River, which flows north to south past the property. This Conservation Plan applies to the entire Scenic Nursery and Landscaping Facility at Dudley Road.

Water Source and Uses

Scenic Nursery has three registered water sources on the property (Figure 1). The first source is a 15 foot deep dug well (20747-S01) which is encased in concrete, has a concrete cap and is located within 70 feet of the river. The second registered water source was a dug well (S02), but due to excessive siltation problems, this well is currently not used. In its place, an intake pump was placed in the river and the piping from the temporary intake ties into the irrigation system piping in the former dug well. The third water source (20747-S03) is a small pond located in the northwest portion of the property. The pond measures approximately 130 by 80 feet and 5 feet deep. The Scenic Nursery withdrawals are located upstream of the Designated River; therefore the drainage area of the impact point of the withdrawals on the Designated River is equal to the drainage area at the head of the Designated River; 152.5 sq. mi.

In response to a water use questionnaire, Scenic Nursery stated that the water obtained at these three sources was used to water annual plants in a greenhouse and approximately seven acres of container and field-grown nursery stock (trees and shrubs). Most of the watering is done by a drip irrigation system, but there is some blanket watering by spray irrigation of the container plants.

Water Use Patterns

Scenic Nursery’s water withdrawals were first registered with the Department of Environmental Services (DES) in July 2001 and water use data are available for 2002 through 2012 (excepting 2009, for which no data area available). Water use is measured based on the pump-run time and is not directly metered. Water use occurs primarily during the spring through fall, with no reported water use during the winter (November through February). Water use is plant-need dependent and is largely affected by weather conditions (rainfall and air temperature). The greatest use of water is during dry periods in the growing season, during which water use can occur 24 hours a day, seven days a week. During these periods, automated watering occurs from 6 pm to 8 am, followed by manual watering from 8 am to 6 pm.

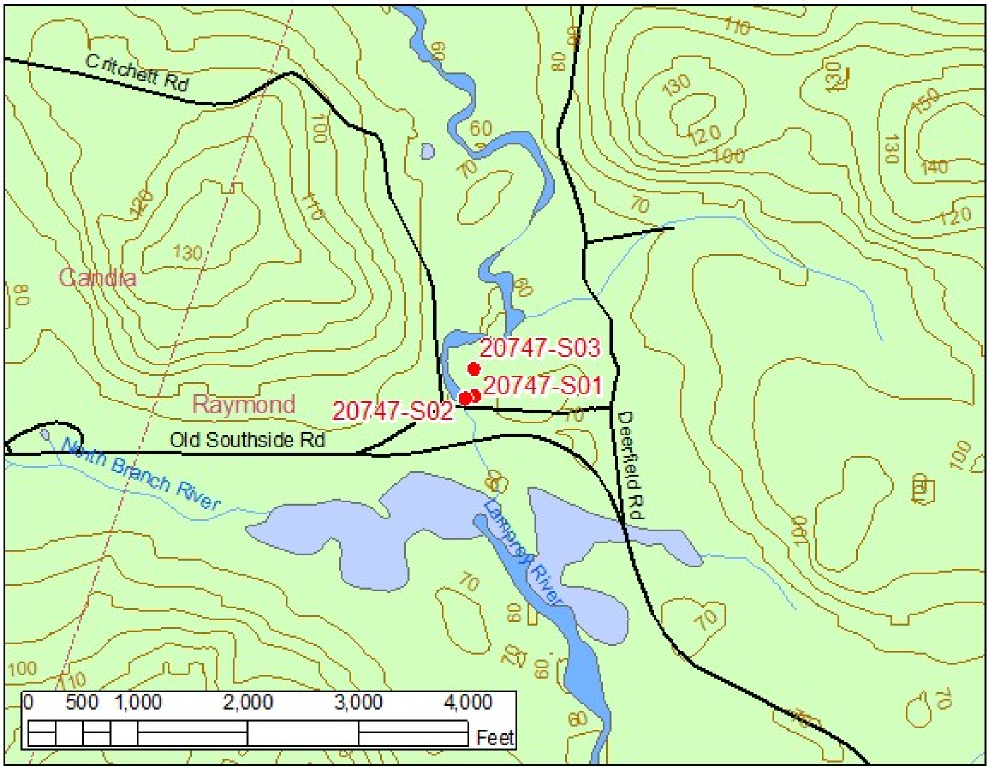

Figure 1 – Location of Scenic Nursery's registered water sources at Raymond, New Hampshire.

Water use data were obtained for Scenic Nursery for the years of 2002 through 2012, except for 2009, for which no data are available. The water use data came from the DES Water Use Registration database, and are summarized in the figures and tables below. Annual water use data were converted from thousands of gallons to cubic feet per second (cfs) and cubic feet per square mile of drainage area (cfsm) to make comparisons with stream flow values in the Lamprey Designated River.

Water use varies from year to year and month to month, depending primarily on weather. Annually, total usage has varied from a low of 0.370 million gallons (2004) to a high of 4.032 million gallons (2007), and average annual use has been 1.377 million gallons for the ten years of record (Figure 2 and Table 1). The principal sources of water have been well #1 (S01) and the pond (S03) (see Figures 3 through 5 and Tables 2 through 4). The high water use reported in 2002 reflects the drought conditions experienced in 2001 – 2002, while the high water use in 2007 reflects the recovery from the flood experienced during that April. According to the owner, most of the nursery stock was destroyed or washed away during the flood event and several years of product had to be replaced. New above ground nursery stock at the time required more watering by spray irrigation until they were replanted into more permanent containers with a pot-to-pot drip irrigation system. The significant decline in water use after 2007 reflects the reduced water use after the establishment of the new plant stock and the reduced reliance upon spray irrigation.

Between 2002 and 2012 total annual water use decreased by 2.685 million gallons or 82.6 percent. This represents an average decrease of 0.244 million gallons per year or 7.5 percent per year for the eleven year period of record. As shown in Figure 2, the year to year total annual water use can be highly variable. Excluding the 2002 drought year, the 2007 plant replacement year, and the 2009 "no-data" year, their annual average water use is 0.862 million gallons.

Scenic Nursery reduced their annual water use after 2009 by harvesting one of their field-grown plant fields and discontinuing its use. They also continued their efforts to reduce water usage through use of water efficient systems and reducing crop water requirements. This is likely to represent a common usage rate, although recent years' usage has stabilized at 0.567 million gallons (2010-2012).

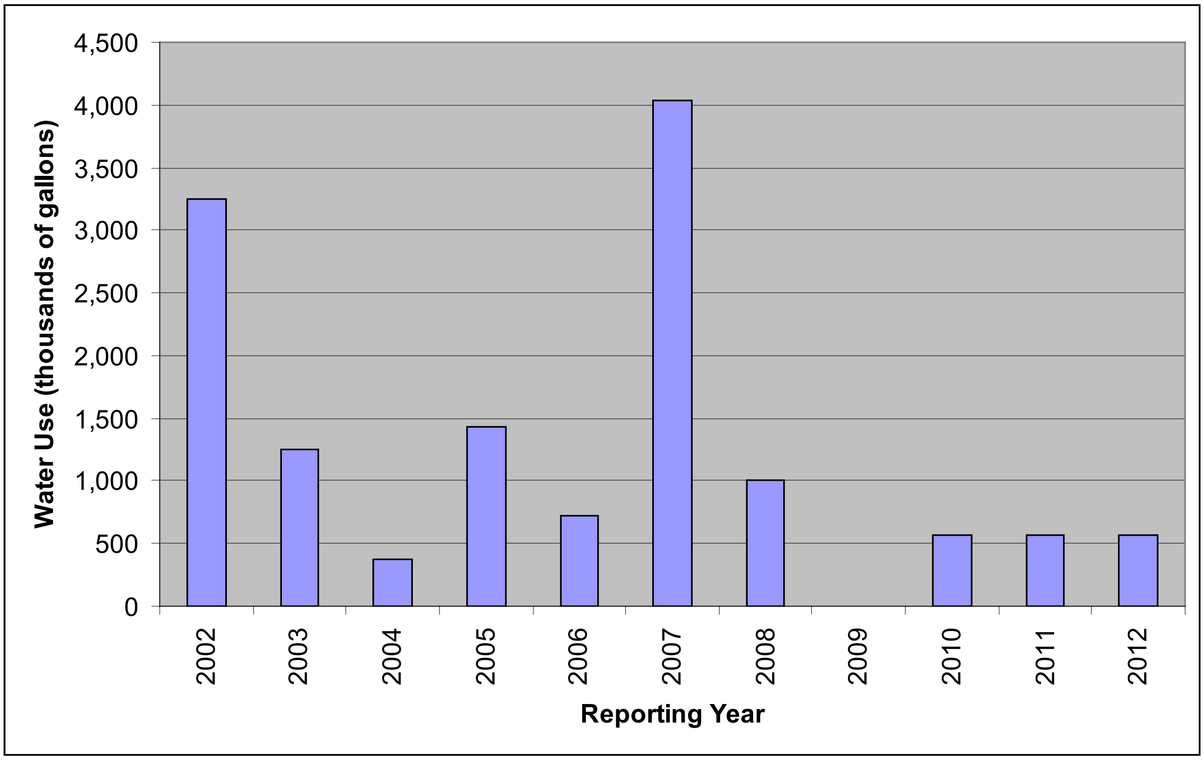

Figure 2 – SCENIC NURSERY (20747) - Annual Water Use (no data in 2009)

Table 1 – Scenic Nursery - Annual Water Use (2002 through 2012, no data in 2009)

	Low	High	Average
Thousands of Gallons	370	4,032	1,377
cfs	0.0016	0.0171	0.0058
cfsm at Packers Falls Gage	0.00001	0.00009	0.00003

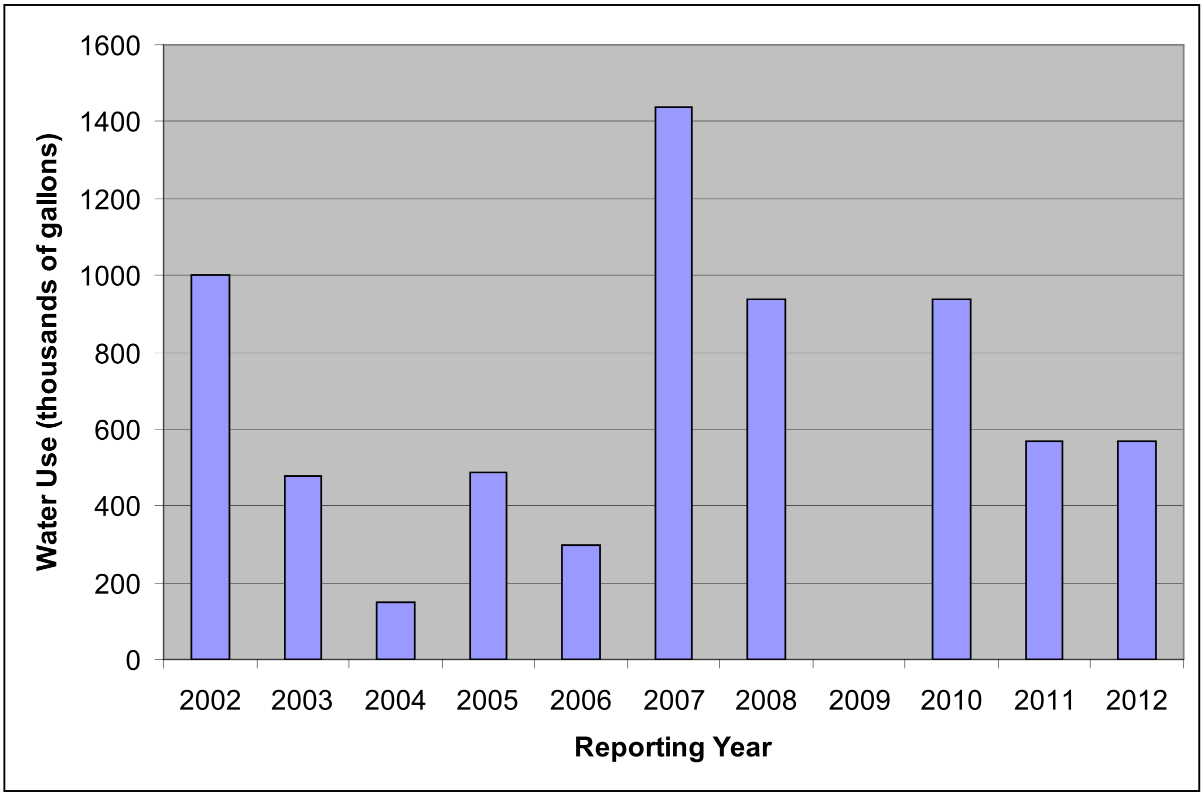

Figure 3 – SCENIC NURSERY - DUG WELL #1 (20747-S01) - Annual Water Use (no data in 2009)

Table 2 - Scenic Nursery - Dug Well #1 - Annual Water Use Statistics (2002 through 2012, no data in 2009)

	Low	High	Average
Thousands of Gallons	150	1,440	686
cfs	0.0006	0.0061	0.0029
cfsm at Packers Falls Gage	0.00000	0.00003	0.00002

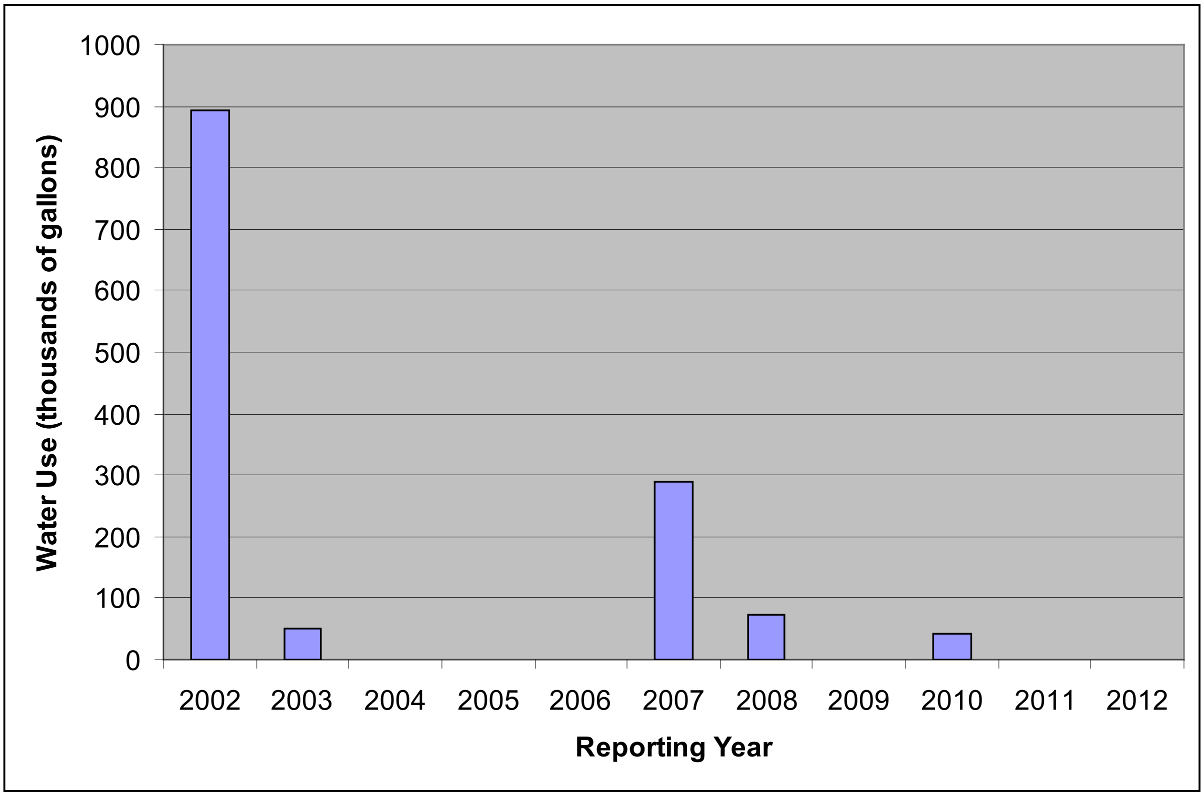

Figure 4 – SCENIC NURSERY - DUG WELL #2 (20747-S02) - Annual Water Use (no data in 2009)

Table 3 - Scenic Nursery - Dug Well #2 - Annual Water Use Statistics (2002 through 2012, no data in 2009)

	Low	High	Average
Thousands of Gallons	-	894	135
cfs	-	0.0038	0.0006
cfsm at Packers Falls Gage	0.00000	0.00002	0.00000

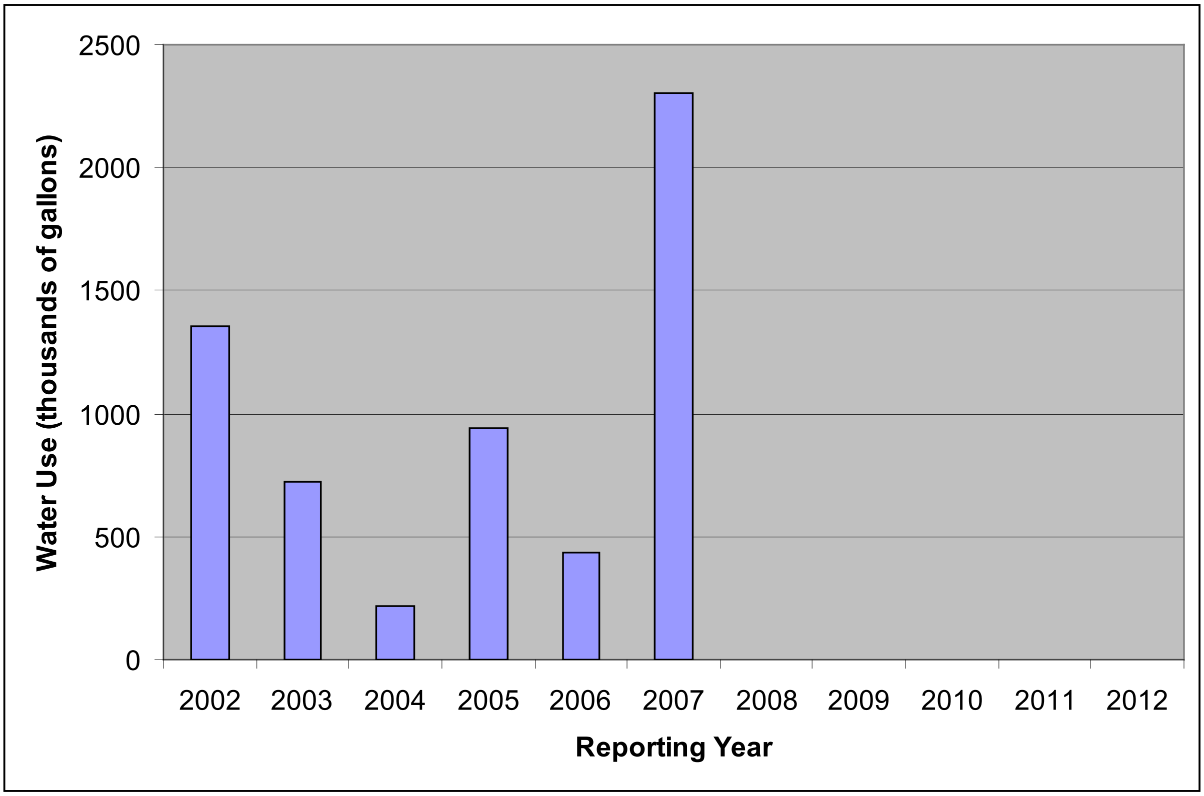

Figure 5 – SCENIC NURSERY - POND (20747-S03) - Annual Water Use (no data in 2009)

Table 4 – Scenic Nursery - Pond - Annual Water Use Statistics (2002 through 2012, no data in 2009).

	Low	High	Average
Thousands of Gallons	-	2,304	598
cfs	-	0.0098	0.0025
cfsm at Packers Falls Gage	0.00000	0.00005	0.00001

Monthly water use is highly variable and is largely related to weather conditions and plant water demands. There has been no reported water use during the months of November through February (Figure 6). Mean monthly water use increases gradually from March to a maximum in August, and then declines back to zero after October. The maximum monthly water use for the reporting period was 1.008 million gallons in both July and August 2007 (Figure 6 and Table 5). The water use during this period reflects recovery from the spring flood and does not reflect normal business operations at Scenic Nursery. Of the normal usage years, the maximum monthly water use reported was 432,000 gallons in July and August of 2005. Maximum monthly use in the last three years has been 156,000 gallons per month.

The monthly water use data were converted to flow in cubic feet per second (cfs) by dividing the monthly values by days and then multiplying this result by a flow unit conversion factor. Based on these values, average daily water use by month by Scenic Nursery has ranged from a minimum of 0 cfs (November through February in all years) to a maximum of 0.0503 cfs (32,516 gallons per day, July and August 2007), with an average of 0.0058 cfs (3772 gallons per day) for the period of 2002-08 and 2010-2012 (Table 5). Average monthly water use during the actual months of use, March through October, during these years was 172,095 gallons/month or .0089 cfs (5,661 gallons per day).

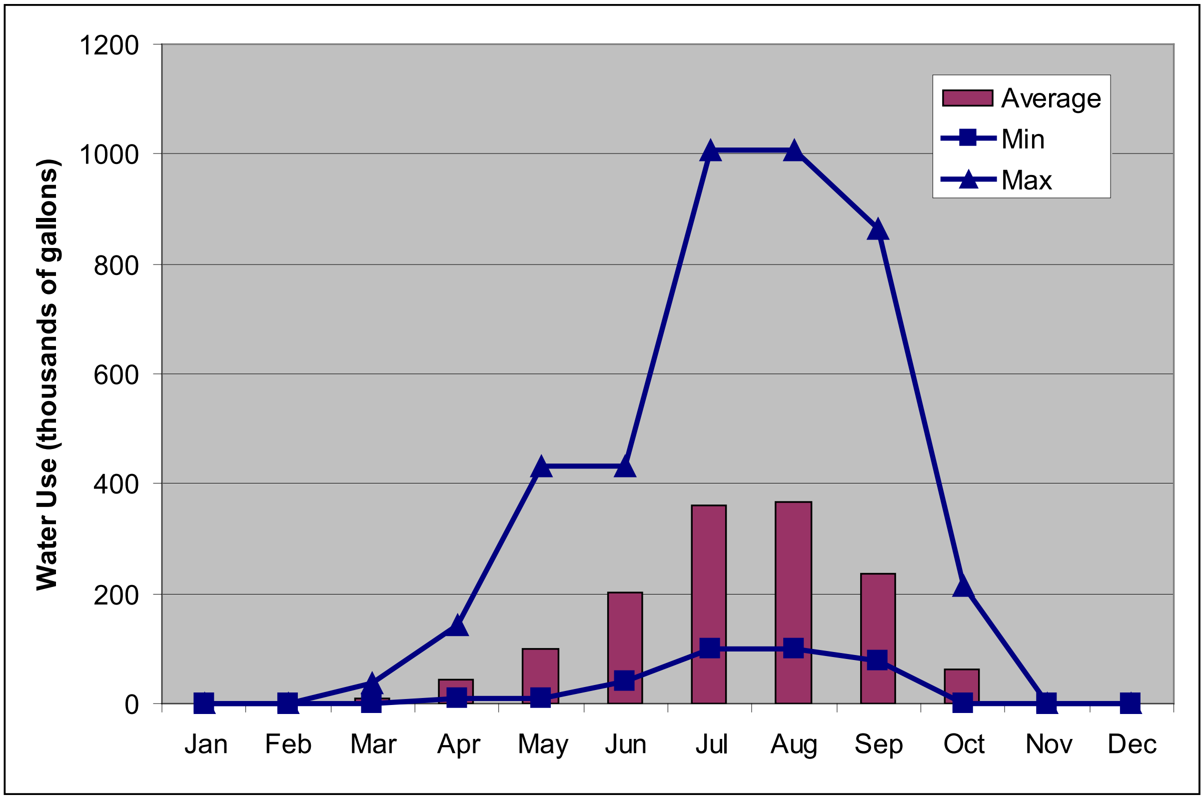

Figure 6 – SCENIC NURSERY (20747) - Monthly Water Use Statistics (2002-08 and 2010-12)

Table 5 - Scenic Nursery - Monthly Water Use Statistics (2002-08 and 2010-12)

	Low	High	Average
Thousands of Gallons	-	1,008	115
cfs	-	0.0513	0.0058
cfsm at Packers Falls Gage	0.00000	0.00028	0.00003

Figures 7 through 9 and tables 6 through 8 show monthly water use statistics by source.

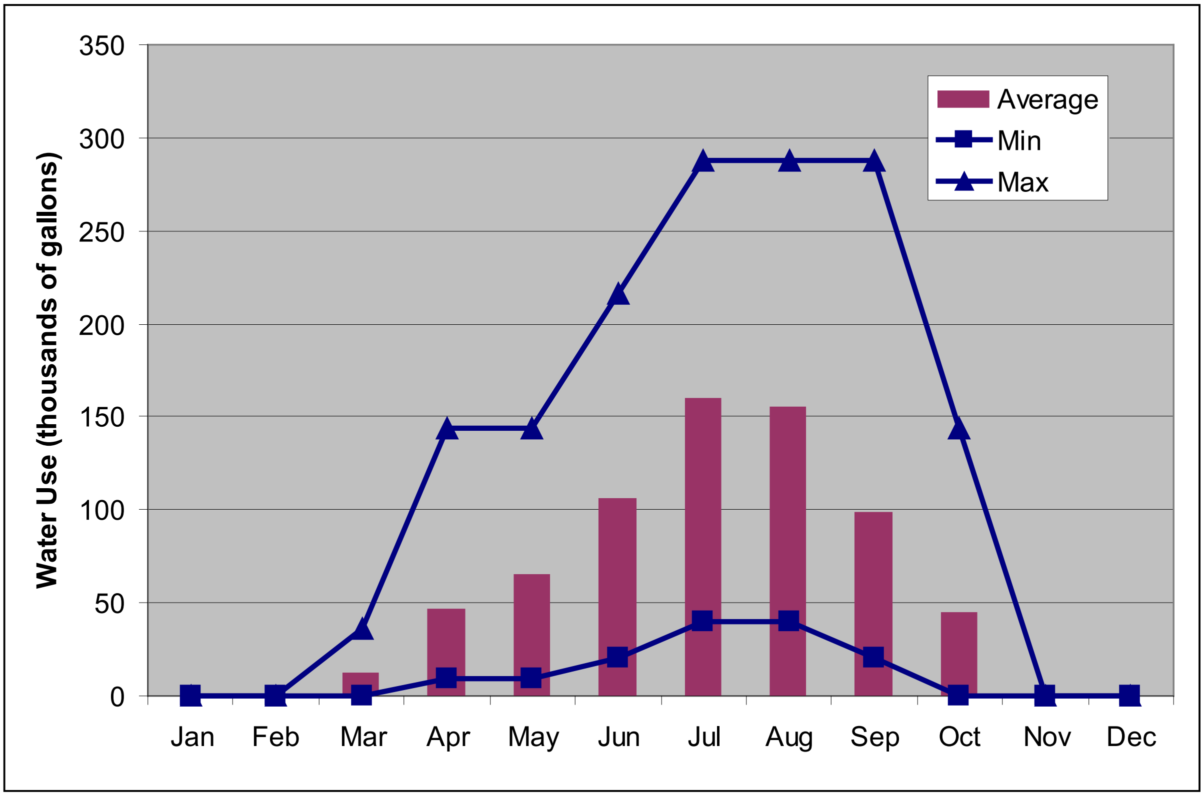

Figure 7 – SCENIC NURSERY - DUG WELL #1 (20747-S01) - Monthly Water Use Statistics (2002-08 and 2010-12)

Table 6. Scenic Nursery - Dug Well #1 - Monthly Water Use Statistics (2002-08 and 2010-12)

	Low	High	Average
Thousands of Gallons	-	288	58
cfs	-	0.0147	0.0029
cfsm at Packers Falls Gage	0.00000	0.00008	0.00002

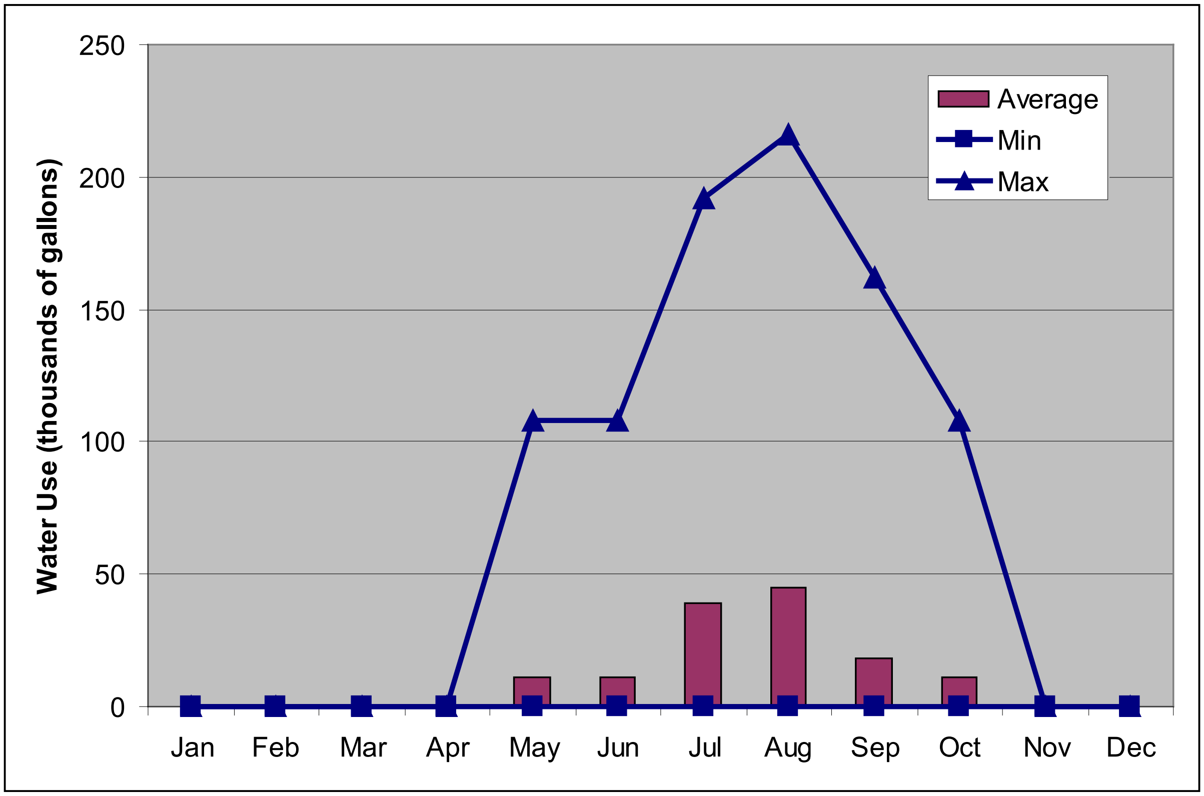

Figure 8 – SCENIC NURSERY DUG WELL #2 (20747-S02) - Monthly Water Use Statistics (2002-08 and 2010-12)

Table 7 - Scenic Nursery - Dug Well #2 - Monthly Water Use Statistics (2002-08 and 2010-12)

	Low	High	Average
Thousands of Gallons	-	216	11
cfs	-	0.0110	0.0006
cfsm at Packers Falls Gage	0.00000	0.00006	0.00000

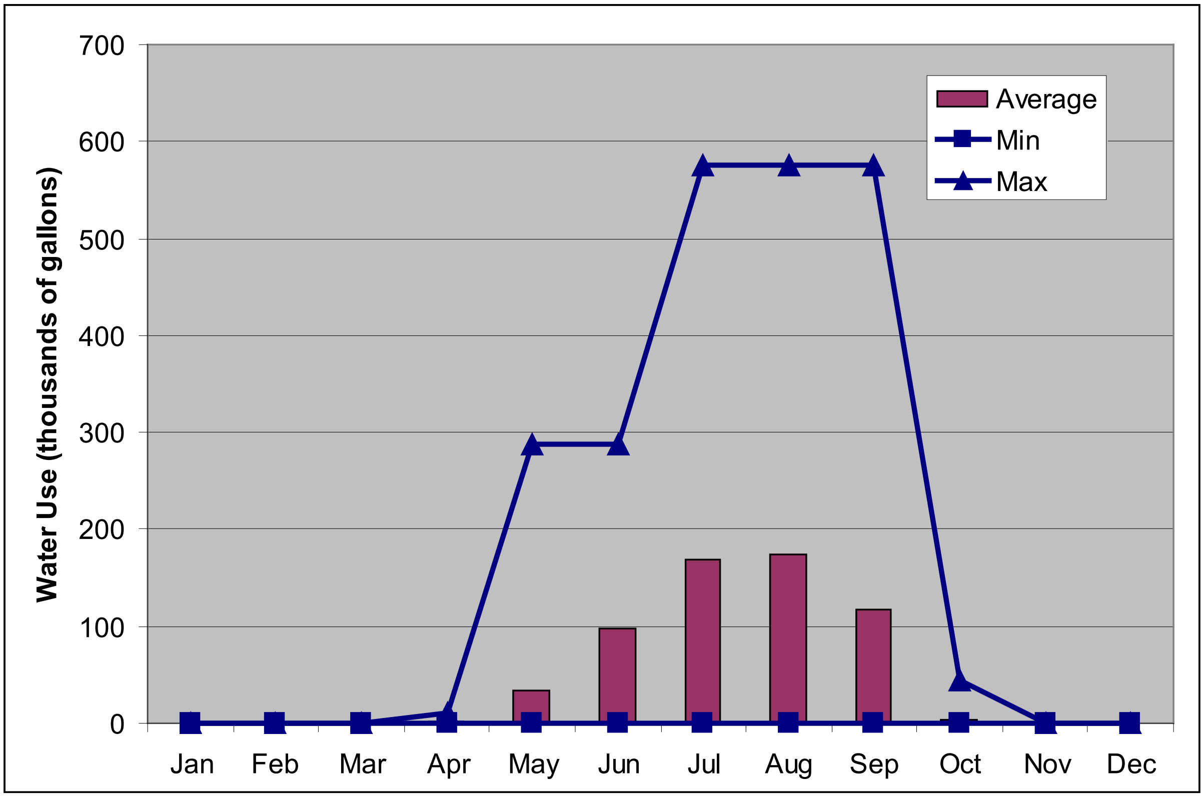

Figure 9 – SCENIC NURSERY - POND (20747-S03) - Monthly Water Use Statistics (2002-08 and 2010-12)

Table 8 - Scenic Nursery - Pond - Monthly Water Use Statistics (2002-08 and 2010-12)

	Low	High	Average
Thousands of Gallons	-	576	50
cfs	-	0.0293	0.0025
cfsm at Packers Falls Gage	0.00000	0.00016	0.00001

Env-Wq 2101 Requirements for Water Conservation Plans

Development and approval of a water conservation plan that meets the Water Conservation Rules requirements will satisfy the Conservation Plan requirements under the Instream Flow Rules. The Water Conservation Rules require different activities depending on the type of water use. All water users who irrigate crops associated with agriculture shall implement irrigation processes in accordance with the 1998 edition of the Irrigation Best Management Practices for Agriculture in New Hampshire, published by the Department of Agriculture, Markets and Food.

The Irrigation Best Management Practices for Agriculture in New Hampshire "provides a set of principles and practices to guide agricultural operators toward the most efficient use possible of the water resources of New Hampshire." The practices included in this manual are recommended for water withdrawals for irrigation and other agricultural purposes at all times. Best Management Practices for irrigation are based on the implementation of the following management techniques in concert with knowledge of site specific variables:

- Scheduling irrigation with appropriate amounts and frequency;
- Measuring current soil water status, rainfall and irrigation water applied; and,
- Balancing rainfall and irrigation applications with crop water use.

Existing Water Conservation Measures

The Scenic Nursery currently employs several of the recommended water conservation practices for agricultural irrigation (DES, 2010 and Env-Wq 2101). The irrigation methods used by Scenic Nursery include drip irrigation of individual plants and only spray irrigating overnight during periods of dry weather, which is automatically controlled. Currently, most potted tree fields are irrigated using drip methods, while low flow overhead sprinklers are used to water the shrub container area. Some plants are also only hand watered on an as-needed basis. To further reduce water demand, the nursery also modifies the container mixes to increase the soil water holding capacity.

The irrigation system is regularly monitored for leaks to reduce water loss and the expense associated with running the pumps. The irrigation system is charged to a water pressure up to 60 pounds per square inch (PSI) before its operation. If there is a leak in the system, a drop in pressure is evident on the system pressure gauge before any water is distributed to the sprinklers or drip heads. The leak is then identified and repaired.

Water Conservation Alternatives and Costs

The accurate measurement of water use is a basic water conservation measure. USDA grants for irrigation system upgrades now usually include a meter as part of the system design. This is done to ensure compliance with calculated water budgets/ efficiency standards. Currently, Scenic Nursery estimates its water use based on pump run time for each of its three water supplies. Scenic Nursery will operate each source such that water use estimates have an accuracy of within 10 percent or will institute water use metering, testing and calibration on its existing water supplies. Scenic Nursery will work with the DES Drinking Water and Groundwater Bureau's Conservation Program to assess its water use measurement accuracy. Meters will be installed if measurement accuracy cannot be maintained within 10 percent.

If meters are installed, the cost of recording water meters is primarily dependent on the size of the water line. For water lines less than 4 inches in diameter, the cost of a new meter can range from $250 to $500. The meters will be tested and calibrated in accordance with the manufacturer's specifications. Bench testing of the meters can range up to $100 per meter and calibration, if needed, may cost an additional $100 to $200 per meter depending on the time required for calibration.

Maximum monthly water use for 2010 through 2012 was 156,000 gallons. Because of their reduced water usage, Scenic Nursery's water use since 2008 has been below the registration and reporting threshold for monthly water use (600,000 gallons per month). If Scenic Nursery demonstrates that it also uses less than 140,000, gallons per week, they would no longer be considered an Affected Water User and would be exempt from the Instream Flow Rules requirements.

Conservation Implementation Schedule

By June 1, 2014, Scenic Nursery will finalize a Water Conservation Plan in accordance with Env-Wq 2101 in order to meet the Instream Flow Rule (Env-Wq 1900) requirements for a conservation plan. The Water Conservation Plan will document Scenic Nursery's existing water conservation activities.

Water User Contact Information

Water User: Scenic Nursery & Landscaping
Address: 9 Dudley Road, Raymond, NH 03077
Contact: Glenn Caron
Phone: 895-0236

Email: glenn@scenicnursery.net

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers.

Env-Wq 2101 Water Conservation Rules, adopted 5/12/05.

Department of Environmental Services (DES) 2010. Water Efficiency Practices for Agricultural Irrigation. Environmental Fact Sheet WD-DWGB-26-5.

New Hampshire Department of Agriculture, Markets & Food 1998. Irrigation Best Management Practices for Agriculture in New Hampshire. Dated March 1998. pg. 18.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. and completed by Glenn Caron.

Personal communication with Glenn Caron, Scenic Nursery & Landscaping.

Water use reports on file with the Department of Environmental Services (DES).

CONSERVATION PLAN

University of New Hampshire/Durham Water Supply (#20066)

Introduction

Conservation plans under the Instream Flow Program (Env-Wq 1900) require meeting the conservation measures and best management practices in the Department of Environmental Services (DES) Water Conservation Rules (Env-Wq 2101). Use of these measures and practices as a standard will provide a common level of effort by all water users.

As part of the permitting of a new water supply source, the University of New Hampshire/Durham Water System (UDWS) prepared a draft Water Conservation Plan (September 2012), which was reviewed by DES Drinking Water and Groundwater Bureau and is under revision by UDWS, but has not yet been approved.

The UDWS is a public water system supplying the Town of Durham and the University of New Hampshire campus. UDWS includes three water supply sources: the Oyster River Reservoir (owned by UNH), in the Town of Durham; the Lee Well (owned by the Town of Durham), in the Town of Lee; and a diversion (owned by UNH) from an impoundment in the Lamprey River above the Wiswall Dam in the Town of Durham. The water system is operated by UNH Water Supply personnel and receives guidance from the Water, Wastewater, and Stormwater Committee, which is staffed by representatives from both the University and the Town of Durham. The maintenance of the system is shared by UNH and the Town of Durham based on the location of the distribution lines. The water use patterns will only be described for the Lamprey River withdrawal, which is the only UDWS source in the Lamprey Water Management Planning Area. This Conservation Plan applies to the entire UDWS service area.

Water Source and Uses

The UDWS has three water sources. Two sources are outside the Lamprey River drainage basin—the Lee Wells (20066-S0x) and the Oyster River withdrawal (20066-S01). The UDWS withdrawal from the Lamprey River is registered with DES as Water User ID #20066-S02. The pumping station and intake, which were constructed in 1970, are located approximately 2,700 feet upstream of Wiswall Dam. The withdrawal is taken from the impounded river segment behind the dam. Figure 1 depicts the location of the pumping station. The withdrawal is located on the Designated River and the drainage area at the location of this diversion is approximately 183.9 square miles.

Prior to 2002, withdrawals from the Lamprey River were used to supplement the Oyster River in times of drought. Water was withdrawn from the Lamprey River on an irregular basis when demand was high and the available supply from the two other water sources was limited. In 2002 a direct connection between the Lamprey River and the Arthur Rollins Water Treatment Plant was completed. Episodes of high water usage for trials and experimentation of the new system configuration occurred from 2002

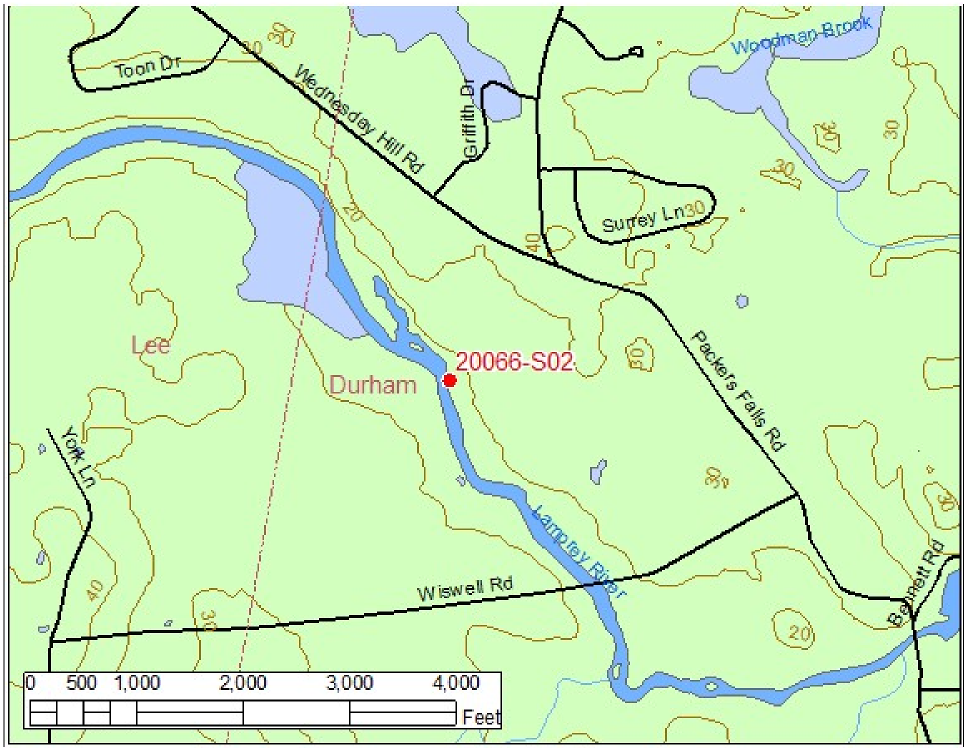

Figure 1. Location of the University of New Hampshire Water Works Lamprey River Pump Station (20066-S02).

to 2004. From 2004 through 2008 the use of the Lamprey River diversion reverted to the historical practice. In the fall of 2008, the Lamprey became the principal year round source of water for the UDWS. Prior to this, the Oyster River was the system's primary source. The water from the Lamprey and Oyster Rivers is treated at the water treatment plant and then distributed to the water system, while the Lee Well, which represents 25 percent of the total supply, supplies the system directly.

Water Use Patterns

Water use data were obtained from the DES Water Use Registration database. Annual water use data were converted from thousands of gallons to cubic feet per second (cfs) and cubic feet per square mile of drainage area (cfsm) to make comparisons with stream flow values in the Lamprey Designated River. The UDWS's water withdrawals were first registered with DES in October 1987 and water use data for the Lamprey River withdrawal are available beginning October 1988. The UDWS's withdrawals are metered and withdrawal volumes are recorded daily and totaled monthly, with the monthly and daily water use data being reported quarterly to DES.

Figure 2 and Table 1 show system-wide water use, although data gaps resulted in some years' data being presented as partial records. Dates presented are for full-year records unless identified otherwise. Water use declined 106.1 million gallons over the 1993 to 2012 period. This is a 27.2 % reduction from the 1993 water use over the 20 years of record, or an average annual decline of 1.36%.

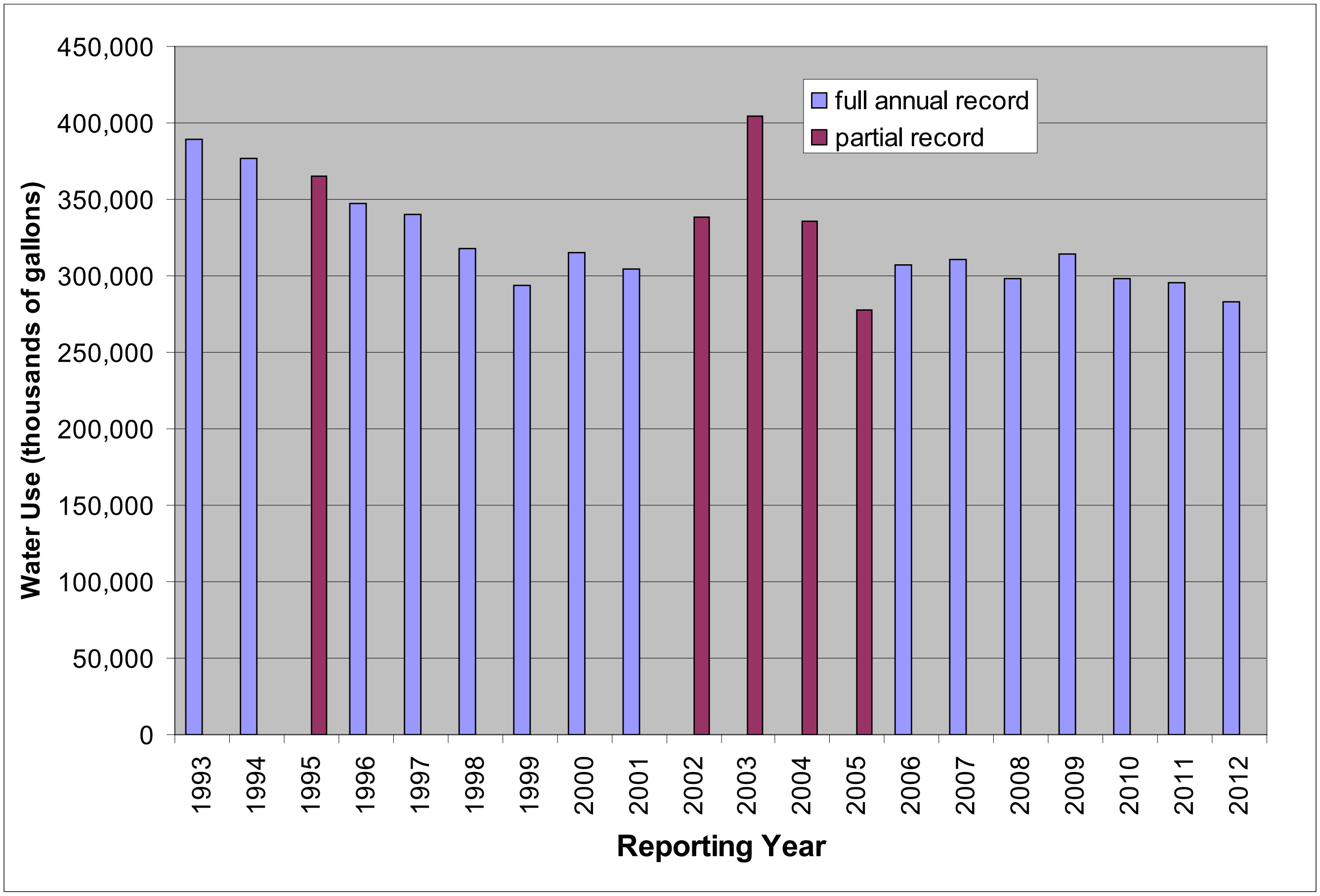

Figure 2 – UDWS (20066) – Annual Water Use

Table 1 – UDWS - Annual Water Use Statistics (from full records during 1993-2012)

	Low	High	Average
Thousands of Gallons	283,369	389,420	319,533
cfs	1.2013	1.6509	1.3546
cfsm at Packers Falls Gage	0.00656	0.00902	0.00740

In 1999, the UDWS increased its use of water from the Lee Well (20066-S03) and used less water from the Oyster River diversion (20066-S01). In late 2008, the UDWS began using the Lamprey River diversion (20066-S02) as its primary water source and use of the Oyster River diversion was further reduced. Annual withdrawals from the UDWS's Oyster River, Lamprey River and Lee well sources are summarized in the figures and tables below.

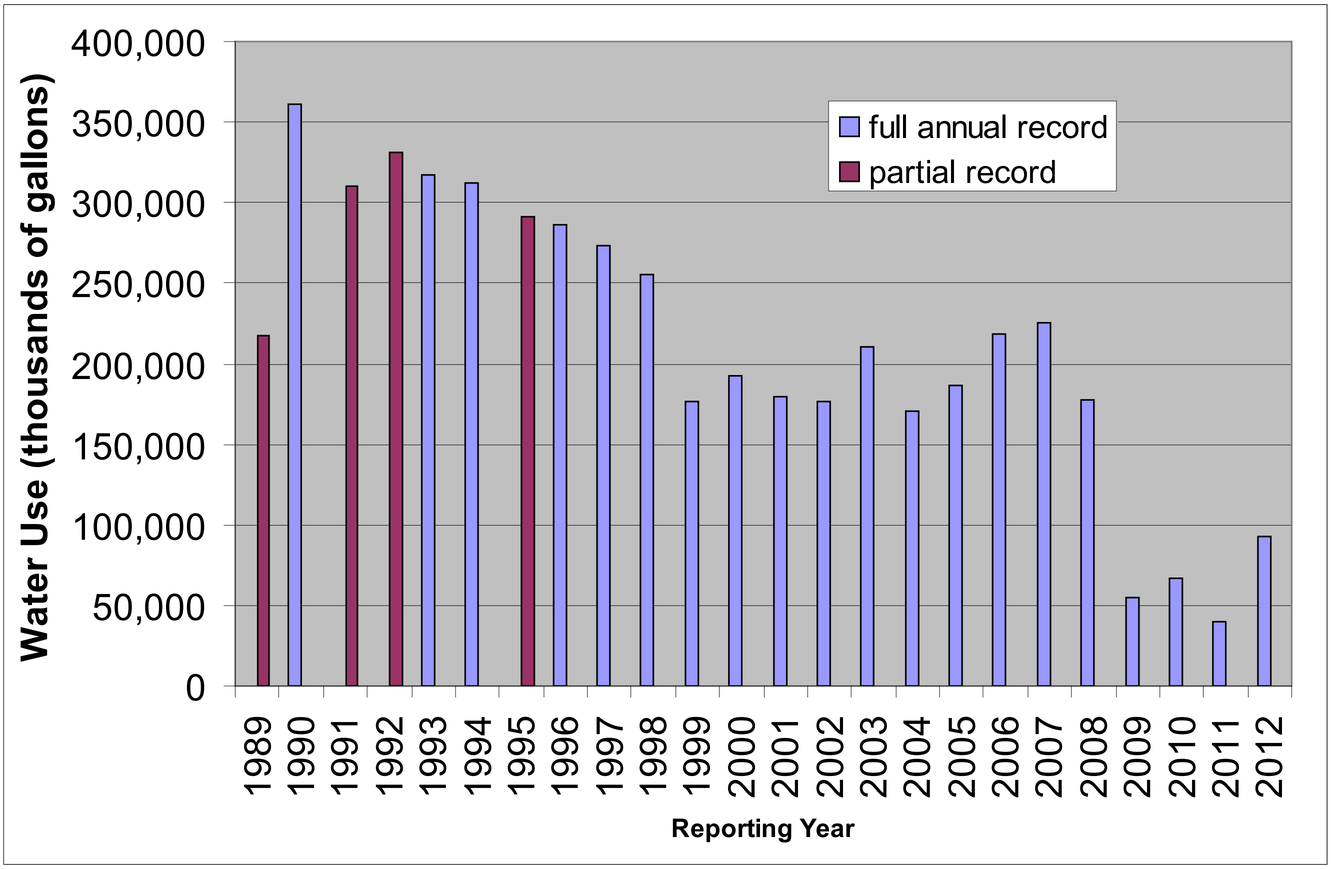

Figure 3 – UDWS – OYSTER RIVER DIVERSION (20066-S01) – Annual Water Use

Table 2 – Oyster River Diversion – Annual Water Use Statistics (from full records during 1989-2012)

	Low	High	Average
Thousands of Gallons	40,310	361,442	198,720
cfs	0.1709	1.5323	0.8424
cfsm at Packers Falls Gage	0.00093	0.00837	0.00460

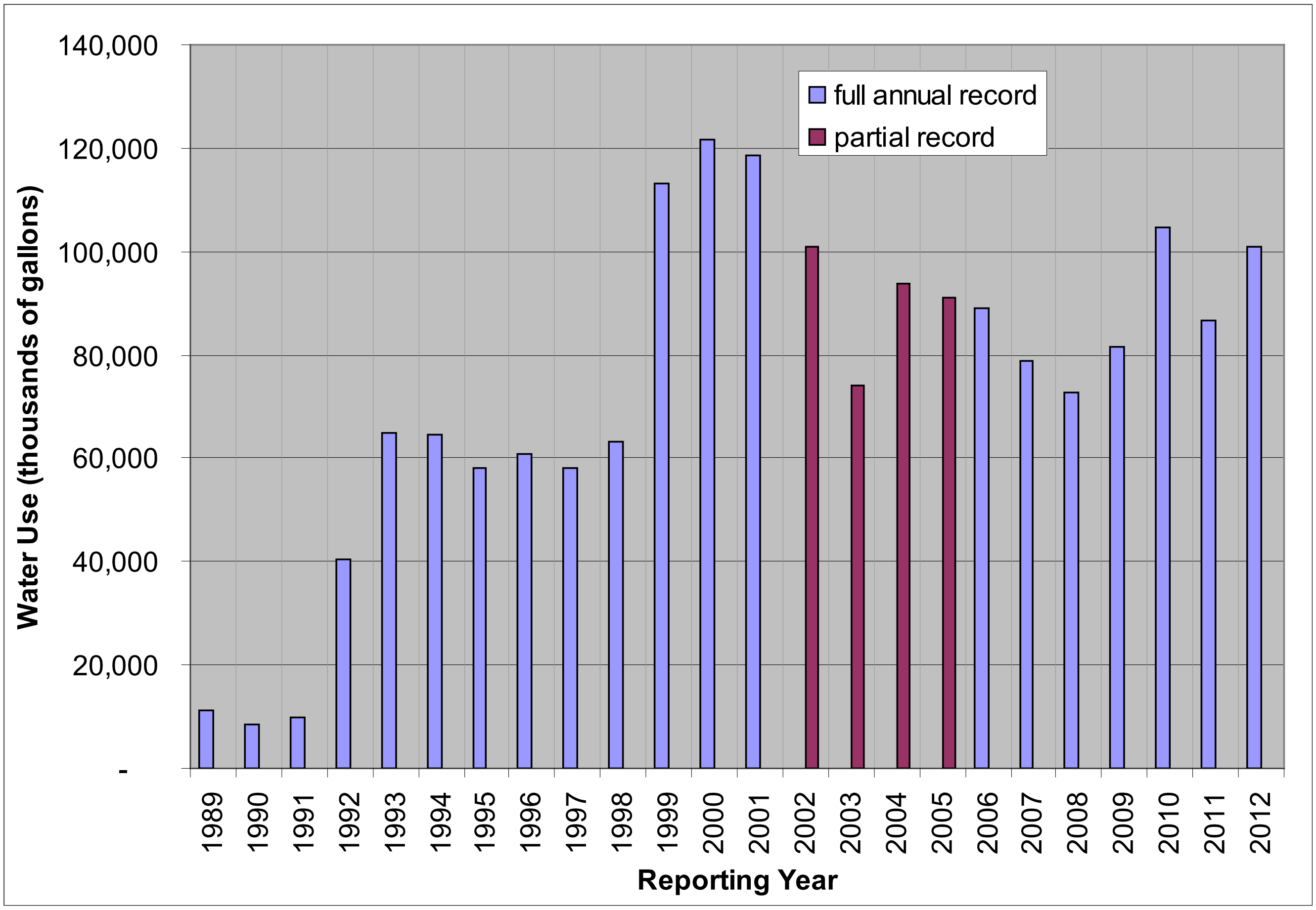

Figure 4 - UDWS – LEE WELL (20066-S03) – Annual Water Use

Table 3 – UDWS – Lee Well – Annual Water Use Statistics (1990-2012, except 2002-2005)

	Low	High	Average
Thousands of Gallons	8,409	121,668	70,392
cfs	0.0356	0.5158	0.2984
cfsm at Packers Falls Gage	0.00019	0.00282	0.00163

Prior to 2009, most supply needs were met with withdrawals from the Oyster River and the Lee Well. Withdrawals from the Lamprey River were made based on increased demand, the combined available supply from the Lee Well and Oyster River Reservoir, and sometimes due to water quality considerations. Withdrawals from the Lamprey River typically occurred during August and September, when demand increased in response to the return of UNH students to Durham, and decreased in the spring with higher stream flow available on the Oyster and the decline in the UNH student population. These withdrawals took advantage of the higher quality of the Lamprey River water to reduce the requirements for water quality treatment.

Between 1993 and 2008 water withdrawals from the Lamprey River were sporadic and irregular. Withdrawals from the Lamprey River were significantly greater from 2002 through 2004 than during all other years until 2009 (Figure 5). According to the UDWS staff, this was a result of trials and experimentation as the Lamprey River withdrawal was transitioned from a source of recharge to the Oyster River Reservoir to a direct connection with the water treatment plant. This period also coincided with several summers of below normal flows on the Lamprey and Oyster Rivers due to regional drought conditions. Starting in late 2008, the Lamprey River became the principal source of water for the UDWS. Annual water use beginning in 2009 clearly reflects this change in priority of use. Water use statistics show the shift in emphasis placed on the use of the Lamprey River before and after the beginning of 2009.

Annual withdrawals during the period 1993 through 2008 increased by 39.8 million gallons or 515 percent. This represents an average increase of 2.487 million gallons per year or 32 percent per year over this 16 year period of record. In comparison, annual water use by the entire UDWS between 1993 and 2008 decreased by 91.4 million gallons or 23.5 percent. Annual water use from the Lamprey River from 1993 through 2008 ranged from a high of 120.905 million gallons (2003) to a low of 0 gallons (multiple years), with an average annual use of 21.963 million gallons (Table 4a). From 2009 through 2012, water use ranged from a high of 178.760 million gallons (2009) to a low of 89.630 million gallons (2012), with an average annual use of 140.948 million gallons (Table 4b).

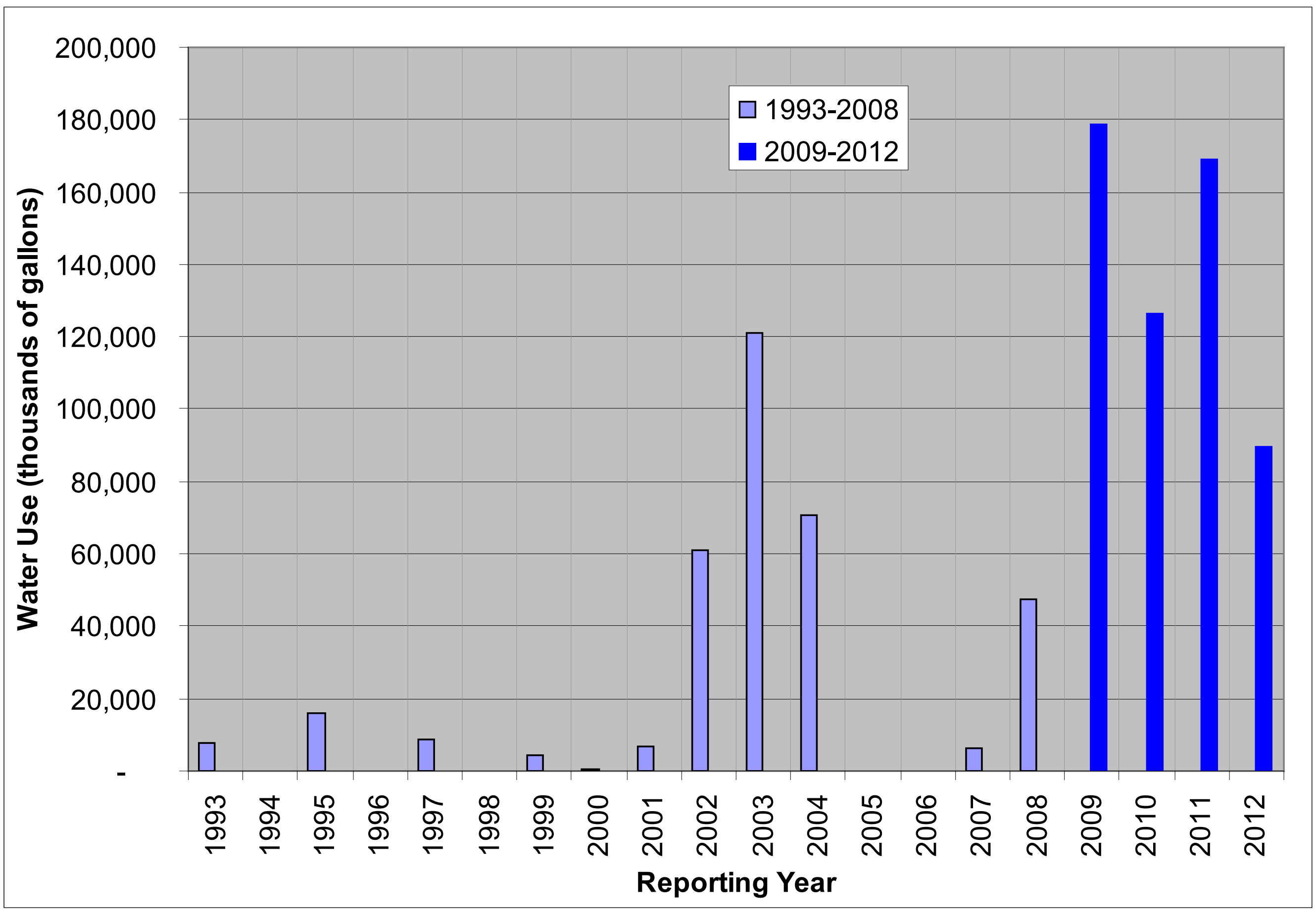

Figure 5 – UDWS - LAMPREY RIVER DIVERSION (20045-S02) - Annual Water Use (1993 through 2012).

Table 4a – UDWS – Lamprey River – Annual Water Use Statistics (1993-2008)

	Low	High	Average
Thousands of Gallons	-	120,905	21,963
cfs	-	0.5125	0.0931
cfsm at Packers Falls Gage	0.00000	0.00280	0.00051

Table 4b – UDWS – Lamprey River – Annual Water Use Statistics (2009-2012)

	Low	High	Average
Thousands of Gallons	89,631	178,760	140,948
cfs	0.3800	0.7578	0.5975
cfsm at Packers Falls Gage	0.00208	0.00414	0.00327

The UDWS's monthly water use is variable due largely to shifts in seasonal demand, particularly related to start of the university year. The monthly usage pattern is different from that of other public water supplies because the highest usage is not during the summer. The average monthly water usage is greatest during the fall and spring, and lowest during the winter and summer (Figure 6). This seasonal pattern reflects higher water usage as the university prepares for the return of students to UNH in the fall and the increased population upon their return.

The highest monthly usage for UDWS was 51.310 million gallons (October 2003). The lowest monthly usage was 13.272 million gallons (Table 5). The average monthly usage was 27.077 million gallons for 1993 through 2012.

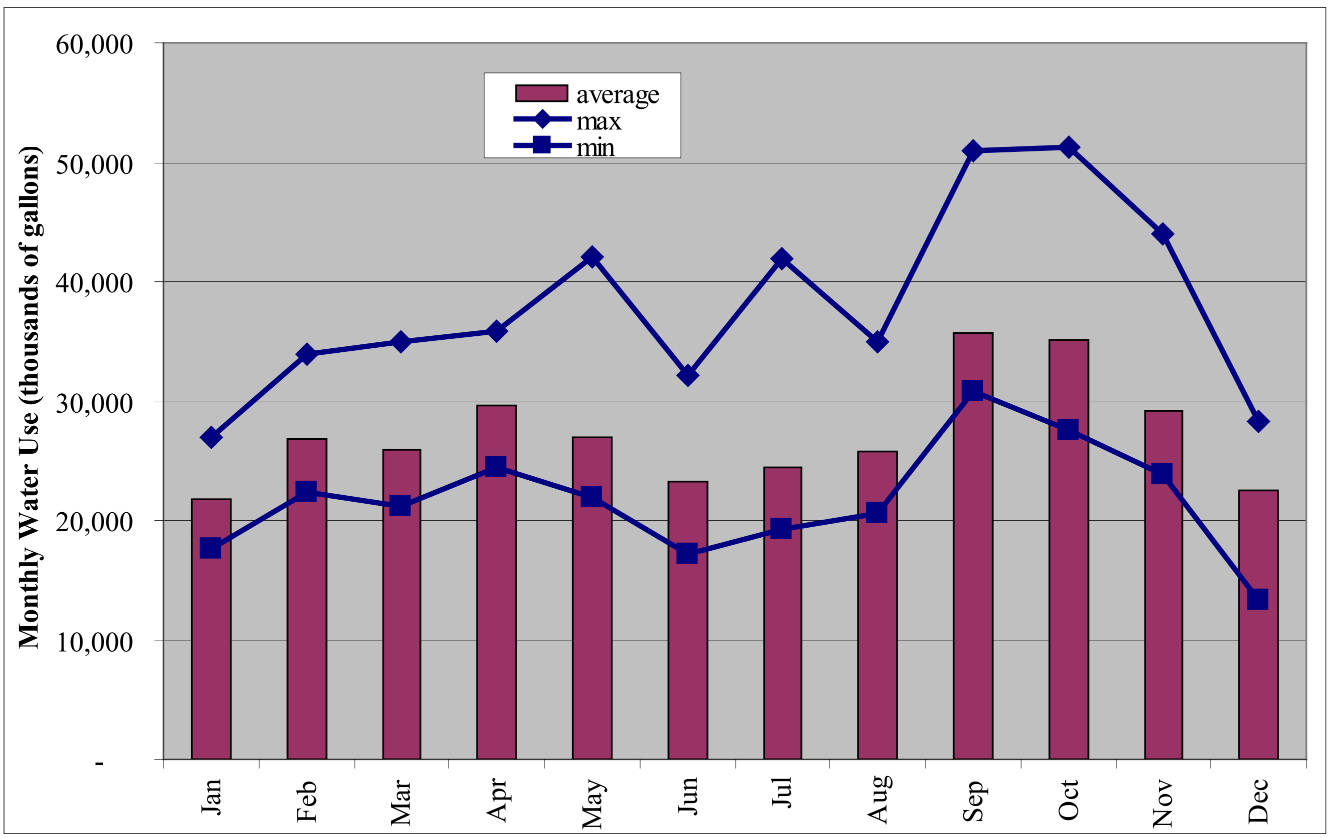

Figure 6 – UDWS – Monthly Water Use Statistics (1993-2012, except Dec 1995 and Sept 2004)

Table 5 – UDWS - Monthly Water Use Statistics (1993-2012, full record months only)

	Low	High	Average
Thousands of Gallons	13,272	51,310	27,282
cfs	0.6752	2.6102	1.3879

Monthly water use data for the Lamprey River withdrawal have been assessed separately for the period before and after the beginning of 2009. The monthly water use data in Figure 7 and Table 6 show that the average monthly water use of the Lamprey River from 1993 through 2008 ranged from a minimum of 0 cfs (multiple occurrences), to a maximum of 1.093 cfs (0.767 million gallons per day) during October 2003, with a mean monthly water use of 0.0929 cfs (65,188 gallons per day).

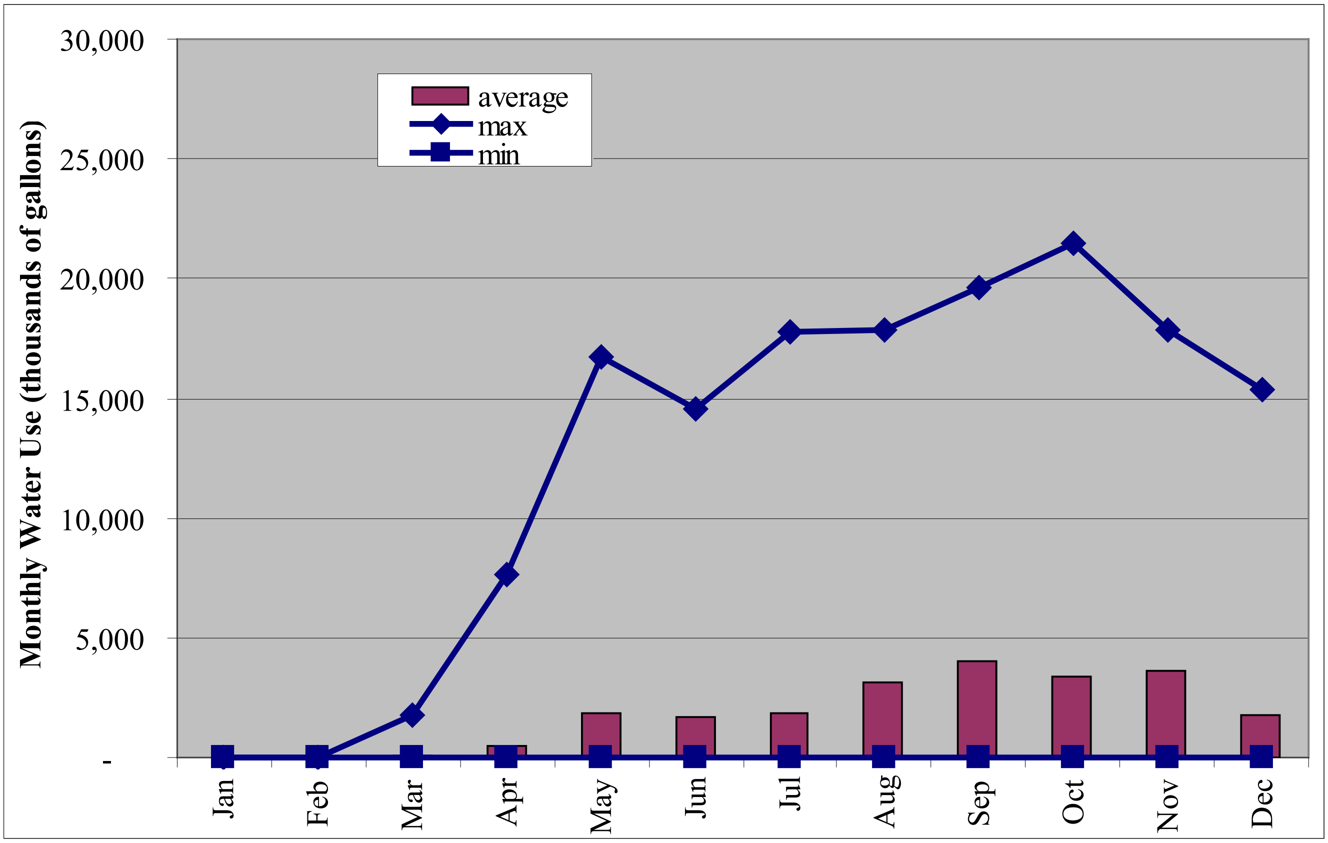

Figure 7 – UDWS – Lamprey River Diversion – Monthly Water Use (1993-2008)

Table 6 – UDWS – Lamprey River Diversion – Monthly Water Use Statistics (1993-2008)

	Low	High	Average
Thousands of Gallons	-	21,480	1,825
cfs	-	1.0927	0.0929
cfsm at Packers Falls Gage	0.00000	0.00597	0.00051

The average monthly water use of the Lamprey River beginning in 2009 through 2012, shown in Figure 8 and Table 7, ranged from a minimum of 0 cfs (multiple occurrences), to a maximum of 1.22 cfs (0.856 million gallons per day, February 2009), with a mean monthly water use of 0.596 cfs (0.385 million gallons per day) over the period 2009-2012 (Table 7).

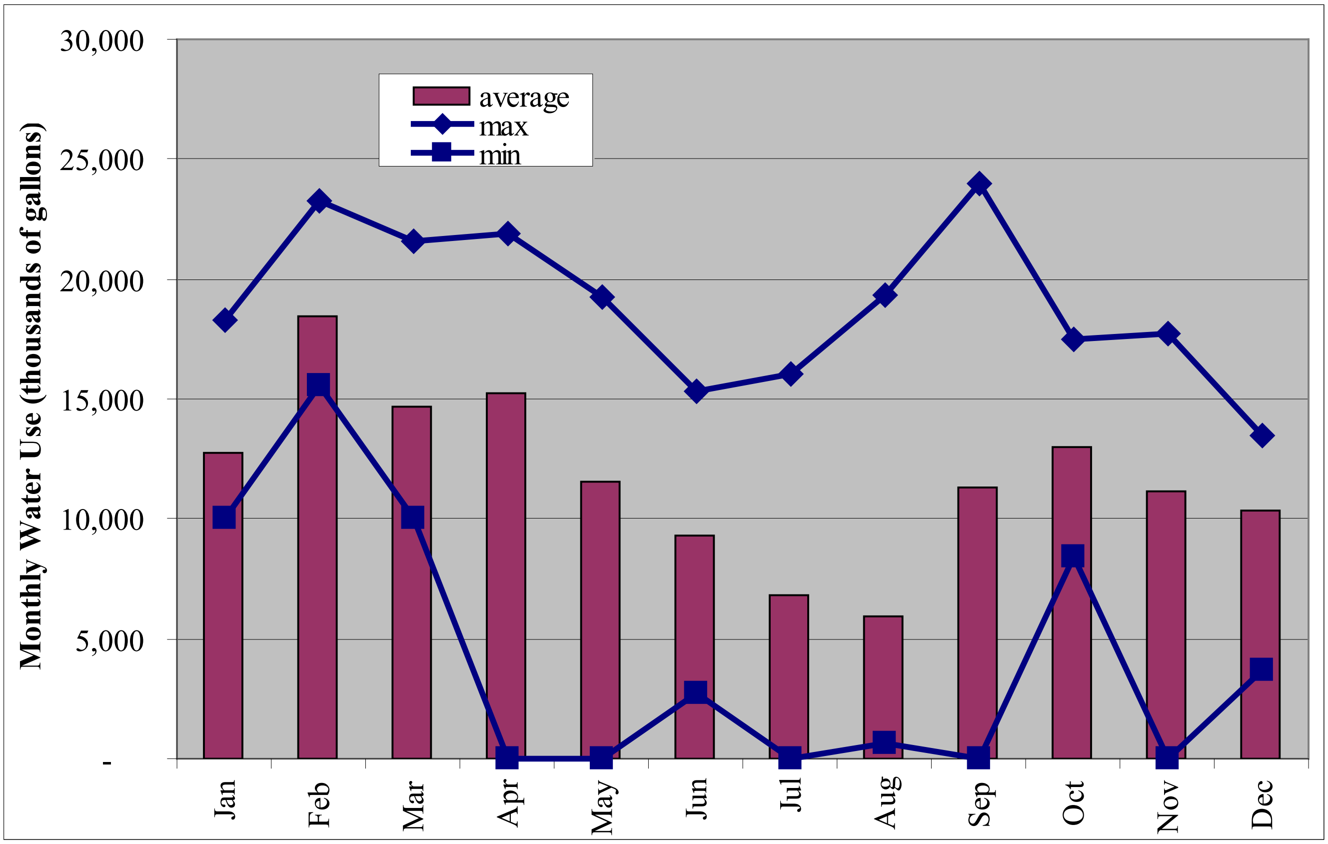

Figure 8 – UDWS – Lamprey River Diversion – Monthly Water Use (2009-2012)

Table 7 – UDWS – Lamprey River Diversion – Monthly Water Use Statistics (2009-2012)

	Low	High	Average
Thousands of Gallons	-	23,955	11,714
cfs	-	1.2186	0.5959
cfsm at Packers Falls Gage	0.00000	0.00666	0.00326

Env-Wq 2101 Requirements for Water Conservation Plan

Development and approval of a water conservation plan that meets the Water Conservation Rules requirements will satisfy the Conservation Plan requirements under the Instream Flow Rules. The Water Conservation Rules require different activities depending on the type of water use. Conservation plans for public water supplies require inclusion of the following components:

- Installation, maintenance, and use of appropriately selected meters;
- Maintaining low levels of unaccounted-for water;
- Performing water audits to assess losses;
- A comprehensive plan for leak detection surveys of the distribution system;
- System pressure reduction where necessary;
- A water conservation educational outreach initiative;
- Adopting a rate structure that promotes water conservation; and,
- On-going water conservation compliance reporting.

The UDWS will be in compliance with the water conservation plan requirements of the Instream Flow Program by completing and obtaining approval of their Water Conservation Plan through DES Groundwater and Drinking Water Bureau.

Existing Water Conservation Measures

UDWS submitted a proposed Water Conservation Plan (September 2012) to the DES Drinking Water and Groundwater Bureau in support of their permit application for the development of a new water supply source near Spruce Hole Bog in Durham. The proposed Water Conservation Plan documents the water conservation measures employed by both UNH and the Town of Durham and how its provisions would meet the water conservation requirements for existing Large Community Water Systems pursuant to Env-Wq 2101.

The 2012 draft Water Conservation Plan describes the existing and planned actions that UNH has implemented as part of its campus sustainability initiative, parts of which are described at UNH's sustainability web site (www.sustainableunh.unh.edu/biodiversity-education-initiative-bei-current-projects#water). The draft plan includes testing and calibration schedules for meters. The master meters at the water treatment facility are tested and calibrated twice a year. The meter at the Lee Well is tested annually. UNH requires all new buildings and renovations to use low flow water fixtures including urinals, toilets, showers and any dishwashers or cooling systems. UNH is also installing waterless urinals and dual flush toilets in two of its most recently renovated buildings. Students at UNH are educated on the water conservation techniques through an annual or biannual outreach effort which includes informational postings and fliers. They are instructed to report leak and drips in sinks, showers and toilets. They are also encouraged only to wash full loads of laundry, to turn the water off while brushing their teeth and to take shorter showers.

As noted in the water conservation section of UNH's Sustainability website (www.sustainableunh.unh.edu/biodiversity-education-initiative-bei-current-projectsl#water), all the water meters on campus buildings are checked via monthly readings. If a meter is 15 percent above or below a running average it is investigated. Meters 2 inches and under are calibrated on an as needed basis or replaced due to unexplained variances. Meters over 2 inches are repaired as needed and calibrated on a rotating basis. Automatic meter reading is being phased in for all meters on campus.

A comprehensive leak detection study was performed on the UDWS system in 2007. The results of the study identified 8 percent unaccounted-for losses, which is lower than the 15 percent limit in the Water Conservation Rules (Env-Wq 2101). To minimize unaccounted-for water, water use is actively monitored and reported leaks are responded to immediately.

The 2012 draft Water Conservation Plan also describes the Town of Durham's current conservation activities. The Town has metered all of its customers and reads its meters twice a year. The Town's water customers pay for their water based on a unit price and the rate structure is the same for all customer classes. The Town periodically sends out water conservation outreach materials with its bi-annual water bills and includes water conservation tips in the weekly Town newsletter that is emailed to Town residents. The Town's engineering department staff present updates to Town committees on water and water conservation issues.

Water Conservation Alternatives and Costs

As required by Env-Wq 2101 for the development of a new water supply source, the UDWS has submitted a proposed Water Conservation Plan (September 2012) to DES for the proposed Large Groundwater Withdrawal identified as Durham/UNH Production Well #2 (DGD-PW2). Completion of this plan by the UDWS and approval by the DES Drinking Water and Groundwater Bureau will meet the Instream Flow Program's Conservation Plan requirements. The Water Conservation Plan will be administered by the Drinking Water and Groundwater Bureau under their existing authority or the authority of the Instream Flow Program.

The costs for the water conservation plan are not considered part of the Instream Flow Program. Completion and approval of the existing draft Water Conservation Plan is a requirement of developing the new water supply source. As such, there are no additional costs associated the Instream Flow Program unless the UDWS abandons its plan to develop the new source.

Conservation Implementation Schedule

Prior to obtaining approval for the proposed new source, but no later than June 1, 2014, the UDWS will finalize its proposed Water Conservation Plan in accordance with Env-Wq 2101.

Water User Contact Information

Water User: University of New Hampshire/Town of Durham Water System

Address: Town of Durham Department of Public Works
100 Stone Quarry Drive, Durham, NH 03824
Contact: David Cedarholm, Town Engineer
Phone: 868-5578
Email: dcedarholm@ci.durham.nh.us

Address: UNH Energy and Utilities
17 Leavitt Lane, Durham, NH 03824
Contact: Jim Dombrosk, Director Energy and Utilities
Phone: 862-2345
Email: jim.dombrosk@unh.edu

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
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1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers.

Env-Wq 2101 Water Conservation Rules, adopted 5/12/05.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Personal communication with Wesley East. UNH/Durham Water System.

Personal communication with David Cedarholm, P.E., Town of Durham.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. completed by Wesley East. UNH/Durham Water System.

Weston & Sampson 2012. Town of Durham University of New Hampshire Water Conservation Plan (draft). Dated September 2012.

Water use reports on file with the Department of Environmental Services (DES).

APPENDIX B

Water Use Plans

Lamprey River Water Management Plan

August 2013

WATER USE PLAN

Epping Water Works (#20045)

Introduction

The following Water Use Plan (WUP) has been prepared for Epping Water Works, which supplies water for the Town of Epping, New Hampshire. This WUP was prepared using information provided by Epping Water Works and from their water use records reported to the Department of Environmental Services (DES). Epping Water Works has five registered water sources that are located within the Town. Two sources are located in the vicinity of Hoar Pond, which drains into the Lamprey River, and three sources are located on a tributary to the Piscassic River, which discharges into the Lamprey Designated River at the Newmarket/Durham town line.

Under the Instream Flow Rules (Chapter Env-Wq 1900), Epping Water Works is considered an Affected Water User because its registered water sources are within 500 ft of the Lamprey Designated River or its tributaries. In addition, its registered water sources are within the Lamprey River Water Management Planning Area ("Planning Area"), which is the watershed area of the Lamprey Designated River. Under Chapter Env-Wq 1900, individual WUPs are to be prepared for each Affected Water User located within the Lamprey River Planning Area. Each individual WUP is to include:

- Water use data and information to define water use patterns and needs for each Affected Water User;
- A description of the potential for water use modification, sharing or both to meet the protected instream flow requirements, including water use patterns and needs;
- An estimate of implementation costs of the plan for each Affected Water User; and,
- An implementation schedule for the individual WUP.

Water Source and Uses

The Epping Water Works supply source consists of five registered wells located in Epping, of which four are actively used (20045-S02; 20045-S03; 20045-S04 and 20045-S05) and one is inactive and will not be reactivated for future use (20045-S01). The Hoar Pond Well 1 (20045-S02) and the Hoar Pond Well 2 (20045-S04) are active bedrock wells located north of Hoar Pond and east of Beniah Lane. The Fremont Road Well (20045-S03), an active bedrock well and Well #1 (20045-S01) an inactive gravel packed well are located along Fremont Road (aka Jenness Road) near an unnamed tributary to the Piscassic River. The fifth well, Hoar Pond Well No. 3 (20045-S05), was developed in bedrock in the vicinity of Hoar Pond. Well use was reported beginning March 2012. 20045-S05 is not included in the GIS coverages yet, but would be located on the map near 20045-S04 and 20045-S02.

Water Use Patterns

The groundwater withdrawn from the four active wells is the water supply for the residents and businesses in the Town. The well pumping rates of the wells are variable. The Hoar Pond wells are permitted for 185 gallons per minute (gpm). The pumping capacity of the Fremont Well is about 40 gpm. The pumping schedule and rates are set by the operators and the wells come on when they are needed to maintain the water levels in the two storage tanks that have a combined capacity of 500,000 gallons. The wells are metered and monthly water use is reportedly quarterly to DES.

Water use data for 1992 through 2012 are summarized in the tables and figures below. Water use data for Epping Water Works were obtained from DES. The water use records for 1989 through 1991, and for 2013, were incomplete so they were not included in the annual use summaries. The monthly summaries include the complete records for the years of 1992 through 2012.

Between 1992 and 2012, annual water use by Epping Water Works ranged from a high of 51.9 million gallons (1999), to a low of 32.4 million gallons (1992) with an average annual use of 41.06 million gallons (Figure 1 and Table 1). During this period the annual water use increased by 18.73 million gallons or 57.7 percent. This represents an average increase of 0.89 million gallons per year or 2.75 percent per year for the 21 year period of record.

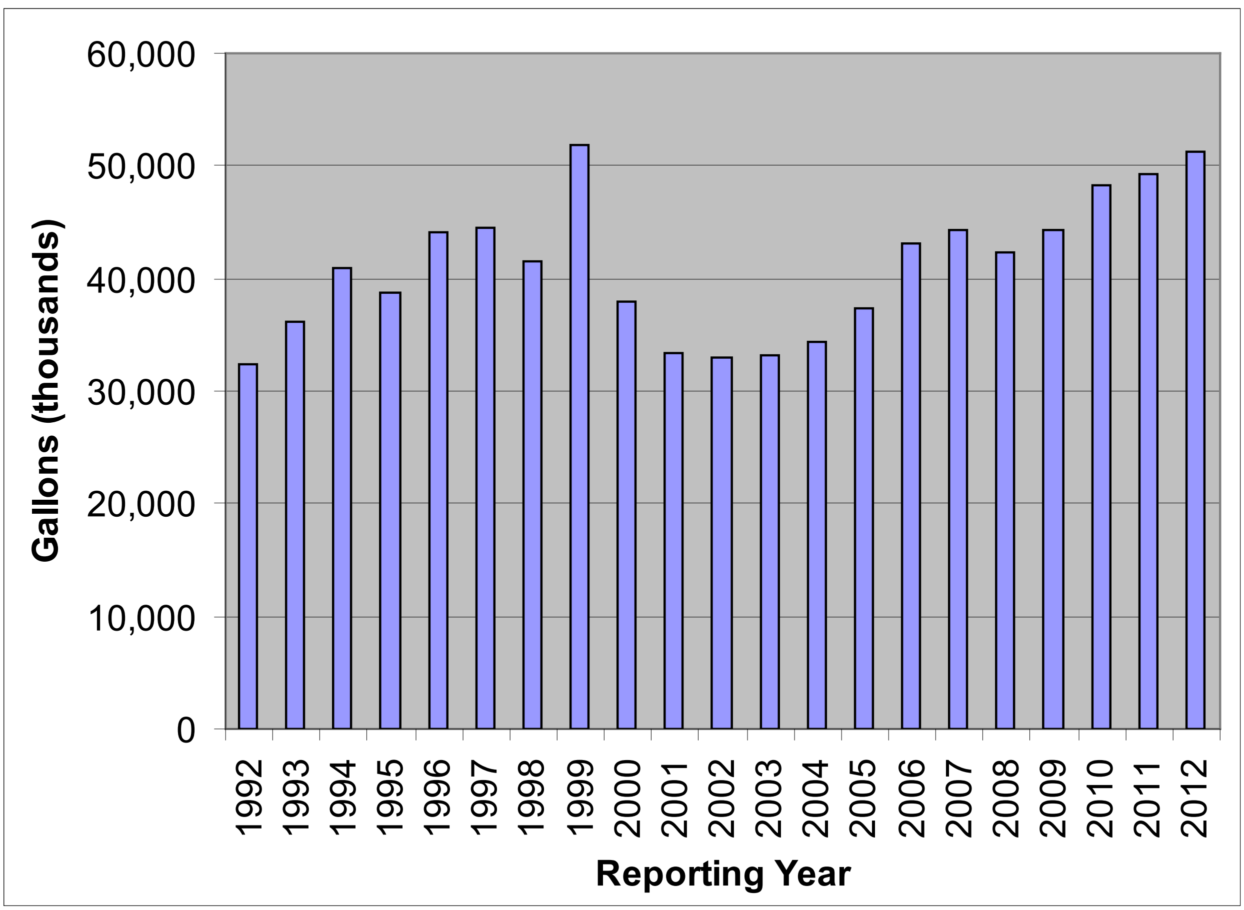

Figure 1 - EPPING WATER WORKS (20045) - Annual Water Use

Table 1 - Epping Water Works Annual Water Use (1992-2012)

	Low	High	Average
Thousands of Gallons	32,452	51,937	41,060
cfs	0.1376	0.2202	0.1741
cfsm at Packers Falls Gage	0.00075	0.00120	0.00095

Monthly water use varies in response to weather conditions and changes in seasonal demand. For the system, the total and average monthly water usage was highest during summer and lowest during winter. This seasonal pattern reflects increased outdoor water usage (lawn irrigation, garden watering, vehicle washing, etc.) during the summer months, which then declines during the fall, remains low during the winter, and begins to increase again in the spring. The highest monthly use was 5.007 million gallons (July 2011), the lowest monthly use was 2.338 million gallons (February 1992), while the average monthly use (1992-2012) was 3.422 million gallons (Figure 2 and Table 2).

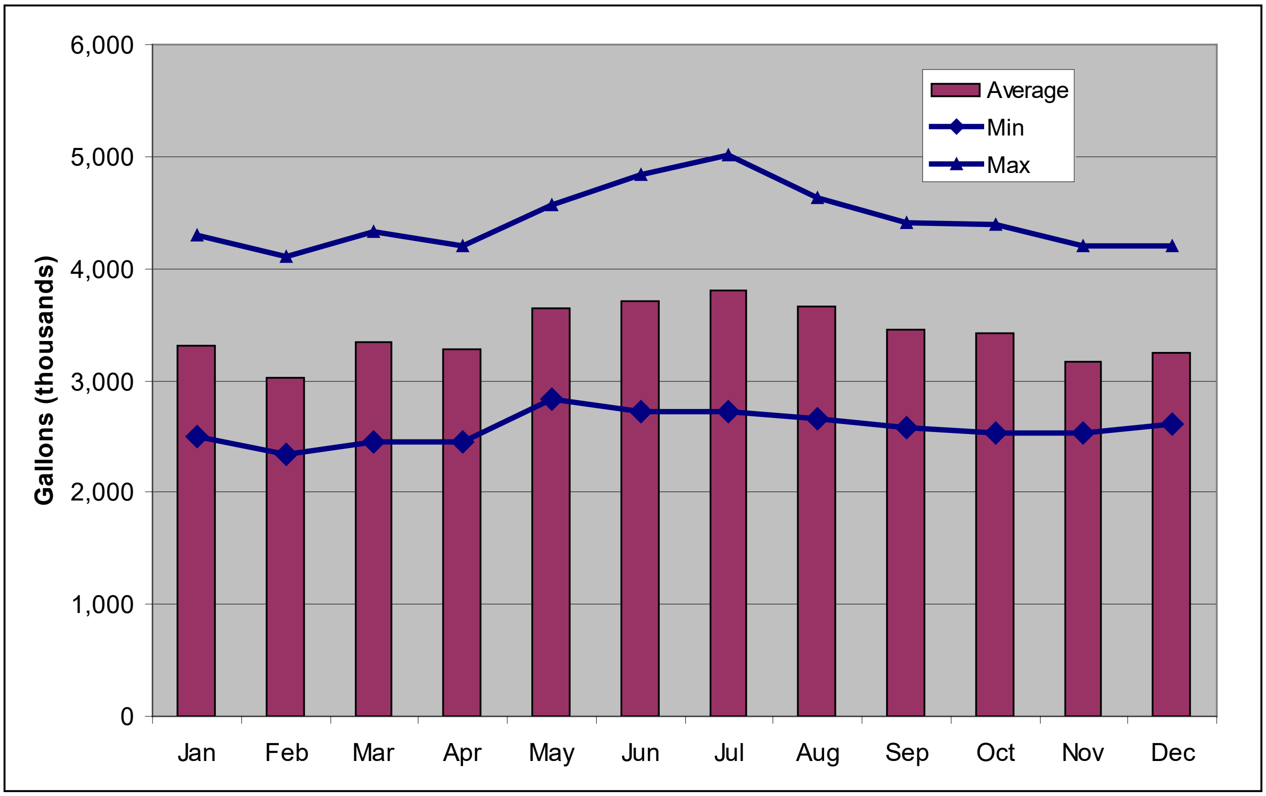

Figure 2 - EPPING WATER WORKS - Monthly Water Use (1992-2012)

Table 2 - Epping Water Works Monthly Water Use Statistics (1992-2012)

	Low	High	Average
Thousands of Gallons	2,338	5,007	3,422
cfs	0.1189	0.2547	0.1741
cfsm at Packers Falls Gage	0.00065	0.00139	0.00095

The monthly water use data for Epping Water Works was converted from thousand gallons per month to cubic feet per second by dividing the monthly values by days and multiplying them by a flow unit conversion factor (Table 2). Daily water use by Epping Water Works has ranged from a minimum of 0.119 cfs (80,621 gallons per day, February 1992) to a maximum of 0.255 cfs (161,526 gallons per day, July 2011), with an average use of 0.174 cfs (112,493 gallons per day) for the period of 1992 to 2012.

Potential for Water Use Management to Support Protected Instream Flows

Epping Water Works has limited potential to manage its water use to support the Protected Instream Flows on the Lamprey Designated River. Epping's existing water supply consists of three bedrock wells, two of which are located near Hoar Pond, and the other of which is located off of Fremont Road in the Piscassic River drainage basin. The effects of the well withdrawal impacts on Lamprey River stream flow were evaluated (DES 2009a). Only the Fremont Road well was identified as having a potential effect on the flow of a tributary to the Piscassic River, which is a tributary of the Lamprey Designated River. These results are being discounted for two reasons. The assessment was conducted using worst-case conditions that the bedrock wells affect stream flow as if they were sand and gravel wells. Also, because of reduced productivity in this well, the reported well use has declined significantly in the past two years. These factors lead to the conclusion that water withdrawals from this well do not have an immediate effect on the stream flow of the Lamprey tributary by inducing recharge.

Although the Epping water supply wells are not expected to have an immediate effect on stream flow, the extraction of groundwater that would otherwise recharge the river or its tributaries does require management, particularly when flow in the river is dependent on groundwater recharge. This condition typically occurs during the summer and early fall, when flows in the river are at a minimum.

Water Use Plan Activity

Epping Water Works has an established Emergency Action Plan (Town of Epping Water Department 2009) that includes a multi-stage, outside water use reduction plan that applies during periods of drought. Outside water use reduction will be accomplished by implementing the plans for outdoor water use reduction included in the Emergency Action Plan (Town of Epping Water Department 2009). Outside water use is heaviest during the summer and early fall. The outside water use reduction plans apply to the two bioperiods that have the highest levels of outside water use, occurring from June 20 to October 6, and when flows in the Lamprey Designated River fall below the rare protected instream flow levels (DES 2009b). Under this Water Use Plan, outdoor water use will be reduced in two stages: an alert with voluntary water conservation, followed by an enforced water use ban.

The prompts for these conservation actions are determined from flow measurements at the United States Geological Survey gaging station on the Lamprey Designated River near Newmarket (0173500). The actions in this Water Use Plan are based on mean daily flow conditions recorded at this gage and based on conditions defined on the DES Instream Flow Program website.

The first action is an alert from DES. During the period from June 20 to October 6, on the first day after the daily mean discharge at the gage falls below 16 cfs, DES will issue an advisory to the Affected Water Users in the Water Management Planning Area. This flow condition represents the rare protected instream flow magnitude. The alert will include a request that voluntary water conservation measures should be taken and a statement that further actions may begin soon if conditions continue to worsen. The Town will distribute the DES advisory to its water users through the Town's website or other suitable notification methods, or both. The Town may rescind an alert when natural rainfall events result in the daily mean discharge exceeding 18 cfs for two consecutive days. A flow release as part of the Lamprey Water Management Plan does not represent a natural exceedance of the protected flow.

If daily mean discharge in the Lamprey Designated River falls below 16 cfs during this period for longer than the 15 days, the Town will enforce a ban on outside water use as described in the Town's Emergency Action Plan (Town of Epping Water Department 2009). This flow condition represents the Rare, Catastrophic protected flow magnitude and duration (DES 2009b). At this flow level, DES intends to generate an artificial flow of water from upstream dams as a relief pulse to help support aquatic and riparian life of the river. The ban on outside water use may be rescinded by the Town when natural rainfall events result in daily mean discharge exceeding 16 cfs for two consecutive days.

A notice of the enforced outdoor water use ban to be implemented will be drafted by the Water and Sewer Commission. Notification of the water users will be the responsibility of the Town Water Administrator and Systems Operators and may include notices in the local newspaper, radio announcements and/or door-to-door distribution of printed notices. Enforcement of the outdoor water use ban will be performed by the Code Enforcement Officer.

Nothing in this Plan precludes the Town from implementing more restrictive water use actions on its own initiative.

Recordkeeping

Recordkeeping by Affected Water Users and Affected Dam Owners shall include documentation of the actions and the dates and times that management actions were taken to meet their Water Management Plans. This documentation shall include records of conditions affected by the management activities, including but not limited to changes in dam gate conditions, number of stoplogs in place, static water levels in impoundments, and pumping rates. From time to time and subject to available appropriations, DES will conduct audits of the management activities taken by the Affected Water Users and Affected Dam Owners in response to protected stream flow conditions. These records will be retained and made available to DES on request. DES recommends, but does not require, that Affected Water Users and Affected Dam Owners create and retain documentation of the costs associated exclusively with water management activities defined by their Water Management Plans.

Estimated Water Use Plan Implementation Costs

The water use management actions are the implementation of Epping's outdoor water use reductions or bans applied when flows on the Lamprey Designated River fall below the rare protected instream flow levels during summer and early fall during periods exceeding their catastrophic duration. There are no additional direct costs associated with the implementation of these water use management actions.

Water Use Management Plan Implementation Schedule

By June 1, 2014, the Town will implement its Water Use Plan and will institute the measures for the management of outdoor water use during the summer and early fall when flows on the Lamprey Designated River fall below the Rare protected instream flow levels for periods greater than their Catastrophic duration.

Water User Contact Information

Water User: Epping Water and Sewer Commission
Address: 157 Main Street, Epping, NH 03042
Contact: Dennis Koch, Administrator
Michael Yergeau (Board of Selectmen Representative)
Phone: (603) 679-5441 ext. 28
Email: waterandsewer@townofepping.com
Website:

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2009a. Effects of Well Withdrawal Impacts on Lamprey River Stream Flow. NHDES-R-WD-09-5. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire.

Department of Environmental Services (DES) 2009b. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. completed by Dennis Koch, Epping Water Works.

Town of Epping Water Department (2009). Emergency Action Plan for the Municipal Water System. Prepared by: the Epping Water Department, Town of Epping Water Administrator and the Epping Water and Sewer Commission. Effective date March 2003, revised version March 2009.

Personal communication with Dennis Koch, Epping Water Works.

Personal communication with Norm Dionne, Epping Water Works.

Water use reports on file with the Department of Environmental Services (DES).

WATER USE PLAN

Raymond Water Department (#20061)

Introduction

The following Water Use Plan (WUP) has been prepared for the Raymond Water Department, which supplies water for the Town of Raymond, New Hampshire. This WUP was prepared using information provided by the Raymond Water Department and from their water use records reported to the Department of Environmental Services (DES). Raymond Water Department has three registered water sources, which are three overburden groundwater wells located in the Town and along the Lamprey River.

Under the Instream Flow Rules (Chapter Env-Wq 1900), the Raymond Water Department is considered an Affected Water User because its registered water source is within 500 ft of the Lamprey Designated River or its tributaries. In addition, its registered water source is within the Lamprey River Water Management Planning Area ("Planning Area"), which is the watershed area of the Lamprey Designated River. Under Chapter Env-Ws 1900, individual WUPs are to be prepared for each Affected Water User located within the Lamprey River Planning Area. Each individual WUP is to include:

- Water use data and information to define water use patterns and needs for each Affected Water User;
- A description of the potential for water use modification, sharing or both to meet the protected instream flow requirements, including water use patterns and needs;
- An estimate of implementation costs of the plan for each Affected Water User; and,
- An implementation schedule for the individual WUP.

Water Source and Uses

The Raymond Water Department's supply source consists of three stratified drift groundwater wells (1 to 3), which were registered and reported to DES as a single wellfield source (20061-S01) until September 2010. A fourth well that is no longer used is located in the center of town. All three active wells are located within 500 feet of the Lamprey River, upstream of the section of the Lamprey Designated River managed under this Water Management Plan.

Water Use Patterns

The groundwater withdrawn from the three active wells is the water supply for the residents and businesses in the Town. Water is withdrawn and the system is operated in a pattern common to municipal water supply needs that is moderated by the availability of system storage. Water demand follows a typical diurnal pattern. The wells are pumped at an equal withdrawal rate. When pumping exceeds demand, excess water fills the distribution system storage, and when pumping is less than demand, stored water makes up the difference. The pumping rates of the wells are variable and are set by the operators to operate approximately

20 hours per day. Depending on whether the Town is operating one, two or all three wells at a time the individual rates can range from 100 to 400 gallons per minute (gpm). Each well is metered and the total production is recorded daily. Monthly water use is reported quarterly to the DES.

Water use data for the Raymond Water Department wells for the years of 1988 through 2013 were obtained from the DES. The water use records for the system were incomplete for 1988 and 2013, so they are not included in the water use summaries. The monthly summaries include complete annual records for the years 1988 through 2012. Years of complete records are summarized in the figures and tables below.

Between 1989 and 2012 annual water use by Raymond Water Department ranged from a high of 121.88 million gallons (2009) to a low of 76.04 million gallons (1990), with an average annual use of 99.78 million gallons (Figure 1 and Table 1). Overall, annual water use has steadily increased over these 24 years (1989 to 2012), briefly reset by short periods of reduced water use after 1998, 2003 and 2010. During this period annual water use increased 26.10 million gallons or 33.25 percent. This represents an average increase of 1.087 million gallons per year or 1.4 percent per year for the 24 year period of record.

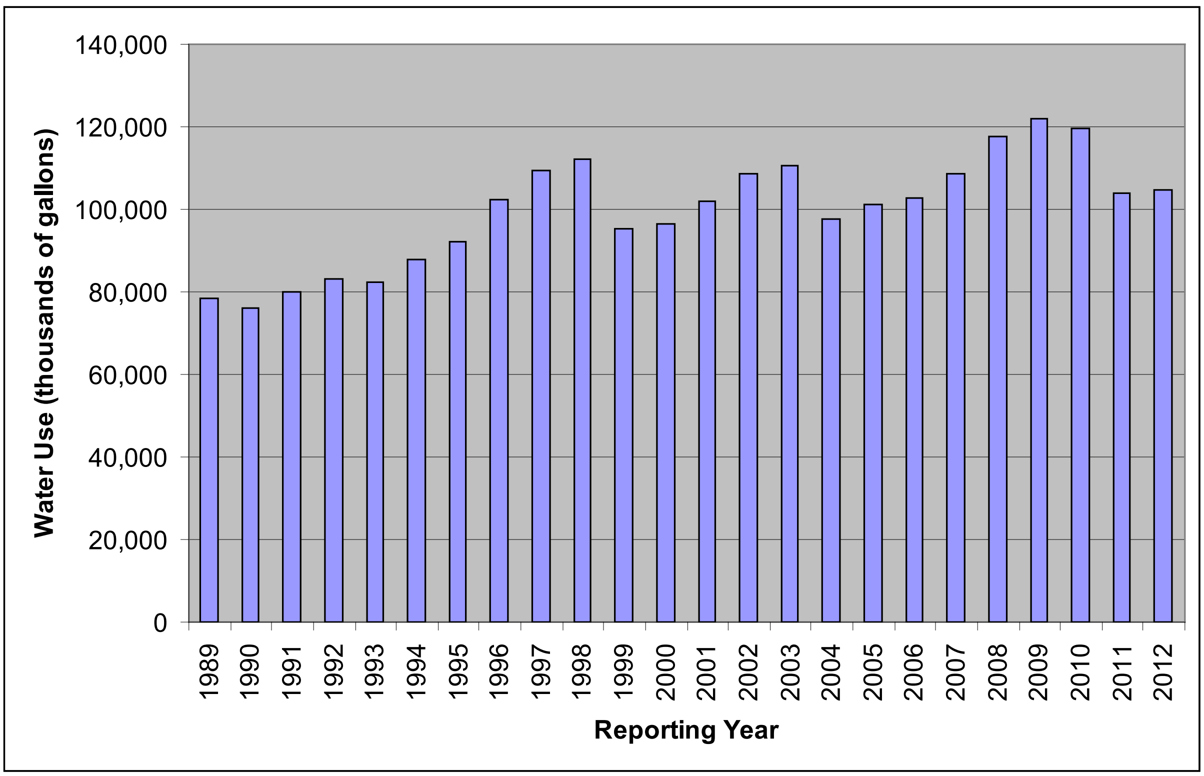

Figure 1 - RAYMOND WATER DEPARTMENT (20061) - Annual Water Use (1989-2012)

Table 1 - Raymond Water Department - Annual Water Use Statistics (1989-2012)

	Low	High	Average
Thousands of Gallons	76,039	121,884	99,784
cfs	0.3224	0.5167	0.4230
cfsm at Packers Falls Gage	0.00176	0.00282	0.00231

The monthly water use records for the entire system begin in October 1988. Monthly water use varies in response to weather conditions and changes in seasonal demand. The total and average monthly water usage was highest during summer and lowest during winter (Figure 4). This seasonal pattern reflects increased outdoor water usage (lawn irrigation, garden watering, vehicle washing, etc.) during the summer months, which then declines during the fall, remains low during the winter, and begins to increase again in the spring. The highest monthly water use was 12.48 million gallons (July 1997), the lowest monthly water use was 4.230 million gallons (November 1989), while the average monthly water use was 8.315 million gallons (Figure 2 and Table 2).

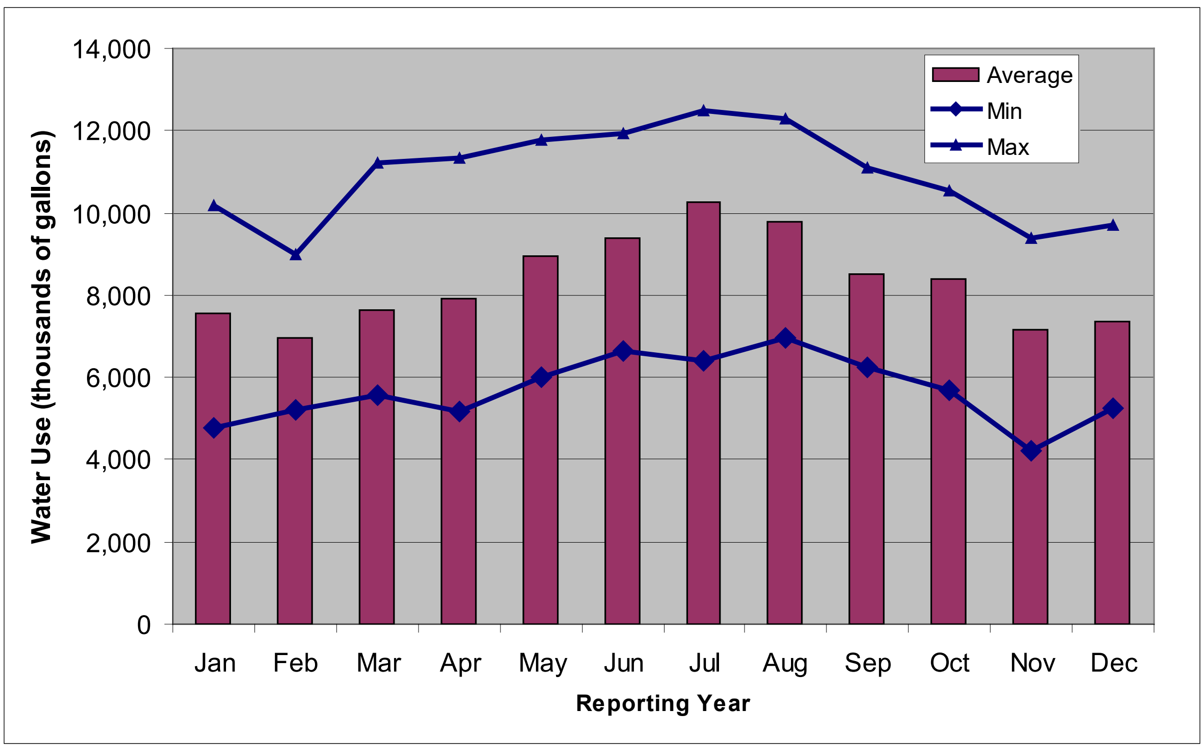

Figure 2 - RAYMOND WATER DEPARTMENT (20061) - Monthly Water Use (1989-2012)

Table 2 - Raymond Water Department - Monthly Water Use Statistics (1989-2012)

	Low	High	Average
Thousands of Gallons	4,232	12,483	8,315
cfs	0.2153	0.6350	0.4230
cfsm at Packers Falls Gage	0.00118	0.00347	0.00231

The monthly water use data for the Raymond Water Department were converted from thousands of gallons per month to cubic feet per second by dividing the monthly values by days and then multiplying this result by a flow unit conversion factor. Based on these values, the average daily water use by the Raymond Water Department has ranged from a minimum of 0.218 cfs (141,067 gallons per day, November 1989), to a maximum of 0.623 cfs (402,677 gallons per day, July 1997) with an average use of 0.423 cfs (273,381 gallons per day) for the period of 1989 through 2012 (Table 2).

Potential for Water Use Management to Support Protected Instream Flows

The Raymond Water Department has limited potential to manage its water use to support the Protected Instream Flows on the Lamprey Designated River. Raymond's existing water supply consists of three stratified drift groundwater wells located within 500 feet of the Lamprey River. The effects of the well withdrawal impacts on Lamprey River stream flow were evaluated (DES 2009a) and none of the wells were found to have an immediate effect on the flow of the Lamprey River. Assessment of these wells showed that none of them pumping individually at average or maximum withdrawal rates induces recharge from the nearest surface water tributary. Generally, this result directs water use planning toward long term strategies instead of changes in pumping schedule or other techniques that result in immediate or short term effects. Pumping all wells simultaneously was not evaluated and there is a small chance that all three wells pumping simultaneously could induce recharge. If, as expected, pumping these wells is not inducing recharge, then changing the pumping rate, duration or frequency will result in slower acting effects on stream flow that may not address in a timely manner the relatively short-term low flow management events that are expected.

Although the Raymond Water Department's supply wells may not have an immediate effect on the Lamprey River, the extraction of groundwater that would otherwise recharge the river requires management, particularly when flow in the river is mostly dependent on groundwater recharge. This condition typically occurs during the summer and early fall, when flows in the river are at a minimum.

Water Use Plan Activity

The Raymond Water Department has an established Emergency Plan (Town of Raymond 2009) that includes a multi-stage, outside water use reduction plan that applies during periods of drought. Outside water use reduction will be accomplished by implementing the plans for outdoor water use reduction included in the Emergency Plan (Town of Raymond 2009). Outside water use is heaviest during the summer and early fall. The outside water use reduction plans are applied to the two bioperiods that have the highest levels of outside water use, occurring from June 20 to October 6, and when flows in the Lamprey Designated River fall below the rare protected instream flow levels (DES 2009b). Under this Water Use Plan, outdoor water use will be reduced in two stages: an alert that includes voluntary water conservation, followed by an enforced water use ban.

The prompts for these conservation actions are determined from flow measurements at the United States Geological Survey gaging station on the Lamprey River near Newmarket (0173500). The actions in this Water Use Plan are based on mean daily flow conditions recorded at this gage or based on conditions defined on the DES web page at: http://www2.des.state.nh.us/onestoppub/watershed/lamprey_pisf_tracking.xls.

The first action is an alert from DES. During the period from June 20 to October 6, on the first day after daily mean discharge at the gage falls below 16 cfs, DES will issue an advisory to the Affected Water Users in the Water Management Planning Area. This flow condition represents the rare protected instream flow magnitude. The alert will include a request that voluntary water conservation measures should be taken and a statement that further actions may begin soon if conditions continue to worsen. The Town will pass the DES notification on to its water users through the Town's website or other suitable notification methods, or both. The Town may rescind an alert when natural rainfall events result in daily mean discharge exceeding 18 cfs for two consecutive days. A flow release as part of the Lamprey Water Management Plan does represent a natural exceedance of the protected flow.

If daily mean discharge in the Lamprey Designated River falls below 16 cfs during this period for longer than 15 days, the Town will enforce a ban on outside water use as described in the Level 2 Ban in the Town's Emergency Plan (Town of Raymond 2009). This flow condition represents the Rare, Catastrophic protected flow magnitude and duration (DES 2009b). At this flow level, DES intends to generate an artificial flow of water from upstream dams as a relief pulse to help support aquatic and riparian life of the river. The ban on outside water use may be rescinded by the Town when natural rainfall events result in daily mean discharge exceeding 16 cfs for two consecutive days.

The notification process for outside water use reductions is defined in the Town's Emergency Plan (Town of Raymond 2009). The Water Division Foreman, under instruction by the Town Manager, will implement notification of the water use restrictions. The Town of Raymond will notify residents of the water use restrictions using the "CodeRED" emergency notification system. This system issues emergency notices to residents and businesses at their registered phone numbers using a high-speed telephone calling system. In addition, notices will be broadcast through local television, radio and newspapers. Enforcement of the water restrictions will be the responsibility of the Raymond Police Department.

Nothing in this Plan precludes the Town from implementing more restrictive water use actions on its own initiative.

Whenever operational considerations of the water system allow during periods when voluntary outdoor water use restrictions are recommended or during a ban on outdoor water use, the Town will manage pumping from the three water supply wells to further minimize potential impacts to the Lamprey Designated River. This includes minimizing the withdrawal of groundwater from the well located closest to the river, balancing this reduction with increased pumping from the well farthest from the river, and operating the withdrawal at lower withdrawal rates over longer periods of time in preference to higher withdrawal rates for shorter periods.

Recordkeeping

Recordkeeping by Affected Water Users and Affected Dam Owners shall include documentation of the actions and the dates and times that management actions were taken to meet their Water Management Plans. This documentation shall include records of conditions affected by the management activities, including but not limited to changes in dam gate conditions, number of stoplogs in place, static water levels in impoundments, and pumping rates. From time to time and subject to available appropriations, DES will conduct audits of the management activities taken by the Affected Water Users and Affected Dam Owners in response to protected stream flow conditions. These records will be retained and made available to DES on request. DES recommends, but does not require, that Affected Water Users and Affected Dam Owners create and retain documentation of the costs associated exclusively with water management activities defined by their Water Management Plans.

Estimated Water Use Plan Implementation Costs

The water use management actions are the implementation of Raymond's outside water use reductions or bans applied when flows on the Lamprey Designated River fall below the Rare protected instream flow levels during summer and early fall during periods exceeding their Catastrophic duration. There are no additional direct costs associated with the implementation of these water use management actions.

Water Use Management Plan Implementation Schedule

By June 1, 2014, the Town will implement its Water Use Plan and will institute the measures for the management of outdoor water use during the summer and early fall when flows on the Lamprey Designated River fall below the Rare protected instream flow levels. The Town will update this Plan in response to any applicable changes in the state's Rules for the Protection of Instream Flow on Designated Rivers (Env-Wq 1900).

Water User Contact Information

Water User: Raymond Water Division
Address: 4 Epping Street, Raymond, NH 03077
Contact: Steve Brewer, Public Works Director
Phone: (603)895-4735 ext. 108
Email: sbrewer@raymondnh.gov

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2009a. Effects of Well Withdrawal Impacts on Lamprey River Stream Flow. NHDES-R-WD-09-5. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire.

Department of Environmental Services (DES) 2009b. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Town of Raymond 2009. Emergency Plan. Town of Raymond, Public Works Department, Water Division.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. and completed by Dennis McCarthy.

Personal communication with Dennis McCarthy, Town of Raymond.

Personal communication with Norm Dionne, Town of Raymond.

Water use reports on file with the Department of Environmental Services (DES).

WATER USE PLAN

Scenic Nursery & Landscaping (#20747)

Introduction

The following Water Use Plan (WUP) has been prepared for Scenic Nursery & Landscaping (Scenic Nursery), which is located in Raymond, New Hampshire. Scenic Nursery has three registered water sources, which include an overburden groundwater well near the Lamprey River, a temporary direct withdrawal from the Lamprey River and a withdrawal from a pond located along the Lamprey River.

Under the Instream Flow Rules (Chapter Env-Wq 1900) Scenic Nursery is considered an Affected Water User because its registered water sources are within 500 ft of a tributary to the Lamprey Designated River. In addition, its registered water sources are within the Lamprey River Water Management Planning Area ("Planning Area"), which is the watershed area of the Lamprey Designated River. Under Chapter Env-Wq 1900, individual WUPs are to be prepared for each Affected Water User located within the Lamprey River Planning Area. Each individual WUP is to include:

- Water use data and information to define water use patterns and needs for each Affected Water User;
- A description of the potential for water use modification, sharing or both to meet the protected instream flow requirements, including water use patterns and needs;
- An estimate of implementation costs of the plan for each Affected Water User; and,
- An implementation schedule for the individual WUP.

Water Source and Uses

Scenic Nursery has three registered water sources on its property. The first source is a 15 foot deep dug well (20747-S01) that is located within 70 feet of the river. The second source is a dug well (20747-S02), but due to excessive siltation problems, this well is currently not being used. In its place, an intake pump was placed in the river and the piping from the temporary intake ties into the irrigation system piping in the former dug well. The third water source (20747-S03) is a small pond located in the northwest portion of the property. The pond measures approximately 130 by 80 feet and is reportedly 5 feet deep.

Scenic Nursery is a full service garden center and nursery, which also provides landscape design services. The water withdrawn from the three registered sources is used to water annual plants in a greenhouse as well as approximately seven acres of container and field grown nursery stock (trees and shrubs). Most of the watering is done by a drip irrigation system, while there is some blanket watering by spray irrigation of the container plants.

Water Use Patterns

Water use is primarily during the spring through fall, with no reported water use during the winter (November through February). Their water use is dependent upon plant needs and is mostly affected by weather conditions (rainfall and air temperature). The greatest use of water is in dry periods during which water use can be 24 hours a day, seven days a week. During these periods automated watering occurs from 6 pm to 8 am, followed by manual watering from 8 am to 6 pm.

Scenic Nursery's water withdrawals were first registered with DES in July 2001. Water use is measured based on pump run time, totaled monthly and reported to DES quarterly. Water use data for Scenic Nursery for the years of 2002 through 2012 (except for 2009 when no data is available) were obtained from DES and are summarized in the figures and tables below.

Between 2002 and 2012 annual water use by Scenic Nursery ranged from a high of 4.032 million gallons (2007) to a low of 370,000 gallons (2004), with an average annual use of 1.377 million gallons (Figure 1 and Table 1). The high water use reported in 2002 reflects the drought conditions experienced in 2001 and 2002, while the high water use reported in 2007 reflects the recovery from the flood during April that year. According to the owner, most of the nursery stock was destroyed or washed away during the flood and several years of product had to be replaced. The new above ground stock required more watering, by spray irrigation, until they were replanted into more permanent containers in a pot-to-pot system, which utilizes drip irrigation. The significant decline in water use from 2007 to 2008 reflects the reduced water use due to the establishment of the new plant stock and the reduced reliance on spray

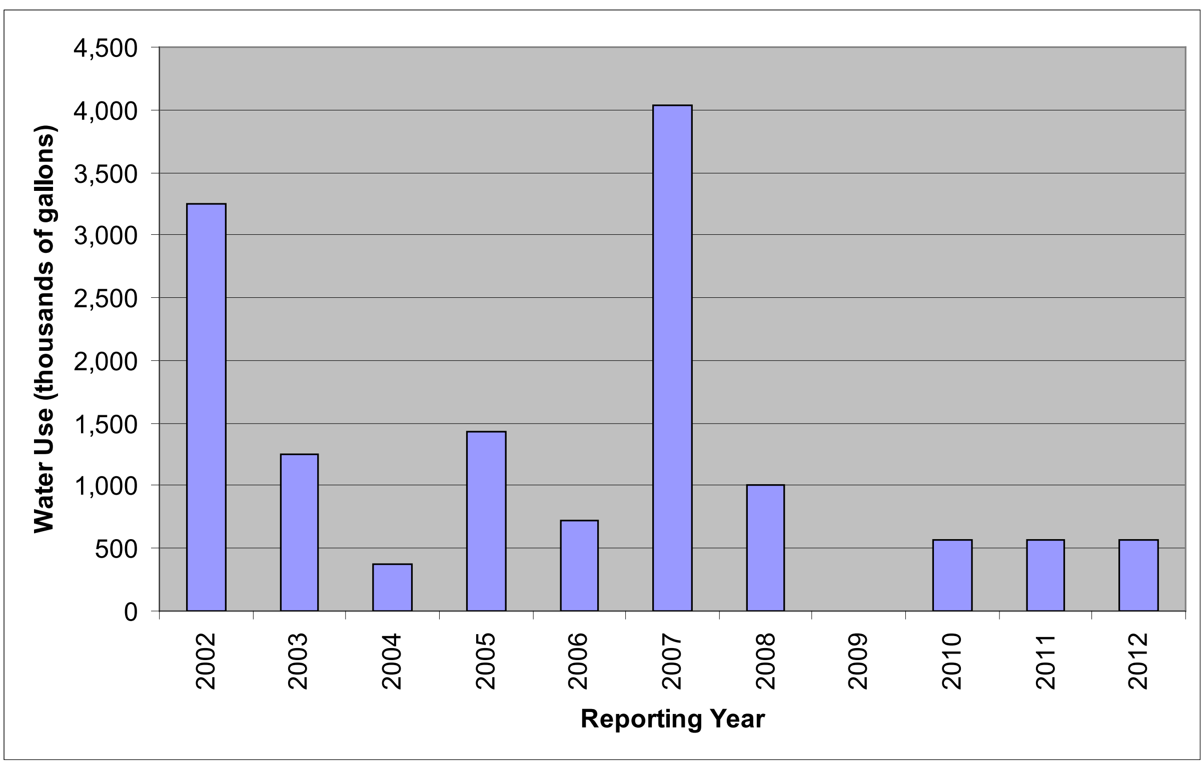

Figure 1 - SCENIC NURSERY - Annual Water Use (2002-2012, no data in 2009)

Table 1 - Scenic Nursery's Annual Water Use Statistics (2002-2012, no data in 2009)

	Low	High	Average
Thousands of Gallons	370	4,032	1,377
cfs	0.0016	0.0171	0.0058
cfsm at Packers Falls Gage	0.00001	0.00009	0.00003

irrigation (Figure 1). Scenic Nursery reduced their annual water use after 2009 by harvesting one of their field grown plant fields and discontinuing its use. They also continued their efforts to reduce water usage through use of water efficient systems and reducing crop water requirements.

Overall, the trend in annual water use from 2002 through 2012 decreased by 2.69 million gallons or 83 percent. This represents an average decrease of 244,000 gallons per year or 7.5 percent per year over the eleven year period of record.

Monthly water use varies in response to weather conditions and plant water demands. There has been no reported water use during the months of November through February due to winter conditions (Figure 2). Mean monthly water use gradually increases from March to a peak in August, in response to high plant irrigation demand, and then declines back to zero by November. The highest monthly water use was 1.008 million gallons in July and August 2007 (Figure 2 and Table 2). The high water use during these months is related to the recovery of the nursery operations after the April 2007 flood. The average monthly water use for the period of 2002 through 2012 was 144,730 gallons. The average monthly water use during the active usage months (March – October) was 172,095 gallons/month or .0089 cfs (5,661 gallons per day).

The monthly water use data for Scenic Nursery were converted from thousands of gallons per month to cubic feet per second (cfs) by dividing the monthly values by days and then multiplying this result by a flow unit conversion factor. These values were also divided by the drainage basin area (183 sq. miles) relative to the location of the Unites States Geological Survey (USGS) gaging station (0173500) on the Lamprey Designated River at Packers Falls near Newmarket. They were also normalized to the drainage area (153 sq. miles) above the start of the Designated Reach (impact point) at the Lee/Durham town line.

Based on these values, water use by the Scenic Nursery has ranged from a minimum of 0 cfs (November through February in all years) to a maximum of 0.05 cfs (32,576 gallons per day, July and August 2007), with an average of 0.007 cfs (2,392 gallons per day) for 2002 through 2008.

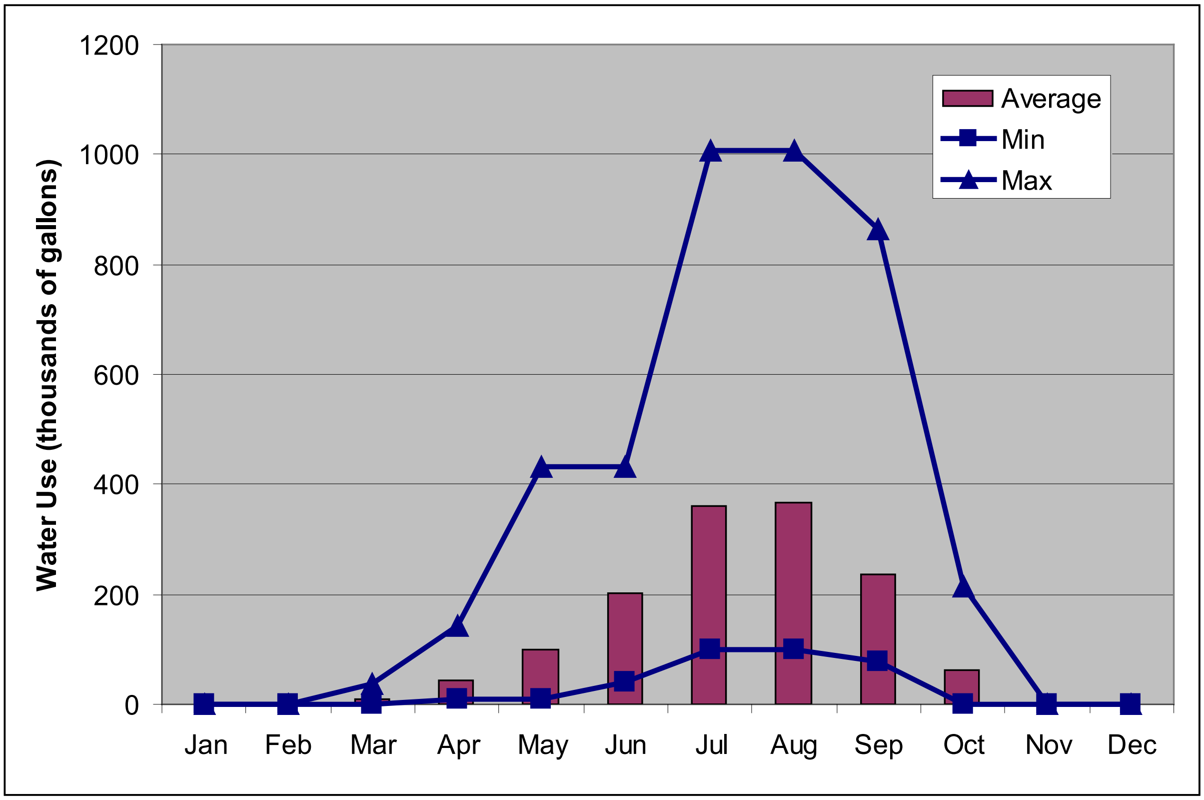

Figure 2 - SCENIC NURSERY - Monthly Water Use (2002-08 and 2010-12)

Table 2 - Scenic Nursery - Monthly Water Use Statistics (2002-08 and 2010-12)

	Low	High	Average
Thousands of Gallons	-	1,008	115
cfs	-	0.0513	0.0058
cfsm at Packers Falls Gage	0.00000	0.00028	0.00003

Potential for Water Use Management to Meet Protected Instream Flows

The potential for water use management at Scenic Nursery to meet the protected instream flows is considered low. This is due to the low volume of water used by Scenic Nursery for their operations. Based on a review of the historical water use by Scenic Nursery, their maximum average daily use is equivalent to 0.05 cfs, which was related to higher than average irrigation use to establish new plants during the recovery of their operations following a significant flood event in 2007. Otherwise, their highest use, 0.02 cfs, occurred in August 2002 during a drought.

Maximum monthly water use for 2010 through 2012 was 156,000 gallons. Because of their reduced water usage, Scenic Nursery's water use since 2008 has been below the registration and reporting threshold for monthly water use (600,000 gallons per month). If Scenic Nursery demonstrates that it also uses less than 140,000 gallons per week, they would no longer be considered an Affected Water User and would be exempt from the Instream Flow Rules requirements.

Water Use Plan Activity

Although the overall water use by Scenic Nursery is low, it utilizes a temporary direct withdrawal from the Lamprey River for irrigation, a consumptive use. During periods when flow on the Lamprey Designated River falls below the Rare flow condition (16 cfs as measured at the United States Geological Survey gaging station 0173500 Lamprey River near Newmarket) during the period of June 20 to October 6 (Rearing and Growth Bioperiod, DES 2009), Scenic Nursery will limit its direct withdrawal from the Lamprey River to its share of the *de minimis* flow available under the Instream Flow Rules (Env-Wq 1903.01).

As noted in the Lamprey Protected Instream Flow Report, the *de minimis* allowable withdrawal from the Lamprey River is 0.21 cfs, or 135,725 gallons per day, under any flow condition. In the Lamprey Water Management Plan, the *de minimis* is apportioned between the two surface water withdrawals at Scenic Nursery (20747-S02) and the University of New Hampshire/Durham Water System (UDWS) withdrawal (20066-S02). Under current water demands, approximately 0.01 cfs (6464 gallons per day) from surface water is available to Scenic Nursery and approximately 0.20 cfs (129,272 gallons per day) is available to UDWS under the *de minimis* withdrawal. The relative availability of the *de minimis* withdrawal may be impacted by future demands by other affected water users, and thus is subject to change. Use of only the *de minimis* amount will be rescinded when natural rainfall events result in daily mean discharge exceeding 18 cfs for two consecutive days.

The prompts for these water use plan actions are determined from flow measurements at the USGS gaging station 0173500 Lamprey River near Newmarket. Flow data can be found at http://waterdata.usgs.gov/nh/nwis/dv/?site_no=01073500&agency_cd=USGS&referred_module=sw. The actions in this Water Use Plan are based on mean daily flow conditions recorded at this gage or based on conditions defined on the DES Instream Flow Program website.

Recordkeeping

Recordkeeping by Affected Water Users and Affected Dam Owners shall include documentation of the actions and the dates and times that management actions were taken to meet their Water Management Plans. This documentation shall include records of conditions affected by the management activities, including but not limited to changes in dam gate conditions, number of stoplogs in place, static water levels in impoundments, and pumping rates. From time to time and subject to available appropriations, DES will conduct audits of the management activities taken by the Affected Water Users and Affected Dam Owners in response to protected stream flow conditions. These records will be retained and made available to DES on request. DES recommends, but does not require, that Affected Water Users and Affected Dam Owners create and retain documentation of the costs associated exclusively with water management activities defined by their Water Management Plans.

Estimated Water Use Plan Implementation Costs

Limiting the direct withdrawal of water from the Lamprey River when flows fall below the rare flow condition during the summer and early fall to *de minimis* flow volumes will not result in any significant direct cost to Scenic Nursery.

Water Use Management Plan Implementation Schedule

By June 1, 2014, Scenic Nursery will institute the condition of limiting its direct withdrawal of water from the Lamprey River during the summer and early fall (Rearing and Growth Bioperiod) when flows on the Lamprey Designated River fall below the Rare flow condition (16 cfs) to its share of the *de minimis* value. Scenic Nursery will update this Plan in response to any applicable changes in the state's Instream Flow Rules (Env-Wq 1900).

Water User Contact Information

Water User: Scenic Nursery & Landscaping
Address: 9 Dudley Road, Raymond, NH 03077
Contact: Glenn Caron
Phone: (603) 895-0236
Email: glenn@scenicnursery.net

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information:

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Personal communication with Glenn Caron, Scenic Nursery & Landscaping.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. and completed by Glenn Caron.

Water use reports on file with the Department of Environmental Services (DES).

WATER USE PLAN

University of New Hampshire/Durham Water System (#20066)

Introduction

The following Water Use Plan (WUP) has been prepared for the University of New Hampshire/Durham Water System (UDWS), which supplies water for the University of New Hampshire and for the Town of Durham, New Hampshire. The WUP was prepared using information provided by the UDWS and from their water use records reported to the Department of Environmental Services (DES). The UDWS has three registered water sources: the Lee Well, the Oyster River and the direct withdrawal from the Lamprey Designated River in Durham.

Because one of its registered water sources is located on the Lamprey Designated River, UDWS is considered to be an Affected Water User under the Instream Flow Rules (Chapter Env-Wq 1900). Under Chapter Env-Wq 1900, individual WUPs are to be prepared for each Affected Water User U located within the Lamprey River Water Management Planning Area ("Planning Area"). Each individual WUP is to include:

- Water use data and information to define water use patterns and needs for each Affected Water User;
- A description of the potential for water use modification, sharing or both to meet the protected instream flow requirements, including water use patterns and needs;
- An estimate of implementation costs of the plan for each Affected Water User; and,
- An implementation schedule for the individual WUP.

Water Source and Uses

The UDWS withdrawal from the Lamprey River is registered with DES as Water User ID #20066-S02. The pumping station and intake, which were constructed in 1970, are located in the reservoir approximately 2,700 feet upstream of Wiswall Dam. The original underground raw water main, also constructed in 1970, transferred water withdrawn at the pump station and discharged directly to the Oyster River at a location approximately 1 mile upstream from UNH's Arthur Rollins Water Treatment Plant (ARWTP) in Durham. To improve the efficiency of the withdrawal, another raw water main was constructed in 2002, which was connected to the original pipe at an intermediate location and run directly to the ARWTP. This withdrawal improvement project, which also included upgrades at the pump station, allowed water withdrawn from the reservoir to be pumped directly to the ARWTP, thereby avoiding losses of the transferred water within the Oyster River and riparian wetlands. The Wiswall Dam, the Wiswall Reservoir and the intake are all located on the Lamprey Designated River.

From 1970 to 2002, withdrawals from the Lamprey River were directly transferred to the Oyster River supply source in times of drought. Water was not withdrawn from the Lamprey River on a regular basis because it was inefficient and increased the turbidity in the Oyster River making it difficult to treat. As a result, infrequent withdrawals were made when demand was high or the available supply from the Oyster River was limited. After 2002, with the direct connection between the Lamprey River and the ARWTP completed, more frequent water usage for trials and experimentation with the new system configuration occurred from 2002 until 2004. From 2004 through 2008 the use of the Lamprey River withdrawal was infrequent and sporadic while a variety of operational complications were resolved. In late 2008, the Lamprey River became the principal source of water for the UDWS. The water from both the Lamprey and Oyster Rivers is treated at the ARWTP and then distributed to the water system, while the Lee Well, which represents 25-50 percent of the total supply depending on flow conditions, supplies the system directly.

Water Use Patterns

Lamprey River withdrawals are metered and withdrawal volumes are recorded daily and totaled monthly, with reports provided to DES on a quarterly basis. Water use data for the UDWS Lamprey River withdrawals for the years 1988 through 2012 were obtained from DES. From January 1988 through December 1992, there is no record of any Lamprey River water use. From January 1993 through December 2012, the monthly water use records are complete. The water use data are summarized in the figures and tables below.

From 1970 to 2008, withdrawals from the Lamprey River were sporadic due to the complexities described above. During this time, supply needs were usually met with withdrawals from the Oyster River and the Lee Well. Withdrawals from the Lamprey River typically began during August and September, when demand increases in response to the return of UNH students to Durham, and ended when demand decreased at the end of May with the conclusion of the UNH spring semester and decline in student population. Starting late in 2008, the Lamprey River became the principal source of water for the UDWS when flow on the Lamprey River exceeds 45 cfs. Water use beginning in 2009 reflects years under this change in priority of use. Water use data have been assessed separately for the period before and after 2009.

Annual water use from the Lamprey River from 1993 through 2008 has ranged from a high of 121.0 million gallons (2003) to a low of 0 gallons (multiple years), with an average annual use of 21.9 million gallons (Figure 1 and Table 1). Withdrawals from the Lamprey River were greater from 2002 through 2004 than during all other years. As described above, this was a result of trials and experimentation as the Lamprey River withdrawal was transitioned from a direct discharge to the Oyster River Reservoir to a direct connection with the ARWTP. This period also coincided with several summers of below normal discharge on the Lamprey and Oyster Rivers due to regional drought conditions. Between 1993 and 2008 water withdrawals from the Lamprey River were sporadic and have little correlation to UDWS overall water use patterns.

Between 2009 and 2012 when the Lamprey was used as the UDWS primary source, annual water use from the Lamprey ranged from a high of 178.3 million gallons (2009) to a low of 89.4 million gallons (2012), with an average annual use of 112.5 million gallons (Table 2).

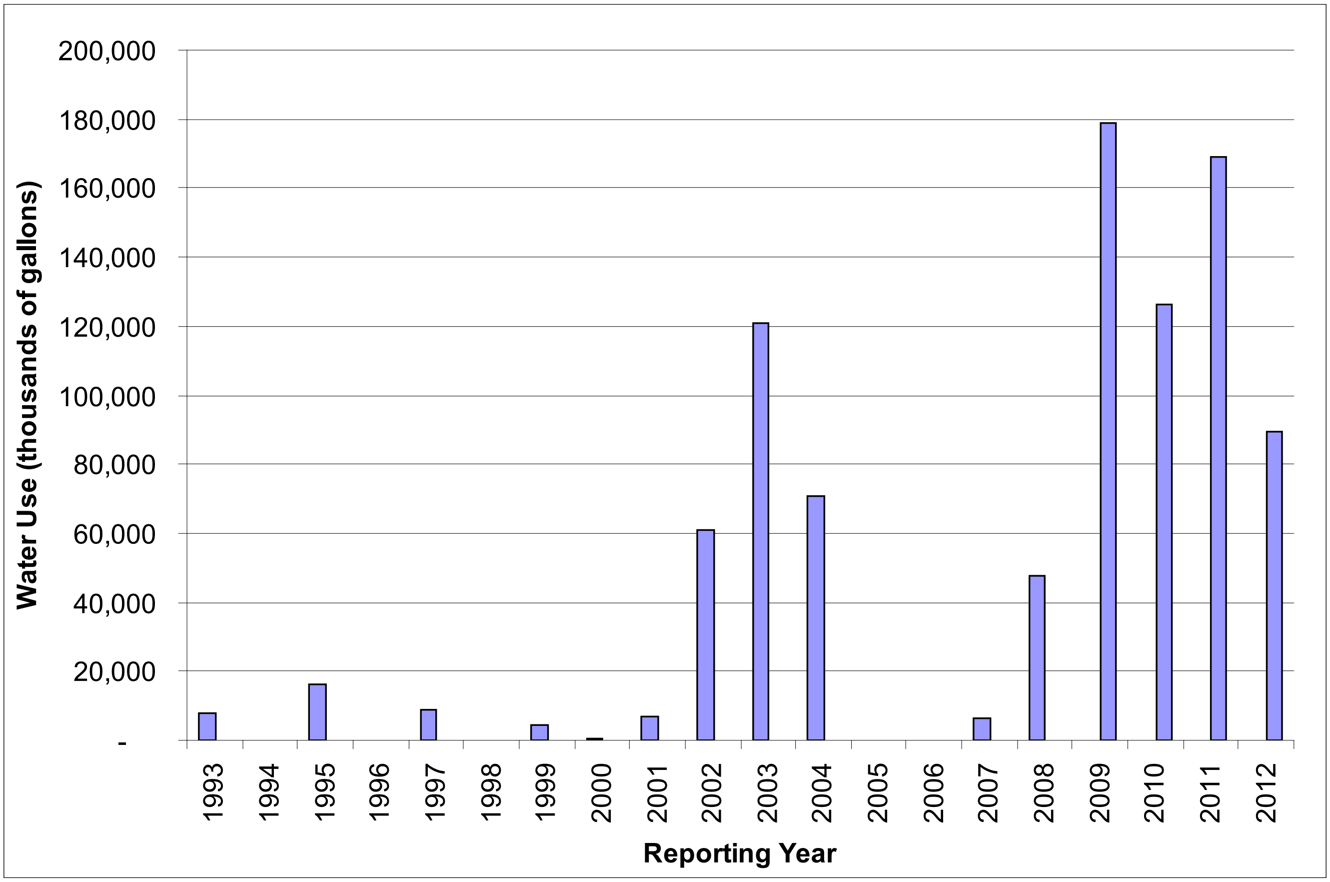

Figure 1 - UDWS - LAMPREY RIVER DIVERSION (20045-S02) - Annual Water Use (1993-2012)

Table 1 - UDWS - Lamprey River Diversion Annual Water Use Statistics (1993-2008)

	Low	High	Average
Thousands of Gallons	-	-120,905	-21,963
cfs	-	-0.5125	-0.0931
cfsm at Packers Falls Gage	0.00000	0.00280	0.00051

Table 2 - UDWS Lamprey River Diversion Annual Water Use Statistics (2009-2012)

	Low	High	Average
Thousands of Gallons	89,631	178,760	140,948
cfs	0.3800	0.7578	0.5975
cfsm at Packers Falls Gage	0.00208	0.00414	0.00327

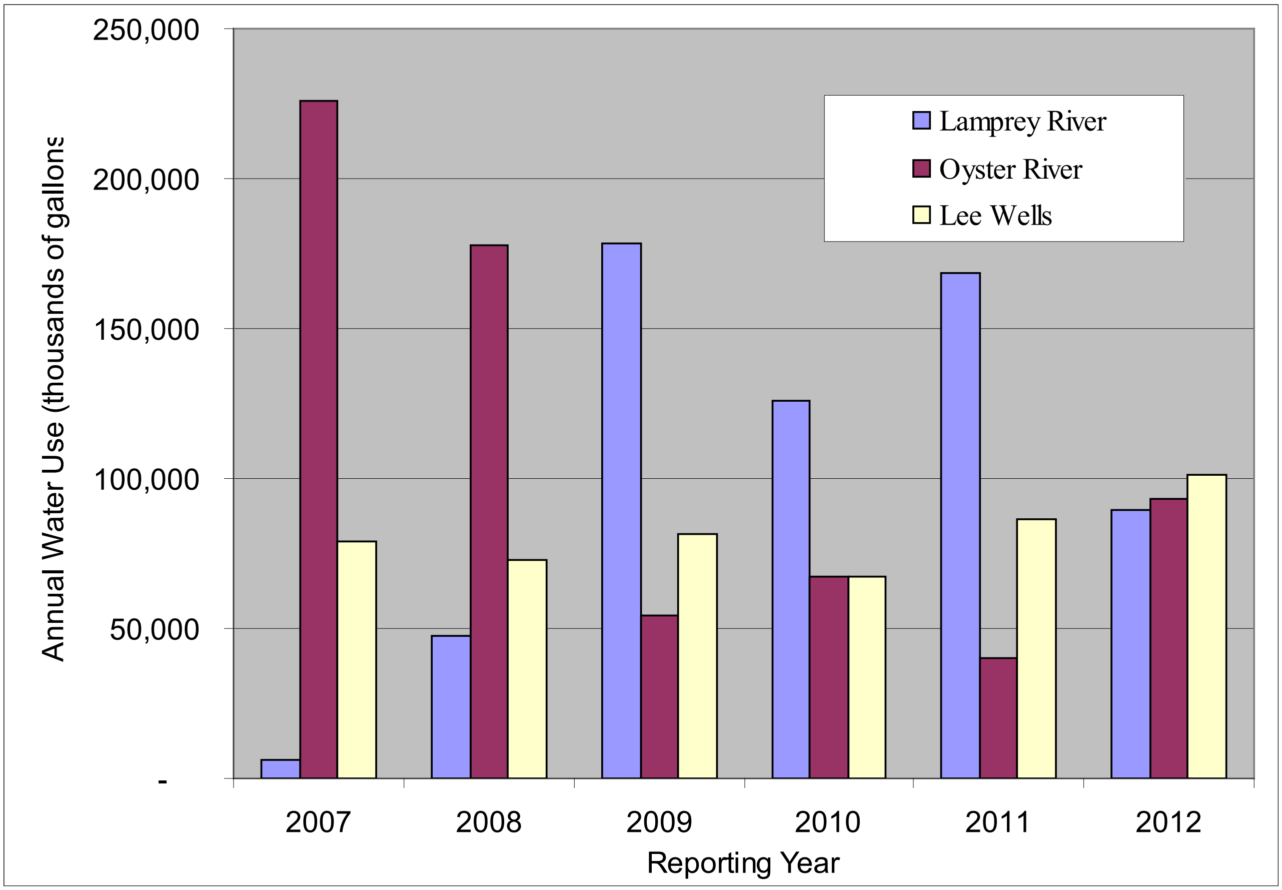

Figure 2 - UDWS (20066) Change in Total Annual Water Use by Sources (2007-2012)

Monthly water use from the Lamprey River from 1993 through 2008 was highly variable due largely to seasonal demand, but was also affected by weather conditions and the availability of water from the Oyster River. The total and average monthly water usage during this time period was greatest during the summer and fall and lowest during the winter (Figure 2). This seasonal use pattern reflects increased use of the Lamprey River due primarily to the return of students to UNH in the fall, and summer droughts which limited water availability and quality in the Oyster River. From late 2008, the Lamprey was used as UDWS's primary source. Monthly water use during 2009 through 2012 were also variable, but on average reflected use related to increased demand changes during the school year and reduced use of the Lamprey during the summer low flows because of use of the UDWS's alternative sources.

The highest monthly usage from the Lamprey River during the period 1993-2008 was 21.480 million gallons (October 2003), while no water use was reported for multiple months during multiple years (Table 3). The average monthly usage from the Lamprey River was 1.83 million gallons for the period January 1993 through December 2008. As described above, between 2002 and 2008, the UDWS was in a period of transition, evaluating the Lamprey River withdrawal and optimizing treatment methods at the Water Treatment Plan. This resulted in sporadic usage which provides limited ability to predict future use patterns.

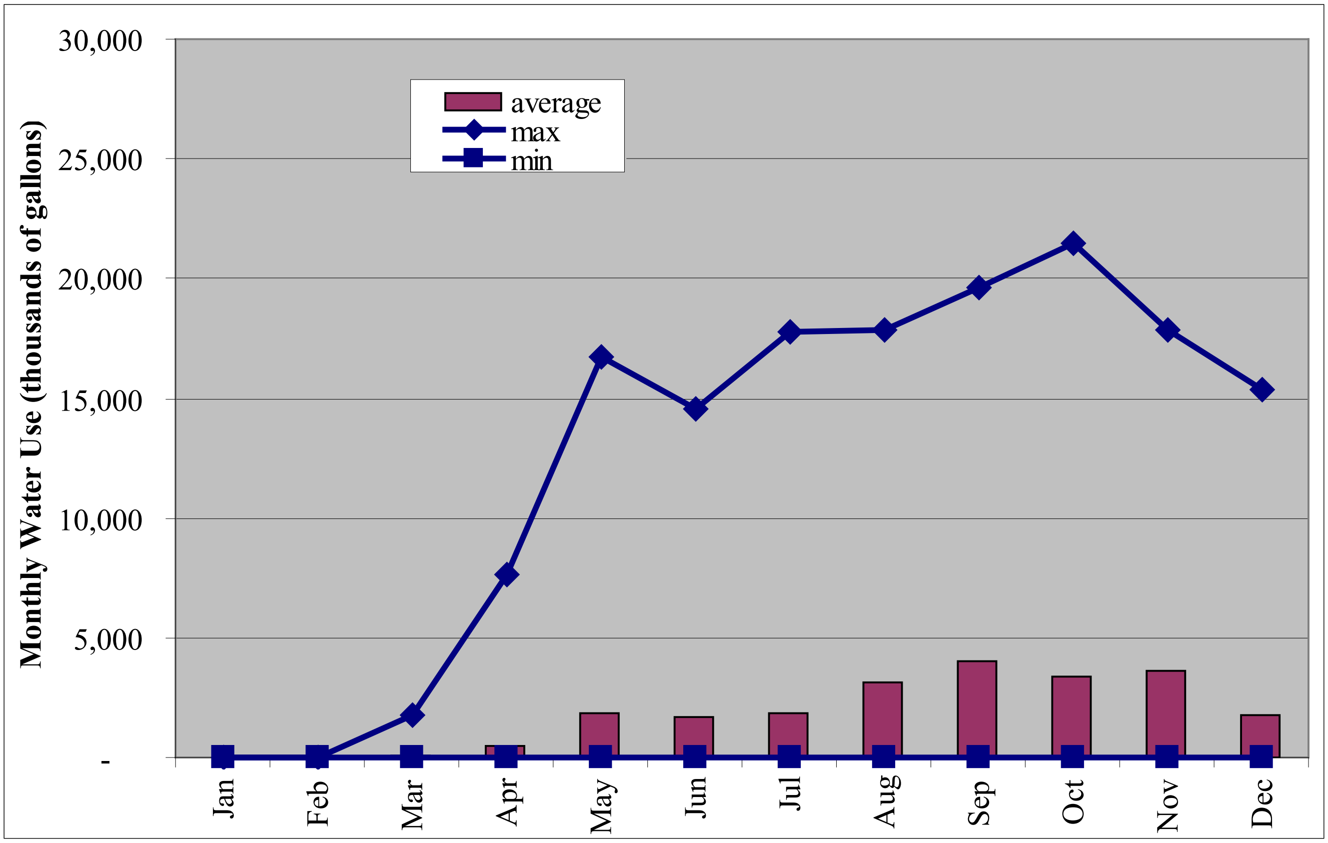

Figure 3 – UDWS - LAMPREY RIVER DIVERSION - Monthly Water Use (1993-2008)

Table 3 – UDWS - Lamprey River Diversion - Monthly Water Use Statistics (1993-2008)

	Low	High	Average
Thousands of Gallons	-	-21,480	-1,825
cfs	-	-1.0927	-0.0929
cfsm at Packers Falls Gage	0.00000	0.00597	0.00051

Table 4 shows the highest monthly usage from the Lamprey River (2009-2012) was 23.955 million gallons (September 2011), while no water use was reported for several months during several months of these years. The average monthly usage from the Lamprey River was 11.714 million gallons for the period. In general, the monthly water use is likely to follow the pattern shown in Figure 4.

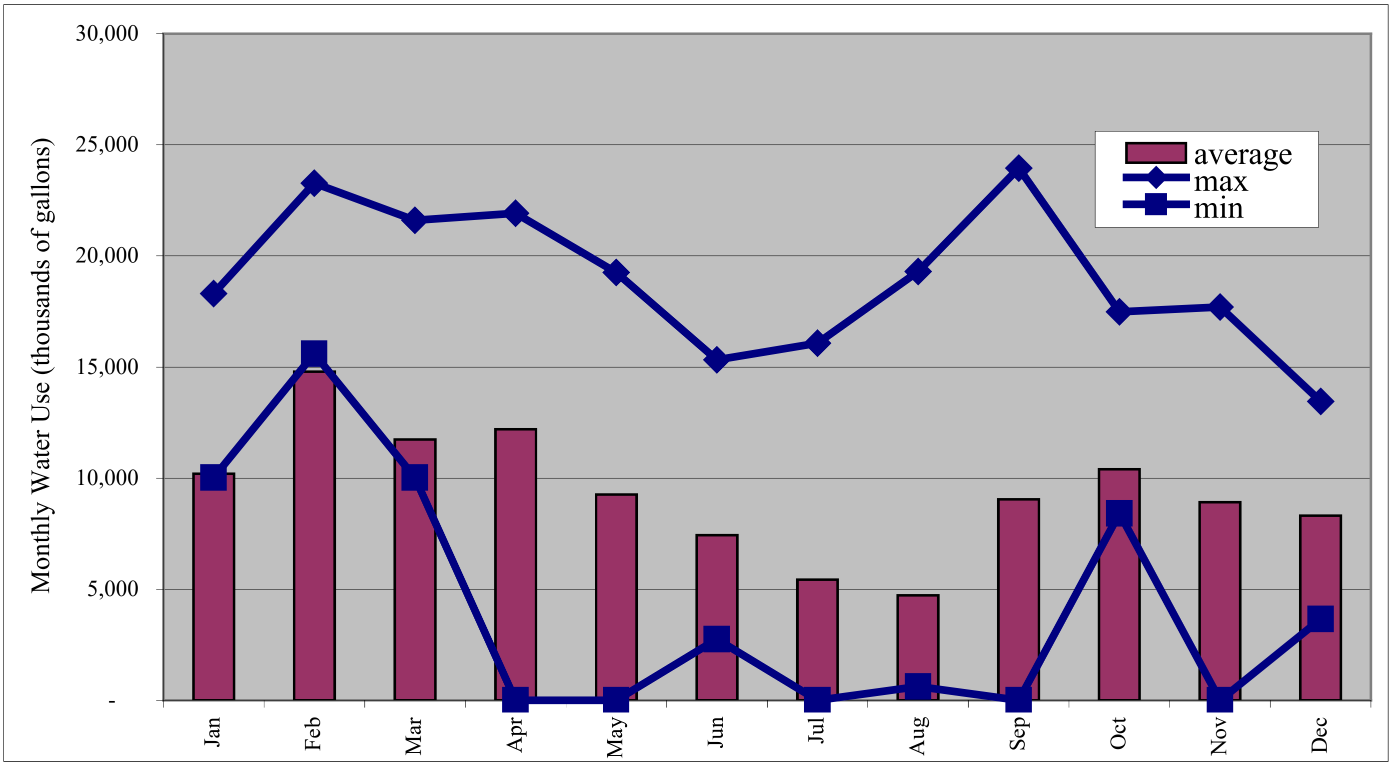

Figure 4 - UDWS - Lamprey River Diversion Monthly Water Use (2009-2012).

Table 4 - UDWS - Lamprey River Diversion Monthly Water Use Statistics (2009-2012).

	Low	High	Average
Thousands of Gallons	-	23,955	11,714
cfs	-	1.2186	0.5959
cfsm at Packers Falls Gage	0.00000	0.00666	0.00326

The monthly water use data were converted to flow in cubic feet per second by dividing the monthly values by days and then multiplying this result by a flow unit conversion factor. Based on these monthly values over the period 1993 to 2008, the average daily water use of the Lamprey River pump station has ranged from a minimum of 0 cfs (multiple occurrences) to a maximum of 1.093 cfs (0.767 million gallons per day, October 2003) with a mean monthly water use of 0.093 cfs (65,188 gallons per day). Based on monthly values for the period 2009 to 2012, the average daily water use of the Lamprey River pump station has ranged from a minimum of 0 cfs (multiple occurrences) to a maximum of 1.22 cfs (0.856 million gallons per day, September 2011), with a mean monthly water use of 0.67 cfs (385,062 gallons per day). Again, it should be noted that withdrawals from the Lamprey River for most of the record were not continuous, so the average includes long periods when no water was withdrawn.

Potential for Water Use Management to Meet Protected Instream Flows

The UDWS has the potential to manage water use to support the Protected Instream Flows due to the availability of multiple water sources and the potential for reducing system water demand through the use of water conservation measures. The alternative sources include the Oyster River Reservoir, the Lee Well, and storage in the Wiswall Reservoir. The UDWS also has an established Emergency Response Plan that includes a multi-stage, outside-water-use plan to reduce system demand during periods of drought.

The capacity of the UDWS pump at the withdrawal from the Lamprey Designated River is 2.8 cfs (1.8 million gallons per day.) Withdrawals have the greatest impact during periods when stream flow is lowest, which typically occurs during the months of August and September. August and September also happen to be when water demand by UDWS increases due to the arrival of UNH students to begin the fall semester.

The UDWS has alternative water sources available from the Oyster River and the Lee Well. The Oyster River reservoir has an estimated usable storage volume of 9 million gallons (Underwood Engineers, Inc. 2007). Water withdrawn from the Oyster River is treated and then distributed to the water supply system. The Oyster River watershed is more than ten times smaller than the Lamprey watershed and so has less water available for consumptive use. Due to the requirement for treatment, water supply from the Lamprey River and Oyster River is limited by the maximum capacity of the Arthur Rollins treatment plant, which is 1.55 million gallons per day. The Lee Well has an estimated sustainable yield of 0.54 million gallons per day and discharges directly into the water distribution system after disinfection.

The UDWS has an established Emergency Response Plan that includes a multi-stage, outside-water-use reduction and public awareness/voluntary conservation plan that applies during periods of drought. UDWS has indicated an interest and a willingness to meet reasonable reductions for outside water use during Plan-defined stream flow conditions in order to reduce system demand and support the protected flows.

This Water Use Plan must be coordinated with the Dam Management Plan developed for the Wiswall Dam (State Dam ID #071.04).

Water Use Plan Actions

The main components of the UDWS Water Use Plan are listed below and described further in later paragraphs.

- Withdrawals affecting downstream flow may be limited or restricted during low flow conditions as defined by the Lamprey River Protected Instream Flow report.
- Withdrawals from reservoir storage are available so long as the Water Use Plan conditions for water level drawdown, rate of drawdown and downstream flow are effectively met.
- The UDWS will manage withdrawals from the Lamprey River in cooperation with the Town of Durham's operation of the Wiswall Dam to effectively maintain downstream flows and Reservoir operating conditions.
- The UDWS will acknowledge receipt of DES notifications when a relief flow release is to be made.

- During the relief flow releases, the UDWS will actively manage their withdrawal from the Wiswall Reservoir to ensure that inflow or sufficient flow to exceed the Critical Protected Flow magnitude is passed (as practicable given the requirements of the Wiswall Dam Management Plan).
- Summertime outside watering use restrictions and conservation measures as outlined in the Water Conservation Plan will be implemented when limited source water availability corresponds with low river flow periods in order to limit the impacts of water demands on the Lamprey River flow.
- The UDWS will have access to 0.20 cfs of the *de minimis* flow of 0.21 cfs, until such time as other users in the designated river segment covered by the Lamprey River Protected Instream Flow require some portion of that *de minimis* flow.
- Longer periods at lower pumping rates will be the preferred operational procedure for withdrawals from the Lamprey River especially during instream flow management events.

The USGS gaging station on the Lamprey River near Newmarket (0173500) located at Packers Falls provides the flow measurements which trigger the Water Use Plan actions as described in this document. The UDWS will monitor flow conditions and act on the Water Use Plan based on mean daily flow conditions recorded at this gage.

Per RSA 483:9-c, IV, "… when the commissioner determines that a public water supply emergency exists which affects public health and safety" the protected instream flow is not required to be maintained. As such, during such an emergency, the conditions in this plan will be set aside until conditions allow for the provisions of the Water Use Plan to resume. If the UDWS experiences conditions which may adversely affect public health and safety, then the UDWS will declare to the Commissioner of DES that it is experiencing a water supply emergency and may take immediate remedial measures in accordance with the UDWS Emergency Response Plan. Upon such declaration, the UDWS will provide the Commissioner with a written description of the factors that resulted in the emergency, the proposed remedial measures, and an estimation of expected duration and corrective action being taken. Factors leading to a water supply emergency could be, but are not limited to, major operational or equipment failures, natural or environmental disasters, acts of terrorism, or unforeseen events or conditions that cause a system-wide water shortage resulting in Stage 4 status, as defined in the UDWS Emergency Response Plan. In addition, the governor may establish a state of emergency per RSA 4:45 which could also suspend the requirements of this plan. During the emergency, the UDWS shall maintain written records of: river flow at the USGS Lamprey River near Newmarket gage; start and end dates and times of uniform withdrawal rates and the pumping flow rate; daily withdrawal volumes from all sources; date and time of beginning and end of emergency conditions; reasons for the emergency; and the name and office of the public official who declared the emergency. Within 60 days of the end of emergency operations, the UDWS shall file with DES a report describing the cause(s) of the emergency and water use and Lamprey withdrawal conditions on a daily basis, including the times and amounts of water withdrawal and reservoir water levels and rates of change. Unless the emergency was caused by one-time, non-recurring circumstances such as fire or a contamination event, the report will detail specific steps to be taken by the UDWS to avoid recurrence of emergency conditions.

The UDWS withdrawal on the Lamprey River (20066-S02) may be operated at up to its maximum pumping capacity of 2.8 cfs when stream flow is greater than or equal to 16 cfs. When stream flows in the Lamprey are below 16 cfs, the UDWS will balance its other water sources with Lamprey River withdrawals so as to satisfy the protected instream flow requirements and meet the minimum UDWS demands. The UDWS may withdraw water from Wiswall Reservoir storage so long as Wiswall Reservoir operating conditions under its Dam Management Plan are effectively met.

Outside water use is typically heaviest during the summer and early fall. Plans for outside water use reduction will be applied during the two bioperiods (June 20 through October 6). Summertime outside water use reductions and calls for conservation measures as outlined below will be implemented by the UDWS to reduce the impact of outside water use on the Lamprey River and the UDWS water supply during defined flow and water system conditions. Measures to reduce outside water use will be implemented as part of the UDWS Emergency Response Plan (UNH/Durham Water Supply). The most recent version of the plan dated 2009 meets the requirements of the Water Management Plan. At the writing of this document, the Emergency Response Plan and Conservation Plans are being integrated under the auspices of Env-Wq 2101. Once this plan is approved by DES, it will replace the 2009 version. Subsequent revisions will be approved by DES as required by administrative rule. Under this Water Use Plan, the goal of reducing outdoor water use will be accomplished in four water conservation stages based on Lamprey River flow and system demand as compared to the maximum available capacity of the combined system source water. Maximum available capacity[1] is defined as the amount of water available to the UDWS from the system's combined water sources on a given day.

The Lamprey River Water Management Plan includes a Conservation Plan for UDWS which details the conservation practices and the outreach efforts needed to implement those practices. The four water conservation stages progress from alert messages and voluntary measures under Stage 1 to a mandatory ban on outside water use and broader restrictions under Stage 4 per UDWS Emergency Response Plan (2009 or most recently DES-approved Conservation Plan) are described below:

> <u>Stage 1 Alert</u>. The first action is an alert that voluntary water conservation measures should be taken and further actions may begin soon. The alert will be announced by the UDWS no later than on the day after daily mean discharge at the gage falls below 16 cfs (the rare protected flow level) and when system demand is ≥ 75% of the maximum available capacity. The UDWS will inform its water users through its notification process that it is necessary to implement voluntary water conservation measures and prepare for further actions as described in **Stage 1** of the Emergency Response Plan. An alert is rescinded when daily mean discharge exceeds 25 cfs for two consecutive weeks.
>
> <u>Stage 2 Alert</u>. When daily mean discharge in the Lamprey Designated River continues to decline and fall below the Critical protected flow level of 16 cfs for longer than 15 days, and when system demand is ≥ 80% of the maximum available capacity, then UDWS will implement outside water use restrictions as described in **Stage 2** of the Emergency Response Plan. These restrictions include, but are not limited to, a ban on vehicle washing and swimming pool filling, and limited watering of lawns and gardens. These restrictions will be rescinded when daily mean discharge exceeds 16 cfs for five consecutive days.
>
> <u>Stage 3 Alert</u>. When daily mean discharge in the Lamprey Designated River falls below the Rare protected flow level of 16 cfs during this period for longer than 20 days, and when system demand is ≥ 85% of the maximum available capacity, then the actions described under **Stage 3** of the Emergency Response Plan will be imposed, including, but not limited to, bans on vehicle washing, swimming pool filling, and watering of lawns and limited watering of vegetable gardens. These

[1] Note regarding calculation of maximum capacity: The UDWS will continue to involve DES in the development of the algorithm to calculate this value.

restrictions on outside water use will be rescinded when daily mean discharge exceeds 16 cfs for two consecutive days.

Stage 4 Alert. When daily mean discharge in the Lamprey Designated River falls below the Rare protected flow level of 16 cfs during this period for longer than the 25 days, and when system demand is ≥ 90% of the maximum available capacity, and/or the UDWS declares and the Commissioner determines that a water supply emergency exists, then a complete ban on outdoor water use will be imposed as described under **Stage 4** of the Emergency Response Plan, including, but not limited to, bans on vehicle washing, swimming pool filling, and lawn and garden watering. These restrictions on outside water use will be rescinded when daily mean discharge exceeds 16 cfs for two consecutive days.

Adaptive management will be applied to evaluate the timing of implementation of water conservation stages. The UDWS continues to review and refine the demand-to-capacity ratios defining the Stage conditions used to initiate the outside water use reductions. DES and the UDWS will evaluate the effectiveness of these magnitudes in starting and ending outside water use reductions appropriate to protect water resources and meet the UDWS's water needs through their critical period of August 15 through October 15. The UDWS and DES will evaluate the applied management during the summers of 2013 and 2014, and beyond if more examples are needed. Similarly, the UDWS will further develop algorithms to define the demand-to-capacity ratio values. The algorithms will be fully reviewed and revised with DES support. Careful review and analysis of the management techniques and Emergency Response Plan may lead to improvement to operations by changing the timing of withdrawals from different sources and revision of the capacity ratios.

As noted in the Lamprey Protected Instream Flow Report, the *de minimis* allowable withdrawal from the Lamprey River is 0.21 cfs under any flow condition. Under current water demands, approximately 0.20 cfs is available to UDWS under the *de minimis* withdrawal. UDWS is one of two direct surface water withdrawals in the Lamprey tributary system. The relative availability of the *de minimis* withdrawal to the UDWS may be impacted by future demands by other affected water users, and thus is subject to change.

Whenever operational considerations of the water treatment plant, pumping station, water use, or other pertinent factors will allow, the UDWS will operate the Lamprey River withdrawal at lower withdrawal rates over longer periods in preference to higher withdrawal rates for shorter periods.

Whenever operational considerations of the water treatment plant, pumping station, water use, or other pertinent factors will allow, the UDWS will operate surface water withdrawals to take make use of high flows so that their groundwater sources are rested by operating at lower rates to preserve the capacity of their groundwater sources.

Nothing in this plan precludes the UDWS from implementing more restrictive water use actions on its own initiative.

Recordkeeping

Recordkeeping by Affected Water Users and Affected Dam Owners shall include documentation of the actions and the dates and times that management actions were taken to meet their Water Management Plans. This documentation shall include records of conditions affected by the management activities, including but not limited to changes in dam gate conditions, number of stoplogs in place, static water levels in impoundments, and pumping rates. From time to time and subject to available appropriations, DES will conduct audits of the management activities taken by the Affected Water Users and Affected Dam Owners in response to protected stream flow conditions. These records will be retained and made available to DES on request. DES recommends, but does not require, that Affected Water Users and Affected Dam Owners create and retain documentation of the costs associated exclusively with water management activities defined by their Water Management Plans.

Estimated Water Use Plan Implementation Costs

The management activities would be performed by UNH and Town staff and/or a consultant and the annual costs to implement and maintain the water use plan is expected to range from $10,000 to $30,000.

To implement this Water Use Plan, the UDWS will update its Draft Lamprey Flow Monitoring Plan dated August 25, 2009. The Town will provide DES with standard operating procedures (SOP) for the operation of the dam under protected flow conditions. The purpose of the SOP is to implement accurate measurements of inflow to the Wiswall Reservoir to determine and meet conditions for Reservoir outflow management. The UDWS installed a water level gage in the Wiswall Reservoir to provide remote measurements of the reservoir level in order to manage withdrawals according to this plan. The UDWS will also develop either a flow measurement at the outlet of the Wiswall Dam or use the USGS gage Lamprey near Newmarket to provide accurate reservoir outflow data with which to manage withdrawals. The estimated cost for the design and installation of these gages is $10,000 to $50,000, depending upon the technology used to record and transmit the water level data.

Water Use Management Plan Implementation Schedule

By June 1, 2014, the UDWS will implement its Water Use Plan and will institute the proposed measures for the management of outdoor water use during the summer and early fall when flows on the Lamprey Designated River fall below the Rare protected instream flow levels.

Water User Contact Information

Water User: University of New Hampshire/Town of Durham Water System

Address: Town of Durham Department of Public Works
100 Stone Quarry Drive, Durham, NH 03824
Contact: Doug Bullen, Assistant Director of Operations
Phone: (603) 868-5578
Email: ~~dcedarholm@ci.durham.nh.us~~
Address: UNH Energy and Utilities
17 Leavitt Lane, Durham, NH 03824
Contact: Matt O'Keefe, Director
Wesley East, Chief Water Utilities Supervisor
Phone: (603) 862-2345
Email: matt.okeefe@unh.edu / Wesley.east@unh.edu

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Sources of Information

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

UNH/Durham Water Supply 2009. UNH/Durham Water Supply Emergency Response Plan. Prepared by Wesley R. East, Chief Operator. Original date August 2002 and Revised March 2009.

Personal communication with David Cedarholm, P.E., Town of Durham.

Personal communication with Wesley East. UNH/Durham Water System.

Survey of Lamprey River Affected Water Users performed by Normandeau Associates, Inc. completed by Wesley East. UNH/Durham Water System.

Underwood Engineers, Inc. 2007. Draft Update to Water Resources Management Plan Durham NH University of New Hampshire dated October 2007.

Water use reports on file with the Department of Environmental Services (DES).

Appendix C

Dam Management Plans

Lamprey River Water Management Plan

August 2013

DAM MANAGEMENT PLAN

Beaver Pond Dam (State Dam ID #061.07)

Figure 1 – Beaver Pond Dam and outlet structure taken on October 2, 2007.

Introduction

Beaver Pond Dam (lat. 43º 06 '24", long. -71º 19' 43") is located on the North Branch River in Bear Brook State Park in Deerfield, New Hampshire. This dam impounds the headwaters of the North Branch River, which then flows southwest from the dam and joins the main stem of the Lamprey River approximately eight miles downstream in Raymond, New Hampshire. The start of the Designated River is approximately 18 miles further downstream of the confluence of the North Branch River and the Lamprey River.

This dam is owned by the State of New Hampshire Department of Resources and Economic Development (DRED) and managed by the Division of Parks (see contact information). This dam is active and its use is for recreation. A beach and campground are located along the northern shoreline of Beaver Pond, which is effectively a widened portion of the North Branch River.

Dam Design

The dam was built prior to 1985 and was last reconstructed in 1992. The dam consists of earthen material while its outlet structure is constructed of concrete and wood, which has slots for the installation of stoplogs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

There are no flowage requirements or rights. However, recreation in or on Beaver Pond is expected by those with reservations in the campground.

Riparian Property Obligations or Agreements

There are no riparian property obligations or agreements as the dam and impoundment are located entirely within Bear Brook State Park.

Water Quality Requirements or Limits

According to the dam owner there are no water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Beaver Pond Dam is 66.5 acre-feet (ac-ft), while its permanent storage volume is 16.5 ac-ft, for a difference of 50 ac-ft (2.2 million cu. ft. or 16.3 million gallons). The drainage area behind the dam is 4 sq. miles. When compared with the other dams in this Water Management Planning Area the permanent storage volume and contributing drainage area these values are relatively low. Therefore, the water available for flow management from this dam is also considered to be low.

Potential Impacts of Storage and Release of Relief Flows

Upstream of the dam and within the impoundment storage area there is a small area of mapped forested and shrub wetland. The inundation of this area by the storage of water for flow management could negatively impact it.

Any flow released from Beaver Pond Dam would travel via the North Branch River into the main stem of the Lamprey River. There are no other dams on the North Branch River between Beaver Pond Dam and the confluence with the Lamprey River and it would not be necessary to coordinate release efforts with any other dam operators to ensure conveyance of the released flow to the Lamprey River. However, one additional consideration should be the presence of an extensive area of wetlands located approximately 3 miles downstream of Beaver Pond Dam along the North Branch River. These wetlands could potentially cause undesirable attenuation of the relief stream flow by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by these wetland areas and the resulting impacts on any flow management actions.

Beaver Pond is located within Bear Brook State Park and there is a developed beach along a portion of its northern shoreline. The raising or lowering of the water surface could potentially impact the use of the beach by campers staying at the neighboring state-run campground.

Potential for Dam Management to Support Instream Flow Requirements

The potential for using Beaver Pond Dam for flow management on the Lamprey Designated River is considered low. Although the dam is publicly owned, the shoreline of its pond is undeveloped and the dam is located in the upper Lamprey River Basin; these favorable attributes are offset by the relatively small volume of water potentially available, the potential impact to wetlands, its distance upstream from the Lamprey Designated River and the potential impact to water recreation activities in a State Park.

Dam Management Activity

No dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Beaver Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: Department of Resources and Economic Development
Address: P.O. Box 1856, Concord, NH, 03301
Contact: Mr. Seth Prescott
Phone: 603-271-2606
Email: sprescott@dred.state.nh.us

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Beaver Pond Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**2**
Freeboard (ft)	**NA**
Type of spillway controls or outlet works	**Stops Logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**50**
Drainage area (sq. miles)	**4**
Maximum storage (ac-ft)	**66.5**
Normal or permanent storage (ac-ft)	**16.5**
Total discharge capacity (cfs)	**NA**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**NA**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #061.07.

Note:

NA- not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Deer Pond Dam (State Dam ID #184.11)

Figure 1 – Deer Pond Inlet and outlet structure, provided by the DES Dam Bureau.

Introduction

Deer Pond Dam (lat. 43º 05' 11", long. -71º 12' 01") is located off of Brown Road in Nottingham, New Hampshire. This dam impounds a tributary to Mountain Brook, which discharges into the lower portion of Pawtuckaway Lake. This portion of the lake drains into the Pawtuckaway River at Dolloff Dam before joining the main stem of the Lamprey River in Epping, New Hampshire. Deer Pond Dam lies approximately 17 miles upstream of the start of the Designated River. This dam is privately owned (see contact information), is active and its use is for recreation.

Dam Design

The dam was constructed in 1963. The dam consists of earthen material, while its outlet structure is a 20 inch outside diameter HDPE pipe invert (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the owner there are no riparian property obligations or agreements, although he does keep the water level in the pond as constant as he can.

Water Quality Requirements or Limits

According to the owner there are no water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show that the maximum storage volume for Deer Pond Dam is 174 acre-feet (ac-ft), while its permanent storage volume is 100 ac-ft, for a difference of 74 ac-ft (3.2 million cu. ft. or 24.1 million gallons). When compared with the other dams being evaluated as part of this study, the permanent storage volume of Deer Pond Dam is relatively low. In addition, the drainage area behind the dam is only 0.61 sq. miles, which, due to its small area, would provide limited runoff to the impoundment following any drawdown in water levels. Therefore, the water available from this dam for flow management is considered to be low.

Potential Impacts of Storage and Release of Relief Flows

The reach of Mountain Brook downstream of the dam to Pawtuckaway Lake is largely rural with few structures built in or adjacent to the river. In addition, mapped wetlands are sparse within the impoundment storage area and below the dam. Therefore, inundation of these areas by the storage of water or dam releases for flow management would have little impact on wetland areas.

Any release of water from Deer Pond Dam would discharge downstream to Pawtuckaway Lake. Due to the large storage volume of Pawtuckaway Lake, the impact of the release of water from Deer Pond Dam on the lake would be minimal. Release of water from Deer Pond would have to be coordinated with releases from the two dams on Pawtuckaway Lake to be effective.

Potential for Dam Management to Support Instream Flow Requirements

The potential for managing this dam to support instream flows on the Lamprey Designated River is considered low. The major limitations for the use of Deer Pond Dam for flow management of the Lamprey Designated River include: the small drainage area behind the dam; the limited storage volume of the dam; the need to retrofit the outlet to allow for the managed release of water; and the potential reduction in effectiveness due to the presence downstream of Pawtuckaway Lake.

Dam Management Activity

Since the potential use of Deer Pond Dam for maintaining instream flow on the Lamprey Designated is considered low, no dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Deer Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information
Owner: Mr. Chris Stillbach
Address: 36 Brook Drive, Simsbury, CT 06070, or
60 Brown Road, Nottingham, NH 03037
Phone: 860-651-3296
Email:

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Deer Pond Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**12**
Freeboard (ft)	**3**
Type of spillway controls or outlet works	**Pipe Invert**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**38**
Drainage area (sq. miles)	**0.61**
Maximum storage (ac-ft)	**174**
Normal or permanent storage (ac-ft)	**100**
Total discharge capacity (cfs)	**1362**
Maximum unoperated discharge (cfs)	**1362**
Design storm discharge (cfs)	**128**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #184.11.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Doles Marsh Dam (State Dam ID #183.18)

Figure 1 – Doles Marsh Dam and outlet structure, photos taken October 2, 2007.

Introduction

Doles Marsh Dam (lat. 43º 10' 27", long. -71º 11' 21") is located in the Doles Marsh Wildlife Management Area off of Route 43 in Northwood, New Hampshire. Doles Marsh Dam impounds a tributary of the Bean River, which flows southeast to the North River and joins the Lamprey River immediately upstream of the Lamprey Designated River in Epping, New Hampshire. Doles Marsh Dam lies approximately 15 miles upstream of the start of the Designated River.

This dam is owned by the State of New Hampshire Fish and Game Department (see contact information) on land owned by the State of New Hampshire Department of Resources and Economic Development. The dam is active and its use is to create and maintain waterfowl habitat.

Dam Design

The dam was constructed in 1976 and consists of earthen material, while its outlet structure is constructed of concrete, which also has slots for wooden stop logs (Figure 1).
Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the owner there are no riparian property obligations or agreements as the dam and land are located on land owned by the State of New Hampshire.

Water Quality Requirements or Limits

According to the owner there are no water quality rights or agreements.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Doles Marsh Dam is 104 acre-feet (ac-ft), while its permanent storage volume is 41 ac-ft, for a difference of 63 ac-ft (2.7 million cu. ft. or 21 million gallons). The drainage area behind the dam is 0.52 sq. mi., which, due to its small area, would provide limited runoff to the impoundment following any drawdown in water levels. When compared with the other dams in this Water Management Planning Area, the available permanent storage volume and contributing drainage area of Doles Marsh Dam are small. Therefore, the water available for flow management from this dam is considered to be low.

Potential Impacts of Storage and Release of Relief Flows

Water released from Doles Marsh Dam flows through several ponds and wetland areas before joining the Lamprey Designated River. The presence of the ponds and wetland areas could attenuate flows released from Doles Marsh Dam by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the ponds and wetland areas and the resulting impacts on flow management actions. Doles Marsh Dam impounds an extensive wetland system that supports waterfowl habitat in the Doles Marsh Wildlife Management Area. According to the New Hampshire Fish and Game Department the impoundment is drained about one summer out of ten to promote vegetation growth. As a result, any flow management actions taken (storage or release of water) should be coordinated with the owner to maximize the use of the stored water and to minimize any impacts to the extensive wetlands at the site.

Potential for Dam Management to Support Instream Flow Requirements

Factors favoring the use of Doles Marsh Dam for flow management include; an operable outlet structure; a maintenance program that releases water from storage; and, the location of its discharge point upstream of the beginning of the Lamprey Designated River. The limiting factors include the relatively small volume of water available, the small contributing drainage area, the number of ponds and wetlands downstream that could reduce the effectiveness of any dam releases and the potential restriction for water fowl and wildlife management of only lowering the impoundment level one summer in ten or longer (last maintenance release over 15 years ago)' and the timing of the release. The water level is lowered from mid-June to mid-September. The marsh needs to be returned to full level by late September to support migrating waterfowl and winter home building by muskrats and beavers. Due to these limitations, the potential for the management of this dam to meet the instream flow requirements is considered low.

Dam Management Activity

Due to the potential impact of any water releases from Doles Marsh Dam on its management objectives, to support of water fowl and wildlife, no dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Doles Marsh Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information
Owner: New Hampshire Fish and Game Department
Address: 11 Hazen Drive, Concord, NH 03301
Contact: Mr. Edward G. Robinson
Phone: 603-271-2461
Email: Edward.Robinson@wildlife.nh.gov

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Doles Marsh Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**8**
Freeboard (ft)	**2.5**
Type of spillway controls or outlet works	**Stoplogs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**25**
Drainage area (sq. miles)	**0.52**
Maximum storage (ac-ft)	**104**
Normal or permanent storage (ac-ft)	**41**
Total discharge capacity (cfs)	**316**
Maximum unoperated discharge (cfs)	**226**
Design storm discharge (cfs)	**63**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #183.18.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Dolloff Dam (State Dam ID #184.02)

Figure 1 – Dolloff Dam and outlet structure, photos taken August 2005.

Introduction

Dolloff Dam (lat. 43º 04’ 20”, long. -71º 09’ 07”) is one of four dams that store water in Pawtuckaway Lake. This dam is located on the south side of Pawtuckaway Lake at the end of Dolloff Dam Road in Nottingham, New Hampshire. Pawtuckaway Lake was formed when two smaller ponds were raised by dams. The watershed that drained to the south end is 30% of the Pawtuckaway Lake’s total watershed. See Figure 1.

Dolloff Dam affects flow in the Pawtuckaway River which joins the Lamprey River in Epping, New Hampshire. Dolloff Dam lies approximately 14 miles upstream of the start of the Lamprey Designated River.[1] The dam is owned by the State of New Hampshire Water Division (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was built in 1842 and reconstructed in 1974. Constructed of concrete and earth materials, it has a concrete outlet structure that includes slots for wooden stop logs (Figure 1). Three stoplog bays allow the operation of releases from the dam. Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, which owns the dam. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

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[1] This Lamprey Designated River describes the segment designated in 1990 and identified by the legislature in 2002 as the subject for the Instream Flow Pilot Program. The legislature subsequently designated the remainder of the Lamprey River for protection in 2011—the newly designated segments are not part of the Lamprey River Water Management Plan.

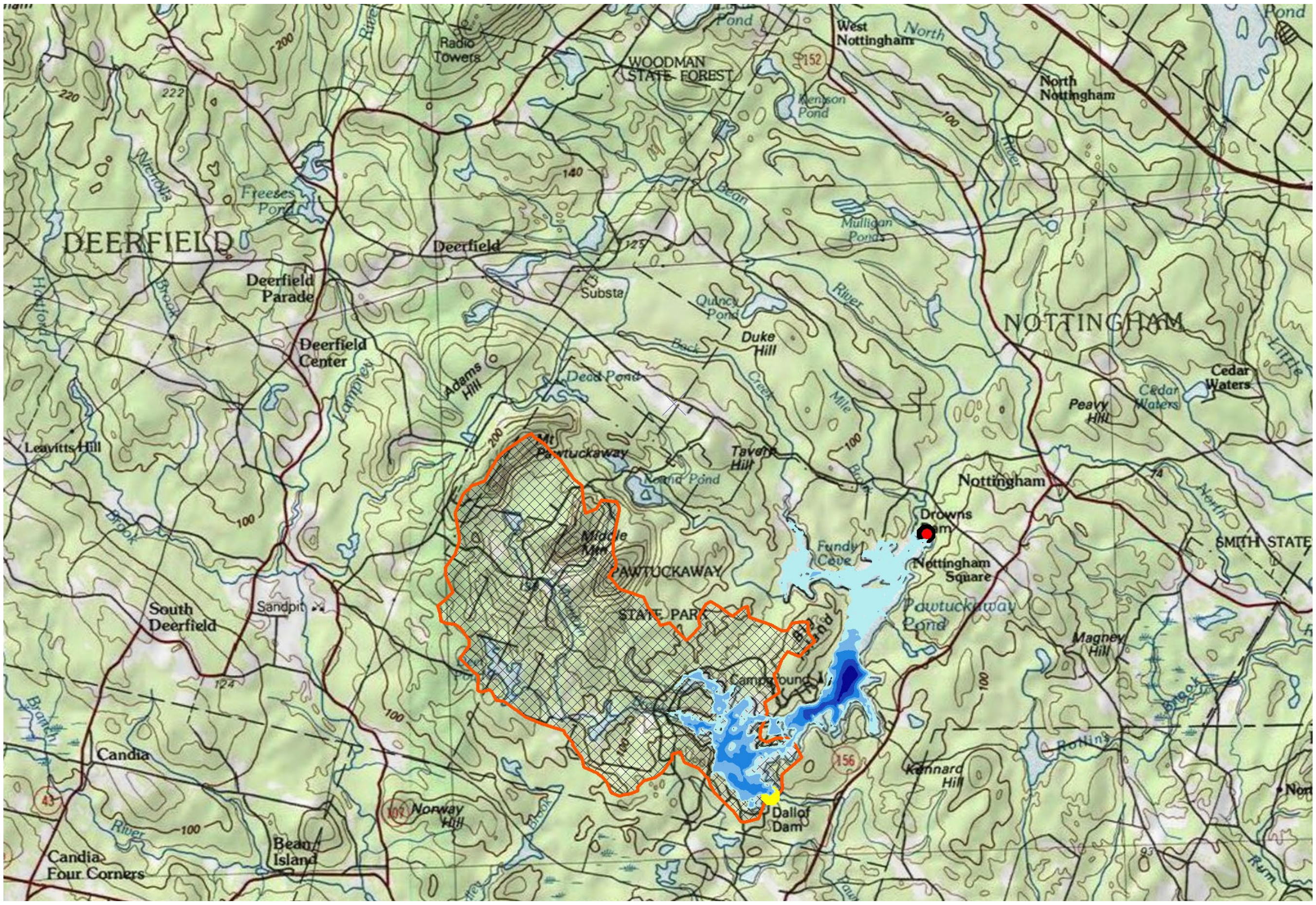

Figure 2 – Dolloff Dam at south end of Pawtuckaway Lake and the drainage area for the southern part of pond.

Protected Flow, Flowage Rights or Contractual Obligations

A 1992 lake level investigation was initiated by lake property owners concerned that the practice of drawing the lake down seven feet was harming the fishery. DES concluded that historical practices would continue. A 2000 lake level investigation and hearing set the operating water levels for Pawtuckaway Lake, as memorialized in "The Notice of Decision of Determination of Lake Level" (DES 2000). Following this Decision, lake levels were managed to draw the lake down seven feet by November 30 and returned to full pool by June 1st.

In 2012, a new lake level investigation was conducted and a hearing was held in June of that year. In 2013, DES changed the lake's management conditions from those under the 2000 NOD (DES 2013). The 2013 Notice established that the annual drawdown level for Pawtuckaway Lake shall be maintained at 4.8 feet in order to achieve a lake level of 20.2 feet by November 30th and a lake level of 25 feet at the gauge on the Dolloff Dam by June 1st. A lake level of 25 feet is considered full pool. Implementation of this change in the winter draw down levels will be conducted over a period of four years with the drawdown target to be decreased by 0.5 feet each year until the new target level of 4.8 feet is attained (20.2 on the gauge at Dolloff Dam). The 4.8 foot fall drawdown retains over 2 feet of storage that allows for a winter relief pulse of 0.64 feet to support instream flows. Dolloff Dam is to be operated in conjunction with Drowns Dam to maintain these water levels, which are managed to serve public interests including recreational opportunities, aquatic habitat, and water quality.

Riparian Property Obligations or Agreements

Since 2000, DES has utilized Dolloff Dam to manage Pawtuckaway Lake levels by approximating the historical median levels to meet the conditions of the 2000 DES Notice of Decision. The 2000 Notice of Decision describes the conditions for an annual fall drawdown and spring fill where by November 30th the lake would be lowered 7 feet to a level of 18 feet on the gauge at Dolloff Dam and returned to a lake level of 25 feet by June 1st (DES 2000). This 2000 Decision was reconsidered in a Lake Level Investigation during 2012-2013 and a new Decision was reached in 2013. The 2013 Decision changed the annual fall drawdown from 7 to 4.8 feet below full pond, which is to be achieved by November 30, and provide for the return to full lake level of 25 feet by June 1st. Lake level between spring and fall, depending on inflow, is maintained at 25 feet as measured on the staff gauge at Dolloff dam.

Water Quality Requirements or Limits

There are no site-specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

Releasing water from storage is one way to offset Lamprey River flow deficits by providing a relief flow pulse. Dolloff Dam is one of the two dams controlling Pawtuckaway Lake that could be used to release water for a relief flow to attain downstream water quality standards.

The DES Dam Bureau files show the maximum storage volume for Dolloff Dam (Pawtuckaway Lake) is 11,700 acre-feet (ac-ft). GIS assessments by Watershed Management Bureau using bathymetry developed in 2011 and 2012 defined its permanent storage volume as 7954 ac-ft, for a difference of 3746 ac-ft (163 million cu. ft. or 1221 million gallons). The permanent storage of Pawtuckaway Lake is the largest of the lakes within the Lamprey River Water Management Planning Area. The drainage area behind the dam is 20.3 sq. miles, which due to its large area provides considerable runoff potential for refilling the impoundment. This watershed represents 11% of the Lamprey River watershed.[2] The surface area of the lake is 783 acres. Therefore, the potential volume of water available for flow management from Pawtuckaway Lake through this dam or Drowns Dam is the highest among the dams in this Water Management Planning Area.

Each of the bioperiods except Spring Flood has a bioperiod-specific flow to be released as the relief flow to maintain protected flows. The volume of water to be added to the release, and its equivalent discharge value and the estimated water level change for each bioperiod, are summarized in Table 2. The relief flow volume and flow rate values in Table 2 are based on supporting the Rare and Critical flow requirements 90 percent of the time, and includes a 20 percent buffer. The twenty percent buffer recognizes that there are unquantified losses that may cause attenuation of flow between the location of the release and the Designated River. The

[2] Relative to the USGS stream flow gauge 01073500 Lamprey River Near Newmarket, NH

Spring Flood bioperiod will not be managed because historically there have been very few low-flow events during this time.

Because of lake management, the volume of the lake is changed through the year, thereby affecting the amount of water in storage that could be available for a relief flow release. Following the Spring Flood bioperiod, the impoundment is expected to be at full pool as the starting point for the summer season. Full lake is the level of the Dolloff Dam's spillway, which is at 25 feet as measured on the staff gauge at Dolloff dam.

The lake level is usually above 25 feet (full) after the spring melt and declines below this level by mid-July, resulting in minimal water passing downstream. During the bioperiods of early summer through early fall (Clupeid Spawning, GRAF Spawning, and Rearing and Growth), protected instream flows can be supported by relief flows released from storage in Pawtuckaway Lake. Release volumes for summer and fall bioperiods include flow from Mendums Pond. A relief flow release during the three summer periods represents lake level declines of 0.14, 0.02 or 0.05 feet, respectively. Management conditions on releases will be applied to ensure that the lake's recreational use, wildlife, fish and water quality are protected, or these releases will be curtailed.

Under the 2000 Notice of Decision, each fall, beginning in early October, water was released from Dolloff Dam (in combination with Drowns Dam at the northern end of the lake). The goal of the drawdown under the 2000 Decision was to lower the lake by seven feet (to 18 feet on the gage by November 30).[3] The annual seven-foot drawdown release currently supports most of the Salmon Spawning bioperiods instream flow needs without active management for protected instream flows.

Protected flows during the October 7 through December 8 bioperiod are usually met because of the fall lake drawdown. A pulse may be applied during this bioperiod if protected flows are not being maintained by managing the timing and release rate of the fall drawdown. The annual fall drawdown will be managed such that the volumes leaving Drowns and Dolloff Dams are proportional to the subwatershed areas of the northern and southern pond areas; namely, 70% via Drowns Dam and 30% via Dolloff Dam. Achieving the 4.8 foot drawdown level will be targeted for November 30.

During the Overwintering bioperiod, relief flows will be provided from some of the water retained from the 4.8 foot annual fall drawdown. At the final lake level of 4.8 feet below full pool, one relief flow release is possible during the winter. The reduction of lake level for this release is expected to be 0.65 feet (about 8 inches) or less.

Refilling the lake has historically begun between mid-January and early-February. From late January continuing through May, the DES Dam Bureau adds stoplogs to reduce the outflow from the dam and refill the lake to its full lake stage of 25 feet by June 1 (DES 2000). As the Spring Flood bioperiod approaches, depending on spring flood storage needs, the water stored for the Overwintering bioperiod may be saved to maintain stream flows during the Spring Flood bioperiod, or released before the Spring Flood bioperiod to provide additional flood storage, as the

[3] The lake was rarely dropped to 18 feet -- the 1982-2012 median winter lake level is deepest in mid- to late January at about 18.7 feet or 6.3 feet below full pond.

DES Dam Bureau deems necessary. Relief flow releases are not proposed during the Spring Flood bioperiod because there is insufficient storage to both fill the lake and maintain downstream flows. At the end of the Spring Flood bioperiod, the water level should again be at full lake level and have sufficient storage to support management, public recreation and lake ecology during the next three bioperiods of early summer through early fall.

Potential Impacts of Storage and Release of Relief Flows

Impacts of the water management actions on existing wetland in Pawtuckaway Lake are limited. Except for Burnham's Marsh, there are few mapped wetlands within the impoundment area of the dam. Burnham's Marsh is separated from the lake by Burnham's Marsh Dam, so the storage or release of water from Dolloff or Drowns dam for flow management would have little potential impact on wetlands in Burnham's Marsh.

Mapped wetland areas are present below the dam in the riparian area along the Pawtuckaway River. These wetlands could reduce the effectiveness of any flow released from Dolloff Dam by temporarily storing the released water. A test relief pulse, conducted in September 2012, demonstrated that these wetlands have little discernible impact on the flow or timing of the pulse.

Pawtuckaway Lake has been a nesting area for up to two Common Loon pairs. Common Loons are state-listed as Threatened. Loon nesting success is sensitive to water level changes because changes of six inches or more have the potential to either flood the nest or strand it above the reach of the parents. The primary nesting period for loons is May 15 through July 15, although secondary nesting periods occur later in the year if the initial nesting attempt fails. Water levels should not vary more than 6 inches to support loon nesting success.

Managing water levels on Pawtuckaway Lake for the purpose of flow management on the Lamprey Designated River should not have a significant effect on shoreline properties or on recreational opportunities on the Lake. DES has defined a limit of 18 inches below full pond level of the total water level change caused by management and by the usual decline—this would represent an extreme condition that would occur very infrequently, if at all. In addition, 18 inches is considered to be within the natural range of variability for summer lake levels.

The period of most common management needs is from July 5 through October 6. Thirty-four of 56 years would have required no management and twelve years would have required only one management event. A single management event during this time of year would change the lake level by 0.05 feet (0.6 inches). During the driest two years on record, six relief flows would have been applied throughout the spring, summer and fall, for a cumulative lake level effect of four inches.

The change in winter drawdown practices is expected to reduce both the amount and residence time of phosphorus in the lake. The reduction in phosphorus will reduce the likelihood of algal blooms. The summer releases are unlikely to either promote or retard algal blooms.

The DES Dam Bureau has assessed the difference in flood protection resulting from a reduced winter drawdown. Because the difference on lake volume between 7 feet and 5 feet of drawdown is relatively small, the increase in flood protection attributable to a deeper drawdown is small. Further, the DES Dam Bureau will always have the ability to manage Pawtuckaway Lake dams for the protection of health and safety such that water may be released to help preempt the effects of an incoming storm.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Dolloff Dam for flow management to support the instream flow requirements on the Lamprey Designated River is high due to the public ownership of the dam, the amount of storage potentially available, the large drainage area above the dam and the existence of an outlet structure designed to manage water levels.

Dam Management Activity

Pawtuckaway Lake is controlled by two operable dams. Water can be released from Pawtuckaway Lake from either Dolloff Dam or Drowns Dam or from a combination of both dams. When compared with Drowns Dam, Dolloff Dam is slightly farther from the beginning of the Lamprey Designated River (14 miles versus 10 miles). Releases from Dolloff Dam to provide for flow management will be coordinated with the timing and volume of Drowns Dam releases. Non-winter releases would also be coordinated with releases from Mendums Pond. DES will not conduct flow releases for stream flow protection during the spring bioperiod.

Dolloff Dam's primary use is described by the DES Dam Bureau as recreation. The uses of Dolloff Dam will be expanded to include instream flow. The DES Dam Bureau, as the owner of the dam, will be responsible for the operation of the dam to support the protected instream flows on the Lamprey Designated River. If a flow management release becomes necessary, water may be released from Dolloff Dam to create a relief flow pulse to support the protected instream flows on the Lamprey Designated River. The Dam Bureau will take such actions as are necessary to operate the stoplogs at Dolloff Dam to increase flow from Pawtuckaway Lake by the amount shown in Table 2 beginning at a start time identified by the Instream Flow Program. The DES Watershed Management Bureau will identify when flow management is needed and notify the DES Dam Bureau of an approaching event.

Relief flows may be released to support the protected instream flows during five of the six bioperiods. Flow management releases will occur when daily mean discharge falls below the Critical or Rare protected flow magnitudes for longer than its catastrophic duration (DES 2009). No relief flows will be released from Pawtuckaway Lake during the Spring Flood bioperiod (March 1 to May 4).[4] For the Clupeid Spawning, GRAF Spawning, and the Rearing and Growth bioperiods (May 5 to October 6), relief flows will be generated by releases from both Mendums Pond and Pawtuckaway Lake. The volume released from each lake will be proportional to its surface area such that each lake has the same change in water level. During the annual fall drawdown, which occurs during the Salmon Spawning bioperiod (October 7 – December 8), the drawdown may be configured as a pulse to support instream flows. Releases from Pawtuckaway

[4] Minimum flows for the maintenance of downstream flow will be supported during spring refilling.

Lake will be in combination with releases from Mendums Pond, except during the Overwintering bioperiod (December 9 – February 28) when Mendums will not be used.

Flow conditions will be evaluated by DES to determine management need and relief flow release effects based on the records from the United States Geological Survey gaging station Lamprey River near Newmarket, New Hampshire (0173500). If a flow management release is needed, then DES Dam Bureau will release a two-day relief flow from Drowns, Dolloff, or both dams at rates described in Table 2.

DES will also post a notification of approaching management on its website. DES will send an email notification to the Town of Nottingham and to the president of the Pawtuckaway Lake Improvement Association.

To protect the State-listed threatened Common Loon nesting cycle, no relief flow releases will be applied between May 15 and July 15 that would result in reducing the water level more than six inches (combined with natural decline) when any successful loon nesting is occurring. DES will notify NH Fish and Game, The Loon Preservation Committee and the Pawtuckaway Lake Improvement Association of approaching management conditions and request their determination of whether loons are currently actively nesting on the Lake during that period. From July 15 through August 15, DES will consult with NH Fish and Game and The Loon Preservation Committee to determine whether relief flow releases for stream flow protection will affect loon nesting.

In the event of the need for relief flows from Pawtuckaway Lake between May 5 and October 6, the maximum water level drawdown shall not result in the Lake water level dropping more than 18 inches below the spillway crest.

The annual fall drawdown will be managed such that the volumes released from Drowns and Dolloff Dams are proportional to the subwatershed areas of the northern and southern pond areas; approximately, 70% via Drowns Dam and 30% via Dolloff Dam.

Only one Overwintering pulse is possible based upon the amount of water in storage in the winter. Such a release may have to come from Dolloff Dam because of physical restrictions at Drowns Dam.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice after adoption of the Lamprey Water Management Plan. The operations for releases under this Dam Management Plan for the period March 1 through December 8 will begin with the first bioperiod start following adoption. Management during the December 9 through February 28 Overwintering bioperiod includes a change in the annual drawdown to 4.8 feet instead of ~7 feet. This change will be implemented over four years by reducing the drawdown approximately 6 inches each year. During these first four years, no Overwintering bioperiod releases will be applied, barring any unforeseen or unusual circumstances.

Estimated Cost of the Implementation of the Dam Management Plan

The specific actions associated with the implementation of the Dam Management Plan for Dolloff Dam include the placement or removal of stop logs from the dam. This work requires that at least one trained DES employee travel to the site to either place or remove a pre-determined number of stop logs from the dam structure. These trips are expected to include management actions at Drowns Dam and Mendums Pond Dam. The estimated costs associated with this work will be dependent upon the number of personnel involved, the number of site visits required to perform the necessary flow management releases and the travel time and mileage. Accounting for any costs associated with this program will be made through the two-year evaluation period following the approval of this plan.

Dam Owner and Contact Information
Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: james.gallagher@des.nh.gov

Conversion Factors for Volume and Flow Units			
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References

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Department of Environmental Services (DES) 2013. Notice of Decision on Determination of Lake Level. August 2013.

Table 1 – Dolloff Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**250.40**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**243.11**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**28**
Freeboard (ft)	**4**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**41 ft**
Surface area (ac) of impoundment at maximum impoundment	**783***
Drainage area (sq. miles)	**21**
Maximum storage (ac-ft)	**11,700**
Normal or permanent storage (ac-ft)	**11,500**
Total discharge capacity (cfs)	**1,012**
Maximum unoperated discharge (cfs)	**2,900**
Design storm discharge (cfs)	**2,325**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**290**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #184.02.
* - From GIS coverages

Note: NA – not available from NH Dams Data Sheet

Table 2 – Two-Day Flow Release Contribution from Drowns or Dolloff Dams in the Event of Instream Flow Water Management.

Bioperiod name	Period	Relief volume needed to meet 90% of historical deficits (ac-ft)	Relief volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)	Two-day flow release contribution from Pawtuckaway (cfs) [74.7%]	Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)	Water source
Overwintering	Dec 9 – Feb 28	216	259	65*	0.65 – starting from 4.8 ft below full – not from full pool	Water retained from Pawtuckaway Lake from annual fall drawdown.
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	118	142	27	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	20	24	4.5	0.02	from storage and drawdown
Rearing &Growth	Jul 5 – Oct 6	47	56	10.5	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	75	90	17	Occurs during annual fall drawdown	Annual, fall drawdown.
Mendums		265	Acres at full recreational pool [25.3% of combined Mendums and Pawtuckaway surface areas]			
Pawtuckaway		783	Acres at full recreational pool [74.7% of combined Mendums and Pawtuckaway surface areas]			
* Overwintering release is from Pawtuckaway Lake only.						

DAM MANAGEMENT PLAN

Drowns Dam (State Dam ID #184.04)

Figure 3 *– Dam and outlet structure, photos taken August 2005.*

Introduction

Drowns Dam (lat. 43º 06' 26", long. -71º 07' 31") is one of four dams that store water in Pawtuckaway Lake. The dam is located on the north side of Pawtuckaway Lake off of Fernald Road in Nottingham, New Hampshire. Pawtuckaway Lake was formed when two smaller ponds were raised by dams. The watershed that drained to the northern pond is 70% of the Pawtuckaway Lake's total watershed. See Figure 1.

Drowns Dam affects flows in the drainage of Mile Brook, which flows north to the Bean River, a tributary of the North River. The North River flows southeast to join the Lamprey River at a point immediately upstream of the start of the Lamprey Designated River[5] in Epping, New Hampshire. Drowns Dam is approximately 10 miles upstream of the start of the Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was built in 1842 and reconstructed in 1964. The dam is constructed of concrete, stone and earth materials and has a concrete outlet structure that includes slots for wooden stop logs (Figure 1). A single stop log bay allows operation of releases from the dam. Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, which owns the dam. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

[5] This Lamprey Designated River describes the segment designated in 1990 and identified by the legislature in 2002 as the subject for the Instream Flow Pilot Program. The legislature subsequently designated the remainder of the Lamprey River for protection in 2011—the newly designated segments are not part of the Lamprey River Water Management Plan.

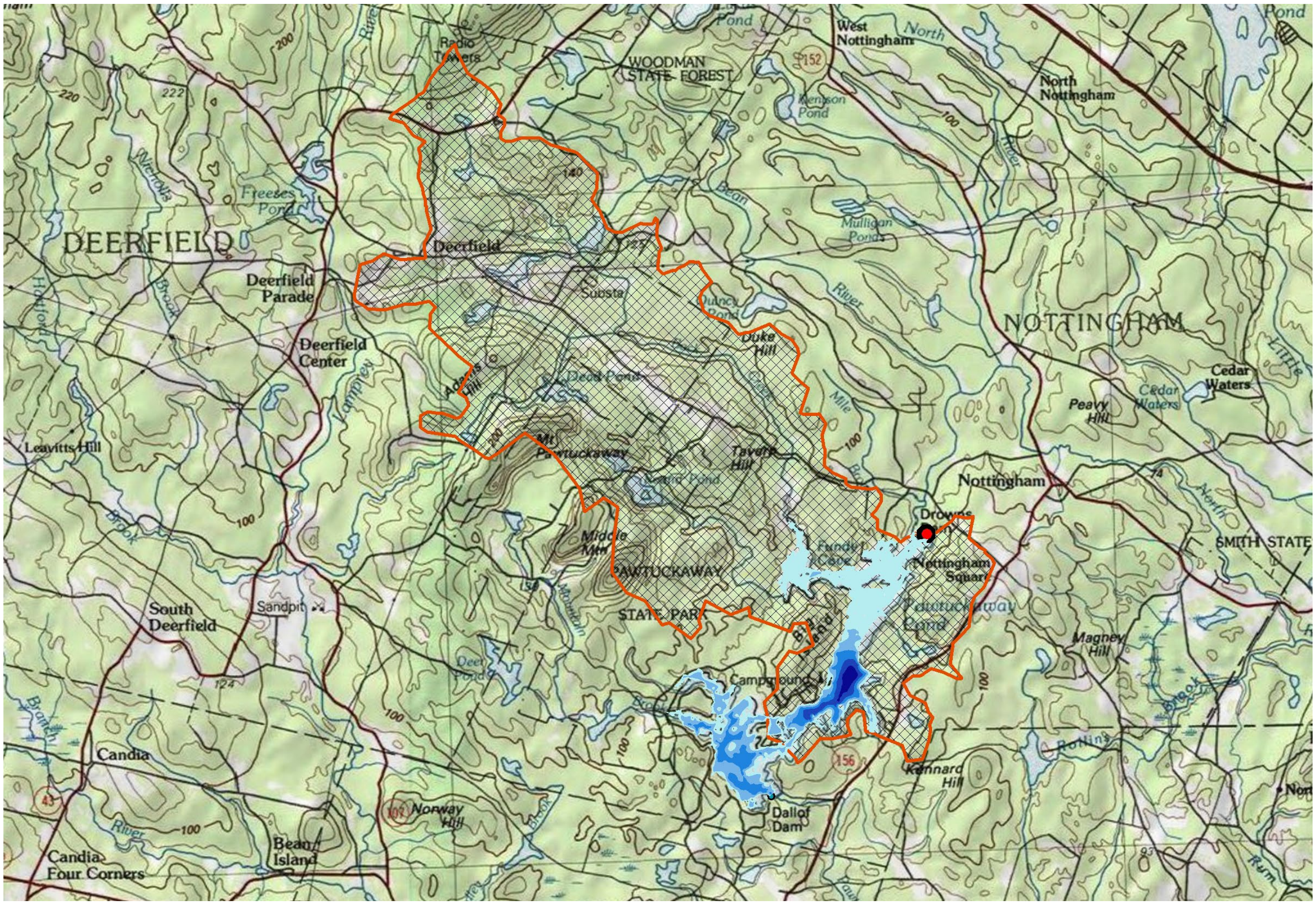

__Figure 4__ – Drowns Dam at north end of Pawtuckaway Lake and the drainage area for the northern part of pond.

Protected Flow, Flowage Rights or Contractual Obligations

A 1992 lake level investigation initiated by lake property owners concerned that the practice of drawing the lake down seven feet over the winter was harming the fishery was concluded by DES deciding that historical practices would continue. A 2000 lake level investigation and hearing set the operating water levels for Pawtuckaway Lake as memorialized in "The Notice of Decision of Determination of Lake Level" (DES 2000). Following this Decision, lake levels were managed to draw the lake down seven feet by November 30 and returned to full by June 1st.

In 2012, a new lake level investigation was conducted and a hearing was held in June of that year. In 2013, DES changed the lake's management conditions from those under the 2000 NOD (DES 2013). The 2013 Notice established that the annual drawdown level for Pawtuckaway Lake shall be maintained at 4.8 feet in order to achieve a lake level of 20.2 feet by November 30th and a lake level of 25 feet at the gauge on the Dolloff Dam by June 1st. A lake level of 25 feet is considered full pond. Implementation of this change in the winter draw down levels will be conducted over a period of four years with the drawdown target to be decreased by 0.5 feet each year until the new target level of 4.8 feet is attained (20.2 on the gauge at Dolloff Dam). The 4.8 foot fall drawdown retains over two feet of storage that allows for a winter release of 0.65 feet to support instream flows. Drowns Dam is to be operated in conjunction with Dolloff Dam to maintain these lake levels, which are managed to serve public interests including recreational opportunities, aquatic habitat, and water quality.

Riparian Property Obligations or Agreements

Since 2000, DES has utilized Drowns Dam to manage Pawtuckaway Lake levels by approximating the historical median levels to meet the conditions of the 2000 DES Notice of Decision. The 2000 Notice of Decision describes the conditions for an annual fall drawdown and spring fill where, by November 30, the lake would be lowered 7 feet to a level of 18 feet on the gauge at Dolloff Dam and returned to a lake level of 25 feet by June 1st (DES 2000). This 2000 Decision was reconsidered in a Lake Level Investigation during 2012-2013 and a new Decision was reached in 2013. The 2013 Decision changed the annual fall drawdown from 7 to 4.8 feet below full pond, which is to be achieved by November 30, and provides for the return to full lake level of 25 feet by June 1st. Lake level between spring and fall, depending on inflow, is maintained at 25 feet as measured on the staff gauge at Dolloff dam.

Water Quality Requirements or Limits

There are no site-specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

Releasing water from storage is one way to offset Lamprey River flow deficits by providing a relief flow pulse. Drowns Dam is one of the two dams controlling Pawtuckaway Lake that could be used to release water for a relief flow to attain downstream water quality standards.

The DES Dam Bureau files show the maximum storage volume for Drowns Dam (Pawtuckaway Lake) is 11,700 acre-feet (ac-ft). GIS assessments by Watershed Management Bureau using bathymetry developed in 2011 and 2012 defined its permanent storage volume as 7954 ac-ft, for a difference of 3746 ac-ft (163 million cu. ft. or 1221 million gallons). The permanent storage of Pawtuckaway Lake is the largest of the lakes within the Lamprey River Water Management Planning Area. The drainage area behind the dam is 20.3 sq. miles, which due to its large area provides considerable runoff potential for refilling the impoundment. This watershed represents 11% of the Lamprey River watershed.[6] The surface area of the lake is 783 acres. Therefore, the potential volume of water available for flow management from Pawtuckaway Lake through this dam or Dolloff Dam is the highest among the dams in this Water Management Planning Area.

Each of the bioperiods except Spring Flood has a bioperiod-specific flow to be released as the relief flow to maintain protected flows. The volume of water to be added to the release, and its equivalent discharge value and the estimated water level change for each bioperiod, are summarized in Table 2. The relief flow volume and flow rate values in Table 2 are based on

[6] Relative to the USGS stream flow gauge 01073500 Lamprey River Near Newmarket, NH

supporting the Rare and Critical flow requirements 90 percent of the time and includes a 20 percent buffer. The twenty percent buffer recognizes that there are unquantified losses that may cause attenuation of flow between the location of the release and the Designated River. The Spring Flood bioperiod will not be managed because historically there have been very few low-flow events during this time.

Because of lake management, the volume of the lake is changed through the year, thereby affecting the amount of water in storage that could be available for a relief flow release. Following the Spring Flood bioperiod, the impoundment is expected to be at full pool as the starting point for the summer season. Full lake is the level of the Dolloff Dam's spillway, which is at 25 feet as measured on the staff gauge at Dolloff dam.

The lake level is usually above 25 feet (full) after the spring melt and declines below this level by mid-July, resulting in minimal water passing downstream. During the bioperiods of early summer through early fall (Clupeid Spawning, GRAF Spawning, and Rearing and Growth), protected instream flows can be supported by relief flows released from storage in Pawtuckaway Lake. Release volumes for summer and fall bioperiods include flow from Mendums Pond. A relief flow release during the three summer periods represents lake level declines of 0.14, 0.02 or 0.05 feet, respectively. Management conditions on releases will be applied to ensure that the lake's recreational use, wildlife, fish and water quality are protected, or these releases will be curtailed.

Under the 2000 Notice of Decision, each fall, beginning in early October, water was released from Dolloff Dam (in combination with Drowns Dam at the northern end of the lake). The goal of the drawdown under the 2000 Decision was to lower the lake by seven feet (to 18 feet on the gage by November 30).[7] The annual seven-foot drawdown release currently supports most of the Salmon Spawning bioperiods instream flow needs without active management for protected instream flows.

Protected flows during the October 7 through December 8 bioperiod are usually met because of the fall lake drawdown. A pulse may be applied during this bioperiod if protected flows are not being maintained by managing the timing and release rate of the fall drawdown. The annual fall drawdown will be managed such that the volumes leaving Drowns and Dolloff Dams are proportional to the subwatershed areas of the northern and southern pond areas; namely, 70% via Drowns Dam and 30% via Dolloff Dam. Achieving the 4.8 foot drawdown level will be targeted for November 30.

During the Overwintering bioperiod, relief flows will be provided from some of the water retained from the 4.8 foot annual fall drawdown. At the final lake level of 4.8 feet below full pool, one relief flow release is possible during the winter. The reduction of lake level for this release is expected to be 0.65 feet (about 8 inches) or less.

Refilling the lake has historically begun between mid-January and early-February. From late January continuing through May, the DES Dam Bureau adds stoplogs to reduce the outflow from

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[7] The lake was rarely dropped to 18 feet -- the 1982-2012 median winter lake level is deepest in mid- to late January at about 18.7 feet or 6.3 feet below full pond.

the dam and refill the lake to its full lake stage of 25 feet by June 1 (DES 2000). As the Spring Flood bioperiod approaches, depending on spring flood storage needs, the water stored for the Overwintering bioperiod may be saved to maintain stream flows during the Spring Flood bioperiod, or released before the Spring Flood bioperiod to provide additional flood storage, as the DES Dam Bureau deems necessary. Relief flow releases are not proposed during the Spring Flood bioperiod because there is insufficient storage to both fill the lake and maintain downstream flows. At the end of the Spring Flood bioperiod, the water level should again be at full lake level and have sufficient storage to support management, public recreation and lake ecology during the next three bioperiods of early summer through early fall.

Potential Impacts of Storage and Release of Relief Flows

Impacts of the water management actions on existing wetland in Pawtuckaway Lake are limited. Except for Burnham's Marsh, there are few mapped wetlands within the impoundment area of the dam. Burnham's Marsh is separated from the lake by Burnham's Marsh Dam, so the storage or release of water from Dolloff or Drowns dam for flow management would have little potential impact on wetlands in Burnham's Marsh.

Mapped wetland areas are present below the dam in the riparian area along the Pawtuckaway River. These wetlands could reduce the effectiveness of any flow released from Dolloff Dam by temporarily storing the released water. A test relief pulse, conducted in September 2012, demonstrated that these wetlands have little discernible impact on the flow or timing of the pulse.

Pawtuckaway Lake has been a nesting area for up to two Common Loon pairs. Common Loons are state-listed as Threatened. Loon nesting success is sensitive to water level changes because changes of six inches or more have the potential to either flood the nest or strand it above the reach of the parents. The primary nesting period for loons is May 15 through July 15, although secondary nesting periods occur later in the year if the initial nesting attempt fails. Water levels should not vary more than 6 inches to support loon nesting success.

Managing water levels on Pawtuckaway Lake for the purpose of flow management on the Lamprey Designated River should not have a significant effect on shoreline properties or on recreational opportunities on the Lake. DES has defined a limit of 18 inches below full pond level of the total water level change caused by management and by the usual decline—this would represent an extreme condition that would occur very infrequently, if at all. In addition, 18 inches is considered to be within the natural range of variability for summer lake levels.

The period of most common management needs is from July 5 through October 6. Thirty-four of 56 years would have required no management and twelve years would have required only one management event. A single management event during this time of year would change the lake level by 0.05 feet (0.6 inches). During the driest two years on record, six relief flows would have been applied throughout the spring, summer and fall, for a cumulative lake level effect of four inches.

The change in winter drawdown practices is expected to reduce both the amount and residence time of phosphorus in the lake. The reduction in phosphorus will reduce the likelihood of algal blooms. The summer releases are unlikely to either promote or retard algal blooms.

The DES Dam Bureau has assessed the difference in flood protection resulting from a reduced winter drawdown. Because the difference on lake volume between 7 feet and 5 feet of drawdown is relatively small, the increase in flood protection attributable to a deeper drawdown is small. Further, the DES Dam Bureau will always have the ability to manage Pawtuckaway Lake dams for the protection of health and safety such that water may be released to help preempt the effects of an incoming storm.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Drowns Dam for flow management to support the instream flow requirements on the Lamprey Designated River is high due to the public ownership of the dam, the amount of storage potentially available, the large drainage area above the dam, the existence of an outlet structure designed to manage water levels and its proximity to the beginning of the designated river.

Dam Management Activity

Pawtuckaway Lake is controlled by two operable dams. Water can be release from Pawtuckaway Lake from either Dolloff Dam or Drowns Dam or from a combination of both dams. When compared with Dolloff Dam, Drowns Dam is slightly closer to the beginning of the Lamprey Designated River (10 miles versus 14 miles.) Releases from Downs Dam to provide for flow management would have to be coordinated with the timing and volume of Dolloff Dam releases. Non-winter releases would also be coordinated with releases from Mendums Pond. DES will not conduct flow releases for stream flow protection during the Spring bioperiod.

Drowns Dam's primary use is described by the Dam Bureau as recreation. The uses of Drowns Dam will be expanded to include management for instream flow protection. The DES Dam Bureau, as the owner of the dam, will be responsible for the operation of the dam to support the protected instream flows on the Lamprey Designated River. If a flow management release becomes necessary, water may be released from Drowns Dam to create a relief flow pulse to support the protected instream flows on the Lamprey Designated River. The Dam Bureau will take such actions as are necessary to operate the stoplogs at Drowns Dam to increase flow from Pawtuckaway Lake by the amount shown in Table 2 beginning at a start time identified by the Instream Flow Program. The DES Watershed Management Bureau will identify when flow management is needed and notify the DES Dam Bureau of an approaching event.

Relief flows may be released to support the protected instream flows during five of the six bioperiods. Flow management releases may occur if the daily mean discharge falls below the Critical or Rare protected flow magnitudes for longer than its catastrophic duration (DES 2009). No relief flows will be released from Pawtuckaway Lake during the Spring Flood bioperiod (March 1 to May 4).[8] For the Clupeid Spawning, GRAF Spawning, and the Rearing and Growth

[8] Minimum flows for the maintenance of downstream flow will be supported during spring refilling.

bioperiods (May 5 to October 6), relief flows will be generated by releases from both Mendums Pond and Pawtuckaway Lake. The volume released from each lake will be proportional to its surface area such that each lake has the same change in water level. During the annual fall drawdown, which occurs during the Salmon Spawning bioperiod (October 7 – December 8), the drawdown may be configured as a pulse to support instream flows. Releases from Pawtuckaway Lake will be in combination with releases from Mendums Pond, except during the Overwintering bioperiod (December 9 – February 28) when Mendums Pond will not be used.

Flow conditions will be evaluated by DES to determine management need and relief flow release effects based on the records from the United States Geological Survey stream flow gaging station Lamprey River near Newmarket, New Hampshire (0173500). If a flow management release is needed, then Dam Bureau will release a two-day relief flow from Drowns, Dolloff, or both dams at rates described in Table 2.

DES will post a notification of approaching management on its website. DES will send an email notification to the Town of Nottingham and to the president of the Pawtuckaway Lake Improvement Association.

To protect the State-listed threatened Common Loon nesting cycle, no relief flow releases will be applied between May 15 and July 15 that would result in reducing the water level more than six inches when any successful loon nesting is occurring. DES will notify NH Fish and Game, The Loon Preservation Committee and the Pawtuckaway Lake Improvement Association of approaching management conditions and request their determination of whether loons are currently actively nesting on the Lake during that period. From July 15 through August 15, DES will consult with NH Fish and Game and The Loon Preservation Committee to determine whether relief flow releases for stream flow protection will affect loon nesting.

In the event of the need for relief flows from Pawtuckaway Lake between May 5 and October 6, the maximum water level drawdown shall not result in the Lake water level going below 18 inches below the spillway crest.

The annual fall drawdown will be managed such that the volumes released from Drowns and Dolloff Dams are proportional to the subwatershed areas of the northern and southern pond areas: namely, 70% via Drowns Dam and 30% via Dolloff Dam.

Only one Overwintering pulse is possible based upon the proposed change in storage. Use of Drowns Dam during the Overwintering bioperiod may not be possible because of a remnant channel obstruction described as a coffer dam, which is located upstream of Drowns Dam. This coffer dam reduces flow to Drowns Dam as water level in the lake falls, and stops flow when water levels fall to 5.4 feet below full lake level.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice after adoption of the Lamprey Water Management Plan. The operations for releases under this Dam Management Plan for the period March 1 through December 8 will begin with the first bioperiod start following adoption.

Management during the December 9 through February 28 Overwintering bioperiod includes a change in the annual drawdown to 4.8 feet instead of ~7 feet. This change will be implemented over four years by reducing the drawdown approximately 6 inches each year. During these first four years, no Overwintering bioperiod releases will be applied, barring any unforeseen or unusual circumstances.

Estimated Cost of the Implementation of the Dam Management Plan

The specific actions associated with the implementation of the Dam Management Plan for Drowns Dam would include the placement or removal of stop logs from the dam. This work would require that, at least, one trained DES employee travel to the site to either place or remove a pre-determined number of stop logs from the dam structure. These trips are expected to also include management actions at Dolloff Dam and Mendums Pond Dam. The estimated costs associated with this work will be dependent upon the number of personnel involved, the number of site visits required to perform the necessary flow management actions and the travel time and mileage. Accounting for any costs associated with this program will be made through the two-year evaluation period following the approval of this plan.

Dam Owner and Contact Information

Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
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Department of Environmental Services (DES) 2000. Notice of Decision on Determination of Lake Level. Dated December 19, 2000.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Department of Environmental Services (DES) 2013. Notice of Decision on Determination of Lake Level. August 2013.

Table 1 - Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**241.30**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**18**
Freeboard (ft)	**NA**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**738***
Drainage area (sq. miles)	**20.3***
Maximum storage (ac-ft)	**11,700**
Normal or permanent storage (ac-ft)	**7,954***
Total discharge capacity (cfs)	**1,631**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**2,080**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**290**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #184.04 except those marked with an asterisk which are from recent GIS evaluations.

Note: NA – not available from NH Dams Data Sheet.

Table 2 – Two-Day Flow Release Contribution from Drowns or Dolloff Dams in the Event of Instream Flow Water Management.

Bioperiod name	**Period**	**Relief volume needed to meet 90% of historical deficits (ac-ft)**	**Relief volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)**	**Two-day flow release contribution from Pawtuckaway (cfs) [74.7%]**	**Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)**	**Water source**
Overwintering	Dec 9 – Feb 28	216	259	65*	0.65 – starting from 4.8 ft below full – not from full pool	Water retained from Pawtuckaway Lake from annual fall drawdown.
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	118	142	27	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	20	24	4.5	0.02	from storage and drawdown
Rearing &Growth	Jul 5 – Oct 6	47	56	10.5	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	75	90	17	Occurs during annual fall drawdown	Annual, fall drawdown.
Mendums		265	Acres at full recreational pool [25.3% of combined Mendums and Pawtuckaway surface areas]			
Pawtuckaway		783	Acres at full recreational pool [74.7% of combined Mendums and Pawtuckaway surface areas]			

* Overwintering release is from Pawtuckaway Lake only.

DAM MANAGEMENT PLAN

Drowns Dike (State Dam ID #184.19)

Figure 1 – Southern and northern sides of Drowns Dike, photos taken October 3, 2007.

Introduction

Drowns Dike (lat. 43º 06’ 26”, long. -71º 07’ 23”) is one of four dams that store water in Pawtuckaway Lake. It is located at the end of Beech Road and east of Drowns Dam in Nottingham, New Hampshire. Drowns Dike is located in the drainage of Mile Brook, which flows north to the Bean River, a tributary of the North River. The North River flows southeast to join the Lamprey River immediately upstream of the start of the Lamprey Designated River in Epping, New Hampshire. Drowns Dike is approximately 10 miles upstream of the start of the Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information).

Dam Design

The dike was originally constructed in 1842 and consists of earth and rock material. There are no outlet structures and, as a result, there is no operation of or controlled discharge from the dike (Figure 1). Details on the design and operation of the dike were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, its owner. The information required by Env-Wq 1906.04 on the characteristics of the dike is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

A lake level investigation and hearing set the desired operating water levels at Pawtuckaway lake. The dike is used to manage water levels to serve public interests including recreational opportunities, aquatic habitat, and water quality. Also, seasonal drawdown levels were established to provide for spring flood abatement.

Riparian Property Obligations or Agreements

Drowns Dike, along with Drowns Dam, Dolloff Dam and Gove Dike, are used to manage water levels to maximize public recreation on Pawtuckaway Lake.

Water Quality Requirements or Limits

There are no water quality requirements or limits.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Drowns Dike is 4,320 acre-feet (ac-ft), while its permanent storage volume is 3,564 ac-ft, for a difference of 756 ac-ft (33 million cu. ft. or 250 million gallons). When compared with the other dams being evaluated as part of this study the permanent storage volume of Drowns Dike is considerably higher. The drainage area behind the dam is 21 sq. miles, which due to its large area would provide considerable runoff to the impoundment following any drawdown in water levels. Therefore, the water available for flow management from this dam is high compared to other dams in this Water Management Planning Area.

Potential Impacts of Storage and Release of Relief Flows

One impact of the storage and subsequent release of water from the Drowns Dike for flow management would be the change in the Pawtuckaway Lake water level. Large changes in water level could affect recreation on the lake as well as waterfront residential property. There are a number of mapped riparian wetland areas below the dam along the unnamed tributary as well as along the Bean River and North River which could reduce the effectiveness of any relief flow released from Drowns Dike by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management activities.

Mapped wetland areas are sparse within the flood impoundment storage area above the dam. Therefore, inundation of this area by the storage of water and dam releases for flow management would have little potential impact on wetland areas above the dam.

Potential for Dam Management to Support Instream Flow Requirements

The potential for operation of Drowns Dike to support instream flows is very low. Drowns Dam, which is located in the same vicinity as Drowns Dike, has an existing outlet structure designed for managing water levels in Pawtuckaway Lake. There is no outlet structure on Drowns Dike to manage water releases so flow management would require extensive modification of the dam. Drowns Dam would be used in preference to Drowns Dike.

Dam Management Activity

No dam management activity is currently required for Drowns Dike due to the presence Drowns Dam nearby.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Drowns Dike, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: jgallagher@des.state.nh.us

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Drowns Dike Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**12**
Freeboard (ft)	**4**
Type of spillway controls or outlet works	**None**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**900**
Drainage area (sq. miles)	**21**
Maximum storage (ac-ft)	**4,320**
Normal or permanent storage (ac-ft)	**3,564**
Total discharge capacity (cfs)	**NA**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**NA**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**2,080**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #184.19.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Freeses Pond Dam (State Dam ID #061.02)

Figure 1 – Freeses Pond Dam and outlet structure, photos taken October 2, 2007.

Introduction

Freeses Pond Dam (lat. 43° 09' 01", long. -71° 14' 04") is located on the Lamprey River near the intersection of Routes 107 and 43 in Deerfield, New Hampshire. Freeses Pond Dam lies approximately 28 miles upstream of the start of the Lamprey Designated River. This dam is owned by the Town of Deerfield and operated by the Deerfield Board of Water Commissioners (see contact information). The dam is active and is used for recreation.

Dam Design

The dam was reconstructed in 1987 and it consists of stone and concrete. The outlet structure has slots for wooden stop logs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam operator. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the operator of the dam, there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the operator of the dam, there are no riparian property obligations or agreements.

Water Quality Requirements or Limits

According to the operator, there are no site specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

Freeses Pond is bisected by Route 107, with a 13-foot arched corrugated metal pipe culvert under the road dividing the upper pond from the lower pond. DES Dam Bureau files show the maximum storage volume for Freeses Pond, including both the upper and lower pond, is 432 acre-feet (ac-ft). Its permanent storage volume, measured at the sill of the 17-foot lower spillway, is 66.3 ac-ft for the downstream and upstream ponds. Additional water below the lower spillway could be released by removing stop logs.

The drainage area upstream of the dam is 8.58 square miles and includes the 17-acre Meadow Lake—another impoundment in the Lamprey Water Management Plan. When compared with the other dams in this Water Management Planning Area, the storage volume and the contributing drainage area for Freeses Pond Dam result in a moderate potential for water management use. However, Freeses Pond's surface area represents only 5% of the combined surface areas of it, Pawtuckaway Lake and Mendums Pond, the latter two being the impoundments with high potential for dam management. Mendums Pond surface area is five times, and Pawtuckaway Lake is 14 times, the size of Freeses Pond.

Potential Impacts of Storage and Release of Relief Flows

Within the impoundment area of Freeses Pond Dam there are extensive areas of mapped wetlands, particularly in the portion of the impoundment located on the northeast side of Route 107. Excessive or repeated inundation and draining of these areas by the storage and release of water for flow management on the Lamprey Designated River could negatively impact them. Insufficient information is available to quantify the resulting impacts of flow management actions. Freeses Pond is managed for recreation, and raising or lowering the water surface could potentially impact recreation opportunities on the pond. The beginning of the Designated River is 28 miles downstream of the dam and there are several ponds and wetland complexes along this portion of the Lamprey River. The temporary storage of water released from the dam by these features could reduce the effectiveness of a flow management action.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Freeses Pond Dam for flow management to support the instream flow requirements on the Lamprey Designated River is moderate. Factors considered favorable for the use of Freeses Pond Dam for flow management on the Lamprey Designated River include: the size of the contributing drainage area upstream of the dam; the amount of water potentially available for flow management; and an existing outlet structure that can be used to regulate dam releases.

Factors considered unfavorable for flow management include: the distance (28 miles) that the dam is located from the start of the Lamprey Designated River; the number of ponds and wetlands located between the dam and the start of the Designated River; and the potential impact of flow management on the wetlands and recreation.

An assessment of the water level changes that might occur under a relief flow release as part of a dam management action showed that the water level changes in Onway Lake would be small, especially if releases were in combination with Pawtuckaway Lake and Mendums Pond. See Table 3 – Water Level Change on Freeses Pond, Mendums Pond and Pawtuckaway Lake with Flow Management. The maximum annual water level change if Freeses Pond were to provide the entire relief flow would be over 10 feet. (Assumes that one management event will occur during each bioperiod except the Spring Flood bioperiod.) A more likely scenario would be water releases from Freeses Pond in combination with releases from Mendums Pond and Pawtuckaway Lake. The releases would be prorated based on their surface areas. With the combined effect of the three lakes, the annual water level change would be 0.52 feet. Winter releases solely from Pawtuckaway are anticipated that would make the annual change in Freeses Pond 0.28 feet.

Dam Management Activity

Since the potential for its use for flow management on the Lamprey Designated River is only moderate due largely to the distance of the impoundment from the Designated River, no dam management activity is currently required. Freeses Pond represents the second alternate should a contingency be needed.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Freeses Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: Town of Deerfield, Deerfield Water Commission
Address: P.O. Box 159, Deerfield, NH 03037
Contact: Mr. John Dubiansky, Chairman, Deerfield Water Commission
Phone: 603-463-8811

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Freeses Pond Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**12.5**
Freeboard (ft)	**2**
Type of spillway controls or outlet works	**Stop logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**55.3**
Drainage area (sq. miles)	**8.58**
Maximum storage (ac-ft)	**192**
Normal or permanent storage (ac-ft)	**66.3**
Total discharge capacity (cfs)	**2460**
Maximum unoperated discharge (cfs)	**2460**
Design storm discharge (cfs)	**831.8**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #061.02.
Note: NA – not available from NH Dams Data Sheet.

Table 2 – Freeses Pond relative to Mendums Pond and Pawtuckaway Lake.

	Acres of surface area	% of combined surface area	Size relative to Freeses Pond surface area
Mendums Pond	265	24.0%	4.8
Pawtuckaway Lake	783	71.0%	14.2
Freeses Pond	55.3	5.0%	1.0
Sum	**1103.3**	**100.0%**	

Table 3 – Water Level Change on Freeses Pond, Mendums Pond, and Pawtuckaway Lake with Flow Management.

Bioperiod name	Period	Release volume - 90% coverage with 20% buffer (ac-ft)*	Release volume in cubic feet	Drawdown using Freeses Pond only (feet)	Drawdown using Freeses Pond with Pawtuckaway and Mendums (prorated by area) (feet)
Overwintering	Dec 9 – Feb 28	259	11,290,752	4.69	0.23
Spring Flood	Mar 1 – May 4	-			
Clupeid Spawning	May 5 – Jun 19	142	6,168,096	2.56	0.13
GRAF Spawning	Jun 20 – Jul 4	24	1,045,440	0.43	0.02
R&G	Jul 5 – Oct 6	56	2,456,784	1.02	0.05
Salmon Spawning	Oct 7 – Dec 8	90	3,920,400	1.63	0.08
			Sum	**10.33**	**0.52**

*** Volume for a dam release that meets 90% of the historical (1976-2005) deficits of catastrophic and persistent low-flow events to which has been added a buffer of 20% as a contingency to account for unforeseen losses.**

DAM MANAGEMENT PLAN

Gove Dike (State Dam ID #184.03)

Figure 1 – Lake side of Gove Dike embankment, photo taken October 3, 2007.

Introduction

Gove Dike (lat. 43º 04' 50", long. -71º 08' 02") is one of four dams that store water in Pawtuckaway Lake. It is located on Shore Drive in Nottingham, New Hampshire. The dam is located in the drainage of an unnamed tributary to the Pawtuckaway River, which flows south to join the Lamprey River in Epping, New Hampshire. Gove Dike lies approximately 14 miles upstream of the start of the Lamprey Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information).

Dam Design

The dike was originally built in 1842 and was last reconstructed in 1983. The dike consists of earth and rock material. It has no outlet structures and as a result, there is no operation of or controlled discharge from the dike (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, its owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

A lake level investigation and hearing set the desired operating water levels at this lake. This dike is used to manage water levels to serve public interests including recreational opportunities, aquatic habitat, and water quality. Also, seasonal drawdown levels were established to provide for spring flood abatement.

Riparian Property Obligations or Agreements

Gove Dike, along with Dolloff Dam, Drowns Dam and Drowns Dike, is used to maintain water levels on Pawtuckaway Lake to maximize public recreational opportunities.

Water Quality Requirements or Limits

There are no water quality requirements or limits.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Gove Dike is 11,700 acre-feet (ac-ft), while its permanent storage volume is 11,500 ac-ft, for a difference of 200 ac-ft (8.7 million cu. ft. or 65 million gallons). When compared with the other dams being evaluated as part of this study, the permanent storage volume of this impoundment is large. The drainage area behind the dam is 21 sq. miles, which would provide considerable runoff to the impoundment following any drawdown in water levels.

Potential Impacts of Storage and Release of Relief Flows

One effect of the storage and subsequent release of water from the Gove Dike for flow management would be the change in the Pawtuckaway Lake water level. Large changes in water level could impact recreation on the lake as well as waterfront residential property. There are a number of mapped riparian wetland areas along the Pawtuckaway River below the dam which could reduce the effectiveness of relief flows released from Gove Dike by temporarily storing the released water. Insufficient information is available to determine the amount of water that would be attenuated by the wetland areas and the resulting impacts on any flow management activities.

Mapped wetland areas are sparse within the flood impoundment storage area above the dam. Therefore, inundation of this area by the storage of water and dam releases for flow management would have little potential impact on wetland areas above the dam.

Potential for Dam Management to Support Instream Flow Requirements

The potential for operation of Gove Dike to manage instream flows is very low. There is no outlet structure on Gove Dike to manage water releases. Flow management using Gove Dike would require extensive modification of the dam.

Dam Management Activity

No dam management activity is currently required for Gove Dike, due to the presence of Dolloff Dam nearby.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Gove Dike, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: jgallagher@des.state.nh.us

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Gove Dike Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**9**
Freeboard (ft)	**3.6**
Type of spillway controls or outlet works	**None**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**900**
Drainage area (sq. miles)	**21**
Maximum storage (ac-ft)	**11,700**
Normal or permanent storage (ac-ft)	**11,500**
Total discharge capacity (cfs)	**NA**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**2,080**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**261**

Source of information: DES Dam Bureau, NH Dams data Sheet for Dam #184.03.
Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Hoar Pond Dam (State Dam ID #078.07)

Figure 1 – Hoar Pond Dam and outlet structure, photos taken October 3, 2007.

Introduction

Hoar Pond Dam (lat. 43º 02’ 53”, long. -71º 05’ 11”) is located on an intermittent tributary to the Lamprey River off of Beniah Lane in Epping, New Hampshire. This dam is owned by the Town of Epping (see contact information). The dam is active and is used for recreation. Hoar Pond lies approximately 8 miles upstream of the start of the Lamprey Designated River. Hoar Pond is also located within the well protection area for some of the Town of Epping’s water supply wells.

Dam Design

The dam was originally constructed in 1900 and was repaired in 1989. The original dam consisted of a concrete wall and a wood tongue-and-groove wall with earthen fill. The dam has been partially breached, and beaver have constructed an upstream dam that now controls the water level in the pond (Figure 1). Details on the design and operation of the Hoar Pond Dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the owner there are no riparian property obligations or agreements.

Water Quality Requirements or Limits

According to the owner, Hoar Pond is located within the protection radius of two of Epping Water and Sewer's bedrock water supply wells.

Assessment of Potential Water Availability

The maximum and permanent storage volumes for Hoar Pond Dam are both reported as 65 acre-feet (ac-ft), thus there is no additional storage volume available from this dam. The drainage basin upstream of the dam is only 0.52 square miles, which limits the potential amount of runoff to refill the pond. When compared to other dams in the Water Management Planning Area, both the permanent storage volume and contributing drainage area associated with Hoar Pond Dam are low. Therefore, the water available from this dam for flow management is considered low. In addition, water levels in the pond appear to be controlled by a beaver dam, which allows for some seepage downstream to the outlet stream. The lack of an engineered outlet structure further limits the availability of water from this dam for flow management.

Potential Impacts of Storage and Release of Relief Flows

Since the release of water from this dam cannot be controlled, this dam cannot be used for the storage and release of water for flow management on the Lamprey Designated River.

Potential for Dam Management to Support Instream Flow Requirements

Due to the lack of any additional storage, the limited size of the contributing drainage area and the lack of an operating outlet control structure, Hoar Pond Dam has been eliminated from consideration for flow management activities at this time.

Dam Management Activity

Since there is insufficient drainage area to replenish the impoundment and since the dam cannot be used for the storage or release of water without significant alterations, no dam management activity is currently required.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Hoar Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: Town of Epping
Address: 157 Main Street, Epping, NH 03042
Contact: Mr. Dean Shankle, Town Administrator
Phone: 603-679-5441
Email: administrator@townofepping.com

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Hoar Pond Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**5.8**
Freeboard (ft)	**NA**
Type of spillway controls or outlet works	**None**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**26**
Drainage area (sq. miles)	**0.43**
Maximum storage (ac-ft)	**65**
Normal or permanent storage (ac-ft)	**65**
Total discharge capacity (cfs)	**NA**
Maximum unoperated discharge (cfs)	**NA**
Design storm discharge (cfs)	**162**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**223**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #078.07.
Note: NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Lucas Pond Dam (State Dam ID #183.08)

Figure 1 – Lucas Pond Dam outlet structure, photos taken August 2005.

Introduction

Lucas Pond Dam (lat. 43° 10’ 55”, long. -71° 09’ 48”) is located on a tributary to the North River off of Lucas Pond Road in Northwood, New Hampshire. The North River flows southeast from the confluence with the unnamed tributary and joins the Lamprey River immediately above the start of the Designated River. Lucas Pond Dam lies approximately 15 miles upstream of the start of the Designated River. This dam is owned by the State of New Hampshire Fish and Game Department (see contact information). The dam is actively managed by the NH Fish and Game Department for recreation and fishing.

Dam Design

The dam was last reconstructed in 1979. The dam is constructed of concrete and slots are present for the installation of wooden stop logs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner, there are no minimum flows, flowage rights or contractual obligations.

Riparian Property Obligations or Agreements

The New Hampshire Fish and Game Department has flowage rights over the “grantor’s land” according to the deed in the Departments file.

Water Quality Requirements or Limits

According to the owner, there are no water quality requirements or limits.

Assessment of Potential Water Availability

DES Dam Bureau records show the maximum storage volume for Lucas Pond Dam is 92 acre-feet (ac-ft), while its permanent storage volume is 40 ac-ft. The drainage area providing runoff to the dam is 1.16 square miles in size. When compared with the other dams in this Water Management Planning Area, both the permanent storage volume and drainage area associated with Lucas Pond Dam are low. Therefore, the water available for flow management from this dam is also considered to be low.

Potential Impacts of Storage and Release of Relief Flows

The reach of the North River downstream of the dam to the Lamprey River is largely rural and few structures are present in or adjacent to the river. There are no extensive wetland areas within the impoundment storage area that would be impacted by either water storage or dam releases for flow management. However, there are several mapped riparian wetland areas downstream of the dam which could reduce the effectiveness of any flow released from Lucas Pond Dam by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management actions.

Potential for Dam Management to Support Instream Flow Requirements

The potential for the management of Lucas Pond Dam to support instream flows on the Lamprey Designated River is low. Factors favoring the use of Lucas Pond Dam for meeting instream flow requirements on the Lamprey Designated River include its contribution to flow above the start of the Designated River and a functioning outlet structure. Factors limiting the potential use of Lucas Pond Dam include: small volume of water available; small drainage area; the distance to the Designated River; and the existence of extensive downstream wetland areas, which could reduce the effectiveness of any dam releases.

Dam Management Activity

No dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Lucas Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: New Hampshire Fish and Game Department
Address: 11 Hazen Drive, Concord, NH 03301
Contact: Mr. John Magee, Fish Habitat Biologist
Phone: 603-271-2744
Email: john.a.magee@wildlife.nh.gov

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Lucas Pond Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**NA**
Freeboard (ft)	**2**
Type of spillway controls or outlet works	**Stoplogs**
Dimensions of spillway controls or outlet works	**10**
Surface area (ac) of impoundment at maximum impoundment	**40**
Drainage area (sq. miles)	**1.16**
Maximum storage (ac-ft)	**92**
Normal or permanent storage (ac-ft)	**40**
Total discharge capacity (cfs)	**94**
Maximum unoperated discharge (cfs)	**94**
Design storm discharge (cfs)	**60**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #183.08.
Note:
NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Meadow Lake Dam (State Dam ID #183.16)

Figure 1 – Meadow Lake Dam and outlet structure, photos taken October 2, 2007.

Introduction

Meadow Lake Dam (lat. 43º 12’ 08”, long. -71º 12’ 29”) is located in Northwood Meadows State Park, which is off of Route 4 in Northwood, New Hampshire. This dam impounds a headwater tributary stream to the Lamprey River forming Meadow Lake. Meadow Lake Dam lies approximately 32 miles upstream of the start of the Designated Lamprey River. The dam is owned by the State of New Hampshire Division of Resources and Economic Development and operated by the Division of State Parks (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was originally built in 1975 and underwent reconstruction in 1991. The dam is constructed of earth materials and a corrugated metal pipe outlet (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner, there are no minimum release requirements, flowage rights or contractual obligations associated with this dam.

Riparian Property Obligations or Agreements

The dam owner provided no information as to whether there are any riparian property obligations or agreements. Considering that the lake is on state-owned land and the shoreline is undeveloped, DES believes that there are no such obligations or agreements.

Water Quality Requirements or Limits

According to the owner, there are no water quality requirements or agreements.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Meadow Lake Dam is 105 acre-feet (ac-ft), while its permanent storage volume is 85 ac-ft, for a difference of 20 ac-ft (0.87 million cu. ft. or 6.5 million gallons). The size of its contributing drainage area, 0.47 square miles, is relatively small and may not provide sufficient runoff to refill the lake during a period of below normal precipitation. When compared to other dams in this Water Management Planning Area, both the permanent storage volume and contributing drainage area associated with Meadow Lake Dam are low. Therefore, the water available for flow management from this dam is also considered to be low.

Potential Impacts of Storage and Release of Relief Flows

There are no significant wetlands mapped within Meadow Lake, so storage and release of water for relief flows would have no significant affect on wetlands within or immediately bordering the lake.

Below the dam there are extensive mapped wetland complexes, which could reduce the effectiveness of any flow released from Meadow Lake Dam by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management actions.

Potential for Dam Management to Support Instream Flow Requirements

Meadow Lake Dam has low potential to support the instream flow requirements due to the small amount of water available, its small contributing drainage area, its distance upstream of the start of the Designated River, the presence of extensive wetlands immediately downstream of the dam, the need to retrofit the outlet structure and the potential impact of lowered water levels on its use for recreation within a State Park.

Dam Management Activity

No dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Meadow Lake Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no estimated costs.

Dam Owner and Contact Information

Owner: New Hampshire Department of Resources and Economic Development
Address: P.O. Box 1856, Concord, NH 03302-1856
Contact: Mr. Seth Prescott
Phone: 603-271-2606
Email: sprescott@dred.state.nh.us

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Meadow Lake Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**2**
Freeboard (ft)	**NA**
Type of spillway controls or outlet works	**Pipe**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**17**
Drainage area (sq. miles)	**0.47**
Maximum storage (ac-ft)	**105**
Normal or permanent storage (ac-ft)	**85**
Total discharge capacity (cfs)	**59**
Maximum unoperated discharge (cfs)	**59**
Design storm discharge (cfs)	**31**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams data Sheet for Dam #183.16.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Mendums Pond Dam (State Dam ID #184.01)

Figure 1 – Mendums Pond Dam and outlet structure, photos taken August 2005.

Introduction

Mendums Pond Dam (lat. 43º 09' 46", long. -71º 04' 07") is located on the Little River near Route 4 in Nottingham, New Hampshire. The bulk of Mendums Pond, however, is almost entirely in Barrington, NH. Little River flows seven miles southeast from the dam to its confluence with the Lamprey Designated River. The confluence is approximately six miles downstream of the start of the Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was built in 1840 and underwent reconstruction in 1977. The dam is constructed of concrete and earth materials (Figure 1). Three gates are fitted in the stone outlet structure. Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, the owner and operator of the dam. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are no minimum flows or contractual obligations.

Riparian Property Obligations or Agreements

The water level in Mendums Pond is controlled by DES's management of the dam and by weather conditions. During the fall, beginning around November 9, the water level in the pond is lowered by seven feet by opening one or more of the dam's three gates. In the spring, the gates are partially closed and snowmelt and spring runoff fill the impoundment. Refilling the lake historically has begun between mid-January and early February. From late January continuing through May, Dam Bureau reduces outflow in order to achieve full pond status by May 1. The dates of the drawdown and refilling are coordinated with the UNH Recreation Department's interest in boating competitions in the spring and fall.

Water Quality Requirements or Limits

According to the owner there are no site-specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

Releasing water from storage in a relief pulse is one way to offset Lamprey River flow deficits. The dam controlling Mendums Pond could be used to release water for a relief flow to attain downstream water quality standards.

DES Dam Bureau files show the maximum storage volume for Mendums Pond Dam is 3,330 acre-feet (ac-ft), while its permanent storage volume is 1,960 ac-ft. The size of the permanent storage of Mendums Pond is second only to Pawtuckaway Lake (7954 ac-ft) in the Lamprey River Water Management Planning Area. The drainage area upstream of the dam is 6.97 sq. miles, which provides considerable runoff potential for refilling the impoundment. This watershed represents 4% of the Lamprey River watershed.[9] The surface area of the pond is 265 acres. Therefore, the potential volume of water available for flow management from Mendums Pond is the second highest among the dams in this Water Management Planning Area.

Each of the bioperiods except Spring Flood and Overwinter has a bioperiod-specific flow to be released as the relief flow to maintain protected flows. The volume of water to be added to the release, and its equivalent discharge value and the estimated water level change for each bioperiod, are summarized in Table 2. The relief flow volumes in Table 2 are based on supporting the Rare and Critical flow requirements 90 percent of the time and includes a 20 percent buffer. The twenty percent buffer recognizes there are unquantified losses that may cause attenuation of flow between the release and the Designated River. Release volumes for most bioperiods include flow from Pawtuckaway Lake because of the availability of water from that location. Overwintering relief flows will not come from Mendums Pond because the

[9] Relative to the USGS stream flow gauge 01073500 Lamprey River Near Newmarket, NH

dam gates may be damaged by icing. The Spring Flood bioperiod will not be managed because historically there have been very few low-flow events during this time.

Because of lake management, the volume of the lake is changed through the year affecting the water in storage that could be available for a relief flow release. Following the Spring Flood bioperiod, the impoundment is expected to be at full pool as the starting point for the hydrologic year.

During the bioperiods of early summer through early fall (Clupeid Spawning, GRAF Spawning, and Rearing and Growth), protected instream flows can be supported by relief flows released from storage in Mendums Pond. Release volumes for summer and fall bioperiods include flow from Pawtuckaway Lake because of the availability of water from that location.

The annual seven-foot, fall drawdown releases currently support most Salmon Spawning bioperiods instream flow needs without active management for protected instream flows. A pulse may be applied during this bioperiod if protected flows are not being maintained by managing the timing and release rate the fall drawdown. Active management of the annual fall drawdown is expected to provide all the water necessary to support this bioperiod's protected instream flow.

Potential Impacts of Storage and Release of Relief Flows

Although there are no extensive wetland areas mapped within the impoundment storage area, there are several mapped wetland areas in the riparian areas downstream of the dam which could reduce the effectiveness of flow releases from the dam by temporarily storing the released water. Insufficient information is currently available to determine the amount of water that could be stored by these wetland areas and the resulting effect on a flow management release.

Shorefront owners on Mendums Pond include residential properties and recreational facilities. Managing water levels on Mendums Pond for the purpose of flow management on the Lamprey Designated River is not likely to have a significant effect on shoreline properties or on recreational opportunities on the Pond because of the limited affects on lake level and the infrequent occurrence. DES has defined a limit of 18 inches of the total water level change caused by management and by the usual decline—this would represent a extreme condition that would occur very infrequently, if at all.

The period of most common management needs is from July 5 through October 6. From 1956 through 2011, 34 of 56 years would have required no management and twelve years would have required only one management event. A management event during this time of year would change the lake level by 0.05 feet (0.6 inches). During the driest two years on record, six relief flows would have been applied throughout the spring, summer and fall with a cumulative lake level effect of four inches.

Mendums Pond has been a nesting area for Common Loon pairs. Common Loons are state-listed as Threatened. Loon nesting success is sensitive to water level changes because changes of six inches or more have the potential to either flood the nest or strand it above the reach of the parents. The primary nesting period for loons is May 15 through July 15, although secondary nesting periods occur later in the year if the initial nesting attempt fails. Water levels should not vary more than 6 inches to support loon nesting success.

Nottingham Lake Dam, a dam located between Mendums Pond and the Designated River, needs to be operated such that water released from Mendums Pond continues downstream in a timely and unattenuated manner. Nottingham Pond Dam is located approximately 3.5 miles downstream of Mendums Pond Dam. Nottingham Pond Dam, which is privately owned, was recently reconstructed and is operated both for recreation and the production of hydroelectricity. Any releases from Mendums Pond Dam would have to be coordinated with the owner of the Nottingham Pond Dam to ensure that the water released would not be impounded, thereby reducing the effectiveness of the release or negatively impacting hydroelectric power production.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Mendums Pond Dam for flow management to support the instream flow protection on the Lamprey Designated River is high. Because flow released from Mendums Pond Dam would be conveyed to the Lamprey River via the Little River six miles below the start of the Designated River, flow management releases taken at this dam will not support the instream flow requirements upstream of the confluence. The area upstream of the confluence would be slightly under-supported if the flow deficits are very large, but will be supported the majority of the time. Additional flow management releases may need to be taken at dams further upstream in order to support the instream flow requirements on the upper portion of the Lamprey Designated River. Releases from Mendums Pond will be coordinated with releases from Pawtuckaway Lake.

Dam Management Activities

The Mendums Pond impoundment's primary purpose is currently described by the Dam Bureau as recreation. The purpose of Mendums Pond will be expanded to include instream flow.

DES Dam Bureau, as the owner of the dam, will be responsible for the operation of the dam to support the protected instream flows on the Lamprey Designated River. The Dam Bureau will take such actions necessary to operate the outlet gate at Mendums Pond Dam to increase flow from Mendums Pond by the amount shown in Table 2 beginning at a start time identified by the Instream Flow Program. If a flow management is needed, the DES Dam Bureau will release a two-day relief pulse from the dam. Flow conditions will be evaluated by DES to determine management need and relief flow release effects based on the records from the United States Geological Survey gauging station Lamprey River near Newmarket, New Hampshire (0173500). If a flow management release is needed, then DES Dam Bureau will release a two-day relief flow from Drowns, Dolloff, or both dams at rates described in Table 2.

DES will post a notification of approaching management on its website. DES will send an email notification to the Town of Nottingham, the Town of Barrington, the owner and operator of the Nottingham Lake Dam, and the director of the UNH Recreation Department.

Relief flows from Mendums Pond may be released to support the protected instream flows during four of the six bioperiods. Flow management releases may occur if the daily mean discharge falls below the Critical or Rare protected flow magnitudes for longer than its catastrophic duration (DES 2009). No relief flows will be released from Mendums Pond during the Spring Flood bioperiod (March 1 to May 4).[10] For the Clupeid Spawning, GRAF Spawning, and the Rearing and Growth bioperiods (May 5 to October 6), relief flows will be generated by releases from both Mendums Pond and Pawtuckaway Lake. The volume released from each lake will be proportional to its surface area such that each lake has the same change in water level. During the annual fall drawdown, which occurs during the Salmon Spawning bioperiod (October 7 – December 8), the drawdown may be configured as a pulse to support instream flows. No relief flows will be released from Mendums Pond during the Overwintering (December 9 – February 28) and the Spring Flood (March 1 – May 4) bioperiods.

In the event of the need for relief flows from Mendums Pond between May 5 and October 6, the maximum water level drawdown shall not result in a water level decline of more than 18 inches below the spillway crest.

To protect the State-listed threatened Common Loon nesting cycle, no relief flow releases will be applied between May 15 and July 15 that would result in reducing the water level more than six inches when any successful loon nesting is occurring. DES will notify NH Fish and Game, The Loon Preservation Committee of approaching management conditions and request their determination of whether loons are currently actively nesting on the Lake during that period. From July 15 through August 15, DES will consult with NH Fish and Game and The Loon Preservation Committee to determine whether relief flow releases for stream flow protection will affect loon nesting.

Any releases from Mendums Pond Dam will be coordinated with the owner or operator of the Nottingham Pond Dam to ensure that the water released would not be impounded within Nottingham Pond, thereby reducing the effectiveness of the release or negatively impacting hydroelectric power production. The DES Instream Flow Program will also provide the operators of Nottingham Lake Dam with notification 24 hours in advance that a release is to occur and that they are required to pass that release through their dam.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice upon adoption of the Lamprey River Water Management Plan.

Estimated Cost of the Implementation of the Dam Management Plan

[10] Minimum flows for the maintenance of downstream flow will be supported during spring refilling.

The specific actions associated with the implementation of the Dam Management Plan for Mendums Pond Dam would include the opening and closing of the outlet gate. This work would require that, at least, one trained DES employee travel to the site to open and then close the gate. These trips are expected to also include management of the Dolloff and Drowns Dams on Pawtuckaway Lake. The estimated costs associated with this work will depend on the number of personnel involved, the number of site visits required to perform the necessary flow management releases, travel time and mileage.

Dam Owner and Contact Information

Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: james.gallagher@des.nh.gov

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

References

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Department of Environmental Services (DES) 2009. Final Lamprey Protected Instream Flow Report. Prepared by Normandeau Associates, Inc., Rushing Rivers Institute and the University of New Hampshire. NHDES-R-WD-08-26.

Table 1 – Mendums Pond Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**224.50**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**231.82**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**31**
Freeboard (ft)	**7.3**
Type of spillway controls or outlet works	**Gate**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**265**
Drainage area (sq. miles)	**6.97**
Maximum storage (ac-ft)	**3330**
Normal or permanent storage (ac-ft)	**1960**
Total discharge capacity (cfs)	**1890**
Maximum unoperated discharge (cfs)	**1600**
Design storm discharge (cfs)	**NA**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**330**

Source of information: DES Dam Bureau, NHDAMS Data Sheet for Dam #184.01.

Note:

NA – not available from NH Dams Data Sheet

Table 2 – Mendums Pond flow releases supporting 90 percent of the historical 30-year Protected Instream Flow deficits (1976-2005) and the calculated changes in water level from full pool.						
Bioperiod name	**Period**	**Volume needed to meet 90% of historical deficits (ac-ft)**	**Volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)**	**Two-day flow release contribution from Mendums (cfs) [25.3%]**	**Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)**	**Water source**
Overwintering	Dec 9 – Feb 28	216	259	*-	-	Mendums Pond not used.
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	118	142	9.1	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	20	24	1.5	0.02	from storage and drawdown
Rearing &Growth	Jul 5 – Oct 6	47	56	3.5	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	75	90	5.8	Occurs during annual 7 ft drawdown	From annual fall 7-foot drawdown

Mendums	265	Acres at full recreational pool [25.3% of combined Mendums and Pawtuckaway surface areas]
Pawtuckaway	783	Acres at full recreational pool [74.7% of combined Mendums and Pawtuckaway surface areas]

* Overwintering release is from Pawtuckaway Lake only.

DAM MANAGEMENT PLAN

North River Pond Dam (State Dam ID #184.05)

Figure 1 – North River Pond Dam and outlet structure, photos taken August 2005.

Introduction

North River Pond Dam (lat. 43º 11’ 33”, long. -71º 07’ 54”) is located on the North River off of North River Lake Road in Nottingham, New Hampshire. The North River flows southeast and joins the Lamprey River immediately upstream of the start of the Designated River. North River Pond Dam is approximately 15 miles above the start of the Designated River. The dam is owned by the State of New Hampshire Water Division (see contact information). The dam is active and its use is for recreation.

Dam Design

The original construction date of the North River Pond Dam is unavailable, but it last underwent reconstruction in 1973. The dam is constructed of concrete and earth materials and has a concrete outlet structure that includes slots for wooden stop logs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau, which is the dam owner and operator. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are no minimum flows, flowage rights or contractual obligations.

Riparian Property Obligations or Agreements

According to the owner there are no written or otherwise documented agreements. Although, historically there has been a practice of management for recreation benefiting abutting littoral/riparian landowners.

Water Quality Requirements or Limits

According to the owner there are no site specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for North River Pond Dam is 358 acre-feet (ac-ft), while its permanent storage volume is 106 ac-ft. When compared with the other dams in this Water Management Planning Area, the permanent storage volume of North River Pond Dam is relatively low. In addition, the contributing drainage area is 1.32 sq miles, which due to its modest size would require significant runoff to recover water levels in the impoundment following a flow release. Therefore, the water available from this dam for flow management is also considered to be low.

Potential Impacts of Flow Management

There are some forested and scrub-shrub wetland areas within the impoundment area, but their extent is limited. Therefore, inundation of these areas by the storage of water for flow management on the Lamprey Designated River should have little impact. However, there are several mapped riparian wetland areas and ponded areas located along the North River downstream of the dam. Their presence could reduce the effectiveness of any flow released from North River Pond Dam by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management actions.

Managing water levels on North River Pond for flow management could also potentially affect neighboring residential properties as well as recreation opportunities on the Pond.

Potential for Dam Management to Meet Instream Flow Requirements

The overall potential for using the North River Pond Dam for flow management to maintain the instream flow requirements on the Lamprey Designated River is low. Factors considered favorable for the use of the North River Pond Dam for flow management on the Lamprey Designated River include an existing outlet structure that can be used to regulate dam releases. Factors considered unfavorable for flow management include: the distance from the dam to the Designated River (15 miles); the number of ponds and wetlands located along the North River that could reduce the effectiveness of any dam releases; the small size of the contributing drainage area would suggest a long period of time to recover from significant drawdowns; and, managing water levels could effect shoreland properties and recreation on North River Pond.

Dam Management Activity

No dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for North River Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information
Owner: New Hampshire Water Division
Address: P.O. Box 95, 29 Hazen Drive, Concord, NH 03302-0095
Contact: Mr. James Gallagher
Phone: 603-271-1961
Email: james.gallagher@des.nh.gov

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – North River Pond Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**200.75**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**196.76**
Height of the dam (ft) from toe to the highest point on the dam	**8**
Freeboard (ft)	**3**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**80**
Drainage area (sq. miles)	**1.32**
Maximum storage (ac-ft)	**358**
Normal or permanent storage (ac-ft)	**106**
Total discharge capacity (cfs)	**1,012**
Maximum unoperated discharge (cfs)	**743**
Design storm discharge (cfs)	**75**
Estimated 50-year flood flow (cfs)	**75**
Estimated 100-year flood flow (cfs)	**404**

Source of information: DES Dam Bureau, NH Dam Data Sheet for Dam #184.05 and Dam #184.05 Operation & Maintenance Plan.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Nottingham Lake Dam (State Dam ID #184.08)

Figure 1 – Nottingham Lake Dam and outlet structure, photo taken April 2009.

Introduction

The Nottingham Lake Dam (lat. 43º 7' 11", long. -71º 03' 03") is located on the Little River off of Mill Pond Road in Nottingham, New Hampshire. The Little River flows south and then east to join the Lamprey River in the upper half of the Designated River between Tuttle Road and Lee Hook Road in Lee, New Hampshire. Nottingham Lake Dam is approximately 3.5 miles upstream of the confluence of the Little River with the Lamprey Designated River. The dam is privately owned (see contact information), is considered active and is used for recreation. In addition, the dam is used for the production of hydroelectricity. The power plant includes two 6 kilowatt turbines with a maximum capacity of 12 KW, which is net metered into the local electrical grid.

Dam Design

The original construction date is unavailable. The dam was breached during a flood in April 2007 and rebuilt in 2008, and the lake was refilled in the spring of 2009. The dam is constructed of concrete and earth materials and has a concrete outlet structure (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

The manager of the dam indicated that they have flowage rights over private land, but no minimum flow or contractual obligations. For the production of hydroelectricity, the average operating head is 10 feet above the intake and the minimum necessary operating flow is 8.83 cubic feet per second (cfs), based on the specifications of turbine manufacturer. Stoplogs can be placed in the primary spillway to raise the water elevation for power production at low flows, but, typically, the water levels are not actively managed for power production.

Riparian Property Obligations or Agreements

There is in informal understanding with riparian property owners, but there is no written agreement.

Water Quality Requirements or Limits

The manager of the dam indicated that there are no site specific water quality requirements or limits associated with the dam.

Assessment of Potential Water Availability

Information provided to DES by the owner on the reconstructed dam indicates that the maximum storage volume for Nottingham Lake Dam is 265.9 acre-feet (ac-ft), while its permanent storage volume is 172.3 ac-ft. The water level in the impoundment and its volume can be controlled by stoplogs placed in the primary spillway and by the opening of a sluice gate used to drain the lake. The contributing drainage area is 14.6 square miles in size. When compared with the other dams in this Water Management Planning Area, the potentially available volume of Nottingham Lake Dam is moderate, while the size of its contributing area is relatively high.

Potential Impacts of Storage and Relief Flows

There are some mapped wetlands both bordering the lake and along the Little River downstream of the dam, but their extent is limited. Therefore, the impacts due to any flow management actions should also be limited.

Residential development borders the east and west shoreline of the lake. Although there is no written agreement there is an informal understanding between these landowners and the dam owner that water levels will be managed to limit the potential for flooding and to support water recreation (boating, fishing and swimming). There is no public access. The increase or decrease in water levels resulting from any flow management activities would need to support recreational use of the lake and should not should not unduly impact riparian landowners. Nottingham Lake Dam is used for the generation of hydroelectricity. According to the operator, electricity is typically produced during periods of spring runoff and summer storm events when there is sufficient hydraulic head to run the turbines. The electricity produced by the turbines is used on site or distributed to the power grid. The owner of the dam has an agreement with the local electric utility for net metering of the surplus power.

Potential for Dam Management to Meet Instream Flow Requirements

The potential for operation of Nottingham Lake Dam to manage instream flows is moderate. Factors considered favorable for the use of Nottingham Lake Dam include the large volume of water between the impoundment's normal and maximum storage pools and an existing outlet structure that could be used to regulate dam releases.

Factors considered unfavorable for flow management include the use of the dam for hydroelectric production, and the potential impact that managing water levels could have on shoreline residential properties and recreational opportunities on Nottingham Lake.

Dam Management Activity

Nottingham Lake Dam will continue to be operated as a run-of-river hydroelectric facility and its use will be expanded to include instream flow. The required actions for the Affected Dam Owner are to ensure that relief flow resulting from dam management actions taken upstream of Nottingham Lake Dam at Mendums Pond Dam are conveyed through Nottingham Lake with minimal attenuation downstream of the dam. At the same time, operation of the dam under these provisions will not impact the hydroelectric operations of the dam

The Affected Dam Owner may use the relief flow released from Mendums Pond to generate power so long as they continue to pass inflow and meet Surface Water Quality Standards. DES is the owner and operator of the Mendums Pond dam and will contact the owner of the Nottingham Lake Dam through the contact information in this document when an instream flow relief event is imminent. The notification will be by phone and email at least 24 hours in advance of the intended relief flow release. The Affected Dam Owner will confirm receipt of this notification by phone or email. The owner will then operate Nottingham Lake Dam to pass the flow release volume downstream with the attenuation of flow.

Recordkeeping

Recordkeeping by Affected Water Users and Affected Dam Owners shall include documentation of the actions and the dates and times that management actions were taken to meet their Water Management Plans. This documentation shall include records of conditions affected by the management activities, including but not limited to changes in dam gate conditions, number of stoplogs in place, static water levels in impoundments, and pumping rates. From time to time, DES will conduct audits of the management activities taken by the Affected Water Users and Affected Dam Owners in response to protected stream flow conditions. These records will be retained and made available to DES on request. DES recommends, but does not require, that Affected Water Users and Affected Dam Owners create and retain documentation of the costs associated exclusively with water management activities defined by their Water Management Plans.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice upon adoption of the Lamprey Water Management Plan. Any additional coordination between DES and the Affected Dam Owner that is needed to implement the Dam Management Plan should be completed within one year of the adoption of the Lamprey River Water Management Plan. Any of the parties, the dam owner, dam operator or DES, may begin discussions with the other parties concerning activities or responsibilities under this Dam Management Plan within that year or afterwards.

Documentation of the operation plan during a release from Mendums Pond will be posted at the Nottingham Lake Dam facility. Operators of the Nottingham Lake Dam facility will read and sign an acknowledgement of receipt, understanding of the plan, and agreement to operate under this plan.

Estimated Cost of the Implementation of the Dam Management Plan

There are no significant costs associated with the development of the notification agreement.

Dam Owner and Contact Information
Owner: Mill Pond View LLC
Address: 224 Mill Pond Road, Nottingham, NH 03290
Contact: Mr. Lawrence P. Costa
Phone: 207-364-5866
Email: larrycosta@att.net

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Nottingham Lake Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**143.9**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**144.4**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**133.6**
Height of the dam (ft) from toe to the highest point on the dam	**15**
Freeboard (ft)	**1.3**
Type of spillway controls or outlet works	**Gate**
Dimensions of spillway controls or outlet works	**2.5 ft x 2.5 ft**
Surface area (ac) of impoundment at maximum impoundment	**41**
Drainage area (sq. miles)	**14.6**
Maximum storage (ac-ft)	**266**
Normal or permanent storage (ac-ft)	**172**
Total discharge capacity (cfs)	**3,099**
Maximum unoperated discharge (cfs)	**2,316**
Design storm discharge (cfs)	**1,174**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**1174**

Source of information: Application to Construct or Reconstruct a Dam submitted by Mill Pond View, LLC to NH Dam Bureau and from owner.

Note:

NA – information not available from application.

DAM MANAGEMENT PLAN

Onway Lake Dam (State Dam ID #201.01)

Figure 1 – Onway Lake Dam, photo taken October 2, 2007.

Introduction

Onway Lake Dam (lat. 43º 02' 04", long. -71º 12' 57") is located on an unnamed tributary to the Lamprey River in Raymond, New Hampshire, approximately 19 miles upstream of the start of the Designated River. This dam is privately owned (see contact information) and actively managed for recreation.

Dam Design

The dam was constructed in 1915. The dam consists of a concrete and stone structure, which has slots for wooden stop logs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner, there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the owner, there are no riparian property obligations or agreements.

Water Quality Requirements or Limits

According to the owner, there are no site specific water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Onway Lake Dam is 881 acre-feet (ac-ft), while its permanent storage volume is 305 ac-ft, for a difference of 576 ac-ft (25 million cu. ft. or 190 million gallons). The contributing drainage area is 8.45 square miles. When compared with the other dams in this Water Management Planning Area, the potentially available volume of Onway Lake Dam and its contributing drainage area are relatively high. However, Onway Lake represents only 15% of the combined surface areas relative to the combined area with Pawtuckaway Lake and Mendums Pond, the two impoundments with high potential for dam management. Mendums Pond surface area is one and a half times and Pawtuckaway Lake, four times the size of Onway Lake.

Water levels in Onway Lake are managed on a seasonal basis. Starting in mid-October water levels are drawn down a maximum of three feet by removing stop logs from the dam. As a result, during the annual fall drawdown, approximately 250 ac-ft (80 million gallons) of water is released from the dam and into the drainage of the Lamprey River. During the spring (mid-April) water levels are monitored and following spring runoff the stop logs are replaced and the lake refilled.

Potential Impacts of Storage and Release of Relief Flows

Mapped wetlands are located within the impoundment storage area along the western part of Onway Lake. The inundation of these areas by the storage of additional water or the drawdown in water levels in these wetlands in response to a dam release could negatively impact them. Extensive wetland areas are also located along the outlet stream corridor and they could reduce the effectiveness of flows released from the dam.

Residential development is present along the northeast shoreline of Onway Lake and a four-season resort is located along the southern part of the lake. The water levels in the lake are managed for recreation which could be impacts by appreciably lowering the water surface of the lake.

An assessment of the water level changes that might occur under a relief flow release as part of a dam management action showed that the water level changes in Onway Lake would be small, especially if releases were in combination with Pawtuckaway Lake and Mendums Pond. See Table 3 – Water Level Change on Onway Lake, Mendums Pond, and Pawtuckaway Lake with Flow Management. The maximum annual water level change if Onway Lake were to provide the entire relief flow would be 2.98 feet. (Assumes that one management event will occur during each bioperiod except the Spring Flood bioperiod.) A more likely scenario would be water releases from Onway Lake in combination with releases from Mendums Pond and Pawtuckaway Lake. The releases would be prorated based on their surface areas. With the combined effect of the three lakes, the annual water level change would be 0.46 feet. Winter releases solely from Pawtuckaway are anticipated that would make the annual change in Freeses Pond 0.25 feet.

Potential for Dam Management to Support Instream Flow Requirements

The overall potential for using Onway Lake Dam for flow management to support the instream flow requirements on the Lamprey Designated River is considered to be moderate. Factors considered favorable for the use of Onway Lake Dam for flow management include the large amount of water potentially available from the lake and an existing outlet structure that can be used to regulate dam releases.

Factors considered unfavorable for flow management include the dam's location 19 miles above the start of the Lamprey Designated River, the potential impact to wetlands around the lake, and the potential impact to neighboring properties and recreation.

Dam Management Activity

Since the potential for its use for flow management on the Lamprey Designated River is only considered moderate, no dam management activity is required at this time. Onway Lake represents the first alternate should a contingency be needed.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Onway Lake Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: J & D Realty Trust
Address: P.O. Box 779, Raymond, NH 03077
Contact(s): Mr. John Tracy or Mr. David Zaloga
Phone: 603-895-2165 (Tracy) or 603-895-2165 (Zaloga)
Email: None provided

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Onway Lake Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**8.5**
Freeboard (ft)	**3**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**192**
Drainage area (sq. miles)	**8.45**
Maximum storage (ac-ft)	**881**
Normal or permanent storage (ac-ft)	**305**
Total discharge capacity (cfs)	**352**
Maximum unoperated discharge (cfs)	**233**
Design storm discharge (cfs)	**187**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dam Data Sheet for Dam #201.01.
Note: NA – not available from NH Dams Data Sheet.

Table 2 – Onway Lake relative to Mendums Pond and Pawtuckaway Lake.

	Acres of surface area	% of combined surface area	Size relative to Onway Pond's surface area
Mendums Pond	265	21.4%	1.4
Pawtuckaway Lake	783	63.1%	4.1
Onway Pond	192	15.5%	1.0
Sum	1240	100.0%	

Table 3 – Water Level Change on Onway Lake, Mendums Pond and Pawtuckaway Lake with Flow Management.

Bioperiod name	Period	Release volume - 90% coverage with 20% buffer (ac-ft)*	Release volume (cubic feet)	Drawdown using Onway Lake only (feet)	Drawdown using Onway Lake with Pawtuckaway and Mendums (prorated by area) (feet)
Overwintering *	Dec 9 – Feb 28	259	11,290,752	1.35	0.21
Spring Flood	Mar 1 – May 4	-			
Clupeid Spawning	May 5 – Jun 19	142	6,168,096	0.74	0.11
GRAF Spawning	Jun 20 – Jul 4	24	1,045,440	0.13	0.02
R&G	Jul 5 – Oct 6	56	2,456,784	0.29	0.05
Salmon Spawning	Oct 7 – Dec 8	90	3,920,400	0.47	0.07
			Sum	2.98	0.46

*** Volume for a dam release that meets 90% of the historical (1976-2005) deficits of catastrophic and persistent low-flow events to which has been added a buffer of 20% as a contingency to account for unforeseen losses.**

DAM MANAGEMENT PLAN

Piscassic Ice Pond Dam (State Dam ID #171.01)

Figure 1 – Piscassic Ice Pond Dam, photos taken October 3, 2007.

Introduction

Piscassic Ice Pond Dam (lat. 43º 02’ 02”, long. -70º 58’ 06”) is located on the Piscassic River approximately six miles upstream of the Lamprey Designated River and is crossed by Route 87 in Newfields, New Hampshire. This dam is privately owned (see contact information), is active and its use is for recreation.

Dam Design

The dam was constructed in 1939 and rebuilt in 1987. The dam consists of a concrete structure, which has slots for wooden stop logs (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner there are deeded flowage rights.

Riparian Property Obligations or Agreements

There are no riparian property obligations or agreements, although the owner maintains the pond water level at 21 inches during the summer so the neighbors can use the pond to water their gardens.

Water Quality Requirements or Limits

According to the owner there are no water quality requirements or limits.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Piscassic Ice Pond Dam is 109 acre-feet (ac-ft), while its permanent storage volume is 27 ac-ft, for a difference of 82 ac-ft (3.6 million cu. ft. or 27 million gallons). The size of its contributing drainage area is 4.24 square miles. When compared to other dams in this Water Management Planning Area, both the permanent storage volume and contributing drainage area associated with Piscassic Ice Pond Dam are low. Therefore, the water available from this dam for flow management is also considered to be low.

Potential Impacts of Storage and Release of Relief Flows

Extensive, palustrine, scrub-shrub, emergent and forested wetlands are mapped upstream of the dam and within the impoundment storage area. The inundation of these areas by the storage of water or the lowering of water levels during dam releases could affect these wetlands. Downstream of the dam along the Piscassic River are a number of ponds and extensive wetland areas, which could reduce the effectiveness of any flow released from the dam by temporarily storing the released water. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management actions.

Potential for Dam Management to Support Instream Flow Requirements

Flow released from Piscassic Ice Pond Dam would be conveyed via the Piscassic River to the impoundment at the end of the Designated River. Therefore, flow released from Piscassic Ice Pond would have no effect on stream flow. As a result, flow management of the Piscassic Ice Pond Dam would not support instream flow requirements and for this reason it should not be considered as an option for storage or release of relief flows under the Water Management Plan.

Dam Management Activity

No dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Piscassic Ice Pond Dam, there is no proposed implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: Mr. Gilbert Lang
Address: Langs Lane, Newmarket, NH 03857
Phone: 603-659-2256
Email: None provided

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Piscassic Ice Pond Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**12**
Freeboard (ft)	**6**
Type of spillway controls or outlet works	**Stop Logs**
Dimensions of spillway controls or outlet works	**4 ft by 2 ft**
Surface area (ac) of impoundment at maximum impoundment	**13.7**
Drainage area (sq. miles)	**4.24**
Maximum storage (ac-ft)	**109**
Normal or permanent storage (ac-ft)	**27**
Total discharge capacity (cfs)	**NA**
Maximum unoperated discharge (cfs)	**540**
Design storm discharge (cfs)	**NA**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #171.01.

Note:

NA: not available from NH Dams Data Sheet

DAM MANAGEMENT PLAN

Socha Dam (State Dam ID #037.03)

Figure 1 – Socha dam and spillway, photos provided by DES Dam Bureau.

Introduction

The Socha Dam (lat. 43º 04’ 40”, long. -71º 18’ 52”) is located on a tributary of the North Branch River in Candia, New Hampshire, approximately 26 miles upstream of the start of the Lamprey Designated River. This dam is privately owned (see contact information), the property is posted and there is no public access. The dam is actively used for recreation.

Dam Design

The dam was last reconstructed in 1980 and it consists of an earth and concrete structure and an uncontrolled spillway (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

Dam owner did not respond to requests for information on whether there are any minimum flows, flowage rights or contractual obligations associated with this dam.

Riparian Property Obligations or Agreements

Dam owner did not respond to requests for information on whether there are any riparian property obligations or agreements associated with this dam.

Water Quality Requirements or Limits

Dam owner did not respond to requests for information on whether there are any water quality requirements or limits associated with this dam.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Socha Dam is 90 acre-feet (ac-ft), while its permanent storage volume is 45 ac-ft, for a difference of 45 ac-ft (2.0 million cu. ft. or 15 million gallons). The drainage area contributing runoff to this dam is 4.35 square miles. When compared to other dams in this Water Management Planning Area, both the permanent storage volume and the contributing drainage area associated with Socha Dam are low. Therefore, the water available from this dam for flow management is also considered to be low.

Potential Impacts of Storage and Release of Relief Flows

There are no mapped wetland areas within the impoundment of Socha Dam, so inundation of by the storage of water or water level reduction is unlikely to impact fringing wetland habitats. However, immediately below the dam there is a large wetland complex that could reduce the effectiveness of any flow released from Socha Dam by temporarily storing it. Insufficient information is available to determine the amount of water that could be stored by the wetland areas and the resulting impacts on any flow management actions.

Potential for Dam Management to Support Instream Flow Requirements

Factors favoring the consideration of the Socha Dam for the storage and release of water for flow management on the Designated Lamprey River are limited. The dam is located in the headwaters of the North Branch River, which is a major tributary to the Designated Lamprey River and would provide minor relief during periods of low flow.

Limiting factors include: the private ownership of the dam; the need to retrofit the dam to allow for controlled releases; the presence of a large wetland complex immediately downstream which could potentially temporarily store water released from the dam; and the small volume of water potentially available for flow management.

Dam Management Activity

Due to the significant limiting factors associated with this dam, no dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Socha Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information
Owner: Ms. Marie Socha
Address: 547 Londonderry Turnpike, Auburn, NH 03032-1602
Phone: 603-627-8993
Email: Not available

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 - Socha Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**6.0**
Freeboard (ft)	**1.5**
Type of spillway controls or outlet works	**None**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**30**
Drainage area (sq. miles)	**4.35**
Maximum storage (ac-ft)	**90**
Normal or permanent storage (ac-ft)	**45**
Total discharge capacity (cfs)	**437**
Maximum unoperated discharge (cfs)	**437**
Design storm discharge (cfs)	**1,139**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #037.03.

Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Thurston Pond Dam (State ID #061.18)

Figure 1 – Thurston Pond Dam, photos taken October 2, 2007.

Introduction

Thurston Pond Dam (lat. 43º 08’ 22”, long. -71º 17’ 59”) is located in Deerfield, New Hampshire, on an unnamed tributary to Hartford Brook, which is a tributary to the Lamprey River, approximately 30 miles upstream of the start of the Lamprey Designated River. The dam is owned by the Town of Deerfield and managed by the Deerfield Water Commission (see contact information). The dam is active and its use is for recreation.

Dam Design

The dam was constructed in 1772 and permitted in 1999. The dam consists of an earth embankment and a stone outlet structure. A large beaver dam blocks the outlet structure and controls the water level in the pond (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04 on the characteristics of the dam is summarized in Table 1.

Protected Flow, Flowage Rights or Contractual Obligations

According to the owner, there are no flowage requirements or rights.

Riparian Property Obligations or Agreements

According to the owner, there are no riparian property obligations or agreements.

Water Quality Requirements or Limits

According to the owner there, are no water quality requirements or limits.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Thurston Pond Dam is 43 acre-feet (ac-ft), while its permanent storage volume is 6 ac-ft, for a difference of 37 ac-ft (1.6 million cu. ft. or 12 million gallons). When compared with the other dams in this Water Management Planning Area, the permanent storage volume of Thurston Pond Dam falls is small. In addition, its drainage area, 1.27 square miles is also small, which would limit recharge to the pond during periods of below normal precipitation.

Potential Impacts of Storage and Release of Relief Flows

Upstream of the dam and within the impoundment are extensive mapped wetlands. The inundation of this area by the storage and release of water for flow management could affect the existing wetlands. There are several mapped riparian wetland areas downstream of the dam, which could attenuate any flow released from Thurston Pond Dam by storing water temporarily and reduce the effectiveness of the release. Insufficient information is available to quantify the resulting impacts on any flow management actions.

Potential for Dam Management to Meet Instream Flow Requirements

The potential for using Thurston Pond Dam for flow management on the Lamprey Designated River is considered low due to the following: its long distance (30 miles) upstream of the start of the Lamprey Designated River; its small permanent storage volume and contributing drainage area;, the lack of a functioning outlet structure that will allow for the controlled release of water from the dam; the presence of wetlands bordering the impoundment that would be impacted by the storage and subsequent withdrawal of water; and the potential storage effects of wetlands below the dam.

Dam Management Activity

Since the potential for its use for flow management on the Lamprey Designated River is considered low, no dam management activity is required at this time.

Schedule for Dam Management Plan Implementation

Since no dam management activity is currently required for Thurston Pond Dam, there is no implementation schedule.

Estimated Cost of the Implementation of the Dam Management Plan

Since no dam management activity is currently required, there are no costs.

Dam Owner and Contact Information

Owner: Town of Deerfield
Address: P.O. Box 159, Deerfield, NH 03037

Contact: Mr. John Dubiansky, Chairman, Deerfield Water Commission
Phone: 603-463-8811
Email: None provided

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

Table 1 – Thurston Pond Dam Characteristics.

Elevation (ft) of recreation pool or height relative to lowest spillway	**NA**
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**NA**
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**NA**
Height of the dam (ft) from toe to the highest point on the dam	**9**
Freeboard (ft)	**1**
Type of spillway controls or outlet works	**None**
Dimensions of spillway controls or outlet works	**NA**
Surface area (ac) of impoundment at maximum impoundment	**13.5**
Drainage area (sq. miles)	**1.27**
Maximum storage (ac-ft)	**43**
Normal or permanent storage (ac-ft)	**6**
Total discharge capacity (cfs)	**230**
Maximum unoperated discharge (cfs)	**230**
Design storm discharge (cfs)	**230**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**NA**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #061.18.
Note:

NA – not available from NH Dams Data Sheet.

DAM MANAGEMENT PLAN

Wiswall Dam (State Dam ID #071.04)

Figure 1 – Wiswall Dam, photo taken May 13, 2013.

Introduction

Wiswall Dam (lat. 43º 06' 14", long. -70º 57' 48") is located on the Lamprey River, immediately downstream of the Wiswall Road bridge crossing in Durham, New Hampshire. The dam is located on the Lamprey Designated River and is approximately three miles upstream of the end of the Designated River. This dam is owned by the Town of Durham (see contact information), is active, and its primary use is identified as recreation. However, it was evaluated for removal in recent years and retained chiefly for its role is to impound the Wiswall Reservoir, which is one of the water supplies for the University of New Hampshire/Town of Durham Water System (UDWS). The UDWS maintains a pump station upstream of the dam which was constructed in 1970 for the purpose of withdrawing drinking water.

Dam Design

The dam was constructed in 1911. The dam consists of a concrete structure, and has a gated spillway, which can be manually used to regulate water levels in the Wiswall Reservoir (Figure 1). Details on the design and operation of the dam were obtained from the records of the Department of Environmental Services (DES) Dam Bureau and from the dam owner. The information required by Env-Wq 1906.04

describing the characteristics of the dam is summarized in Table 1. A final decision to install a fish ladder and flow structure for outlet migration at the dam was made in 2008. Construction began during the summer of 2011 and completed in late 2011. The construction and repairs on Wiswall Dam adds several functioning mechanisms for managing stream flow. The fish ladder has an operable weir gate and an outlet structure that includes stoplogs on the opposite side of the dam to provide for downstream fish migration. The repairs include replacement of the two low level gate structures.

Minimum Flow, Flowage Rights or Contractual Obligations

The conditions of 401 Water Quality Certification #2001-001 apply to management of this dam in concert with the operation of UDWS's Lamprey River water withdrawal (Water User ID #20066-S02.) A specific right to the use of waters from the Lamprey River was granted to the Town of Durham by the New Hampshire legislature in Chapter 332 of the Laws of 1965. Under this law Durham was granted the right to divert waters from the Lamprey River and it has flowage rights in the Town of Lee to the extent necessary to maintain the dam at Wiswall Falls. The Town of Durham has identified Wiswall Reservoir as one of UDWS's primary drinking water sources. The installation of manual staff gages near the Wiswall Dam and an instrumented water level transducer near the UDWS's pump station was completed in 2011 to record real-time stage elevation and transmit real-time data to the UDWS Water Treatment Plant operator.

Riparian Property Obligations or Agreements

Chapter 332 of the Laws of 1965 dictates that the use of water by the Town of Durham cannot lower the water level upstream from the so-called Hook Island Falls in Lee or result in the breaching of the Hook Island Falls.

Assessment of Potential Water Availability

DES Dam Bureau files show the maximum storage volume for Wiswall Dam is 500 acre-feet (ac-ft), while its permanent storage volume is 360 ac-ft. Durham Public Works
estimated the volume in gallons in the top 18 inches of the Wiswall Reservoir as:

0 to 6" -	7,137,266 gallons	= 954,052 cubic feet	= 21.9 acre-ft
0 to 12" -	12,142,211 gallons	= 1,623,290 cubic feet	= 37.3 acre-ft
0 to 18" -	17,037,153 gallons	= 2,277,390 cubic feet	= 52.3 acre-ft

The drainage area upstream of the dam is 183 square miles, which provides considerable runoff potential for refilling the Wiswall Reservoir following a rain event.

Potential Impacts of Storage and Relief Flows

Use of the Wiswall Reservoir for providing relief flows was evaluated with respect to other existing uses. The Wiswall Dam and Reservoir provide for recreation in addition to water supply storage. Boating, fishing and swimming are commonly observed recreational activities in the Wiswall Reservoir. If Wiswall Reservoir were used as a source of water for a downstream flow relief pulse, lowering of the water level should have little impact on the recreational activities unless the water level is lowered by several feet.

There are mapped wetlands within the Wiswall Reservoir and they could be impacted by either rapid declines in water levels or by prolonged or recurrent periods of below normal water levels.

As previously mentioned, the Wiswall Reservoir is used as a water supply by UDWS. Releasing water from this dam would affect the storage available to the UDWS. As a result, this Dam Management Plan must be coordinated with the Water Use Plan developed for the UDWS withdrawal from the Wiswall Reservoir (#20066-S02).

Potential for Dam Management to Meet Instream Flow Requirements

The overall potential for this dam for flow management of the Lamprey Designated River is considered to be low due to its location, upstream of only the last three miles of the Designated River. A relief pulse release from the Wiswall Reservoir would also result in loss of storage affecting its use as a water supply source for UDWS. Releases from the dam for the protection of instream flows would reduce the water available for use as source of water for UDWS without improving flow conditions in the upper parts of the Designated River.

Wiswall Dam has a potential to impact protected flows needed to maintain stream flow downstream. The volume of the impoundment creates a potential for attenuation of a relief flow release such that the target flow may not be met. Depending on the magnitude of the required relief flow and the reservoir stage elevation relative to the dam's spillway crest at a given time, the dam may need to be operated under this Dam Management Plan to attain the desired downstream relief flow.

Dam Management Activity

Dam management activities are expected to occur on a frequency from as little as none per year to one or more events per bioperiod in five of the six bioperiods. The Spring Flood bioperiod will not be managed under the Lamprey Dam Management Plan.

Because the dam impounds Wiswall Reservoir, this Dam Management Plan is integrally tied to the use of Wiswall Reservoir by UDWS as a water supply. This water supply (Water User ID 20066-S02) has conditions described under the UDWS Water Use Plan for the Lamprey River withdrawal. The Dam Management Plan activities in this sub-plan must be implemented in concert with the UDWS Water Use Plan. The general components of the dam management activities include:

1. At all times, when the flow at the USGS Lamprey near Newmarket gage is less than 16 cfs, the Town of Durham will operate the dam to ensure that downstream flow is maintained at a discharge effectively equal to inflow to the greatest extent practicable. Operation of outflow using stoplogs may include use of modified stoplogs calibrated to release of partial flows as alternatives to removing/replacing whole stoplog increments. Modifying stoplogs may be accomplished by means of notching or boring the stoplogs. Coordination with the UNH/Durham Water System may be required to meet this objective.

2. The Town of Durham will monitor and record flow and dam operational conditions and any other information necessary to determine relative outflow and inflow measurements whenever daily stream flow is equal or less than 16 cfs at the USGS gage Lamprey River Near Newmarket, NH, to the highest practicable accuracy. Flow measurements or height of the stage elevation relative to the spillway crest or other outlet structures will be measured on a frequency of at least once every hour until daily average stream flow exceeds 18 cfs from a natural storm event for

two consecutive days. The University's existing water level data recorder in Wiswall Reservoir has been identified as a means to make hourly measurements to calculate inflow. The logger records hourly water levels in Wiswall Reservoir. If the data logger fails, then Town of Durham will make manual measurements of water level at a minimum of once every four hours. The Town of Durham will also record the dam's current outflow structure conditions and any changes made to the gate position or other criteria defining the outflow. Measurements and results of calculations will be provided to DES upon request.

3. When protected flow conditions are not met and thereby result in catastrophic conditions, DES may release periodic relief flows from impoundments upstream of the Wiswall Reservoir. A relief flow release may start the day before flow conditions are expected to exceed the catastrophic conditions. When a relief flow release event is scheduled, DES will notify the Town of Durham contact identified in this document. The Town of Durham will provide an alternate or emergency contact person to the DES Instream Flow Program upon adoption of this plan. DES's notification will be by phone or email, or both, at least 72 hours in advance of the intended relief flow release. The Town of Durham will confirm receipt of this notification by phone or email within 24 hours unless the notification is received on a Friday or a weekend in which case the acknowledgment will be provide on the following Monday.

4. During a relief flow release conducted under the Lamprey Water Management Plan, the Town of Durham will operate the Wiswall Dam (i.e., open gates or remove stop logs in the Wiswall Dam, or other) to maintain outflow from the Wiswall Reservoir effectively equal to inflow.

5. The Town of Durham will maintain the dam's water release mechanism(s) to allow controlled releases of water in the flow ranges of the proposed relief pulses and of inflow rates. Operation of one or more of the dam's outlet structures will be necessary to pass a relief flow pulse if the Wiswall Reservoir stage elevation has been drawn down below the spillway crest. Operation may also be necessary to maintain flow if water withdrawals from storage are or have been occurring. Variability in daily stream flow discharge is expected. If during the relief flow release the Wiswall Reservoir stage elevation is below the spillway crest, operation of the dam outlet will be required and variable rates of discharge may be required. Consequently, operability of some mechanism for flow release must be assured during all but the Spring Flood bioperiod. If Wiswall Dam is passing outflow at least equal to inflow and UDWS is not withdrawing then no operational changes are necessary.

6. The Town of Durham will not at any time except relating to maintenance operations or in the case of a water emergency[11] cause the reservoir water level to fall below 18 inches below the spillway crest, or cause the water level to drop more than one inch per day. Coordination with the UNH/Durham Water System may be required to meet this objective.

7. Refilling of storage in the Wiswall Reservoir will meet the following conditions for downstream flow. No refilling will occur during a relief pulse or when flows are less than 18 cfs at the Lamprey Near Newmarket gage. Once daily average flows from natural recharge events are greater than 18 cfs for two days at the USGS Lamprey near Newmarket gage, storage equivalent to UDWS's withdrawal rate of 2.8 cfs may be used to refill the Wiswall Reservoir, or for water withdrawal, or a combination of the two.

[11] RSA 4:45 and RSA 483:9-c, IV

8. The Town will provide DES with standard operating procedures (SOP) for the operation of the dam under protected flow conditions. UDWS installed a water level gage in the Wiswall Reservoir to provide remote measurements of the reservoir level in order to manage withdrawals according to this plan. UDWS will also develop either a flow measurement at the outlet of the Wiswall Dam or use the USGS Lamprey River near Newmarket gage to provide accurate reservoir outflow data to manage withdrawals. The SOP will describe UDWS's methods for implementing accurate measurements of inflow to the Wiswall Reservoir to determine and meet conditions for Reservoir outflow management.

Schedule for Dam Management Plan Implementation

This Dam Management Plan will be put into practice immediately upon adoption of the Lamprey Water Management Plan.

Estimated Cost of the Implementation of the Dam Management Plan

As discussed and included in the UDWS Lamprey River withdrawal's Water Use Plan, the estimated cost of the installation of the gages for water level and flow monitoring range from $10,000 to $30,000 depending upon the equipment used and the type of installation.

The actions associated with the implementation of the Dam Management Plan for Wiswall Dam include operation of the dam's outlet structures; and monitoring, recording and reporting of water levels, dam release configuration, and flow measurements. Management will be required during relief flow pulse releases and when flows fall below 16 cfs. These latter management activities will be reduced or eliminated by operation of UDWS's other water sources when flows are low as has been UDWS's practice. However, management operations may be required when low flows persist and water withdrawals are made from Wiswall Reservoir's storage to maintain outflow at effectively equal to inflow.

These actions are expected to be performed by Town personnel, however, the town may chose to subcontract the work to consultants or contractors. The estimated annual costs associated with this work will be dependent upon the number of personnel involved; and either the degree of automation of the system or the number of site visits required to perform the necessary flow management actions; plus travel time and mileage. The estimated cost for monitoring, recording and reporting of water levels, dam release configuration and flow measurements for one relief flow event is $2,000 to $5,000 depending on labor rate and hours expended. The total cost involved will be dependent upon the number of relief flow events. Most years will require no management. During the 1960s drought, six management events would have been conducted during the worst year. The majority of durations below 18 cfs lasted less than 10 days.

Dam Owner and Contact Information

Owner: Town of Durham
Address: Public Works Department, 100 Stone Quarry Drive, Durham, NH 03824
Contact: Mr. David Cedarholm, P.E.
Phone: 603-868-5578
Email: dcedarholm@ci.durham.nh.us

Conversion Factors for Volume and Flow Units

1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	448.86	gpm
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs

References:

Env-Wq 1900 Rules for the Protection of Instream Flow on Designated Rivers, effective 5/29/03.

Email from David Cedarholm, Town Engineer, Durham to Wayne Ives, NH Instream Flow Specialist, June 29, 2010.

Preliminary Dam Engineering Report, Wiswall Dam, Durham, New Hampshire. Prepared for Department of Public Works, Town of Durham. Prepared by Stephens Associates Consulting Engineers, LLC. Dated December 1, 2006.

Table 1 – Wiswall Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	**56.5***
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	**56***
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	**41***
Height of the dam (ft) from toe to the highest point on the dam	**18**
Freeboard (ft)	**5**
Type of spillway controls or outlet works	**2 Gates Stoplog bay**, Fish ladder gate****
Dimensions of spillway controls or outlet works	**Gates =5 ft x 6 ft* Stoplog Bay = 5 ft x 5 ft Fish ladder gate = 4 ft x 5ft**
Surface area (ac) of impoundment at maximum impoundment	**30**
Drainage area (sq. miles)	**183**
Maximum storage (ac-ft)	**500**
Normal or permanent storage (ac-ft)	**360**
Total discharge capacity (cfs)	**6238**
Maximum unoperated discharge (cfs)	**5216**
Design storm discharge (cfs)	**8210**
Estimated 50-year flood flow (cfs)	**NA**
Estimated 100-year flood flow (cfs)	**8210**

Source of information: DES Dam Bureau, NH Dams Data Sheet for Dam #071.04.
*- Information from Stephens and Associates (2006)
**-Added in 2011

NA – not available from NH Dams Data Sheet.

Appendix D

Task 8 Analysis:
Frequency of Not Meeting the Protected Instream Flows

Lamprey River Water Management Plan

August 2013

Withdrawals of Concern

Pertinent withdrawals were considered to be greater than 15% of the lowest recommended PISF (protected instream flow) for the Lamprey River. This PISF occurred during the Rare flow spanning the GRAF (generic resident adult fish) Spawning and Rearing and Growth Bioperiods (June 20 – Oct 6) and was determined to be 0.09 cfsm. Therefore withdrawals lower than 0.0135 cfsm were not considered. The withdrawal comparisons to the flow duration curves at the three stated locations can be found in the following three figures. The vertical axis for these figures is the flow per unit watershed area (cubic feet per second per square mile – cfsm) and the horizontal axis is the probability that this flow will be exceeded. For example, the lowest recorded flow for the gage at Packer's Falls is 0.004 cfsm, and that flow will be exceeded nearly 100% of the time. Subsequent higher flows will decrease in their likeliness to be exceeded.

In the three Figures (D.1, D.2, and D.3) you will see a thick blue dashed line with a thin red line almost directly over it. These are the flow-duration curves for Today's and Naturalized Flows, respectively. These flow values are from the hydrographs which were derived as described earlier. There will also be a horizontal green line representing the aforementioned lowest recommended PISF value of 0.09 cfsm.

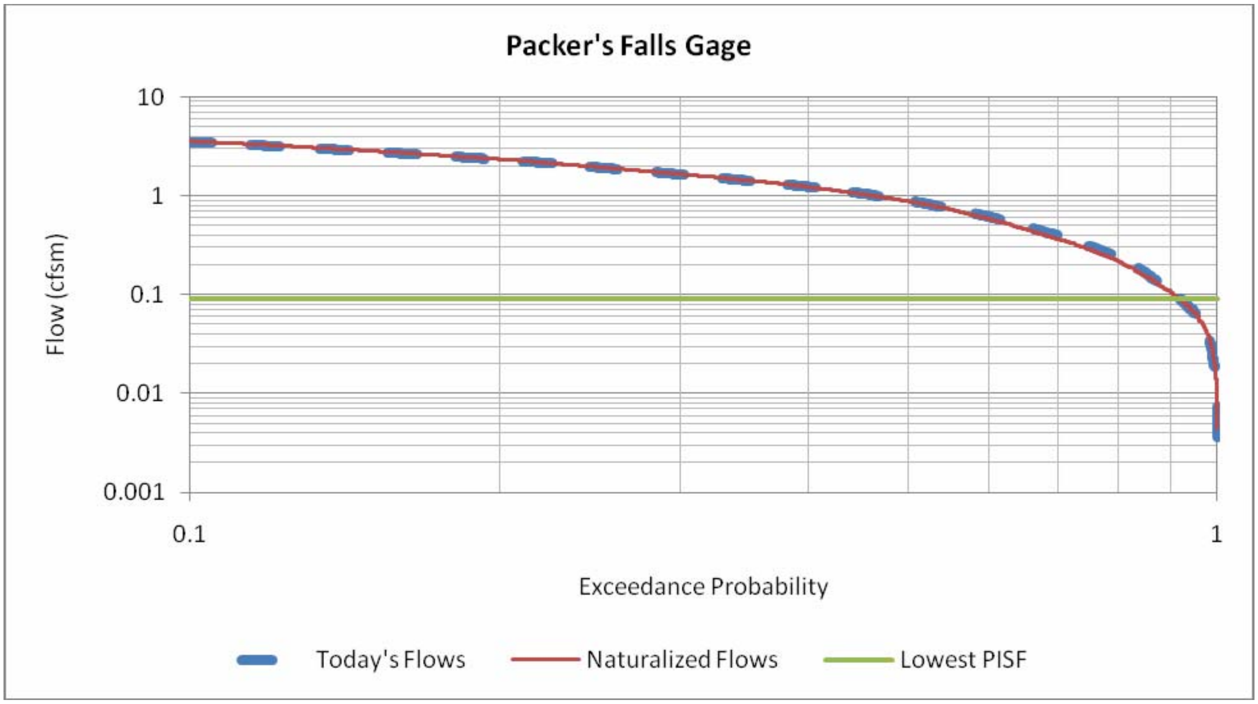


Figure D.1 – Comparison of Withdrawals at the Packer's Falls Gage.

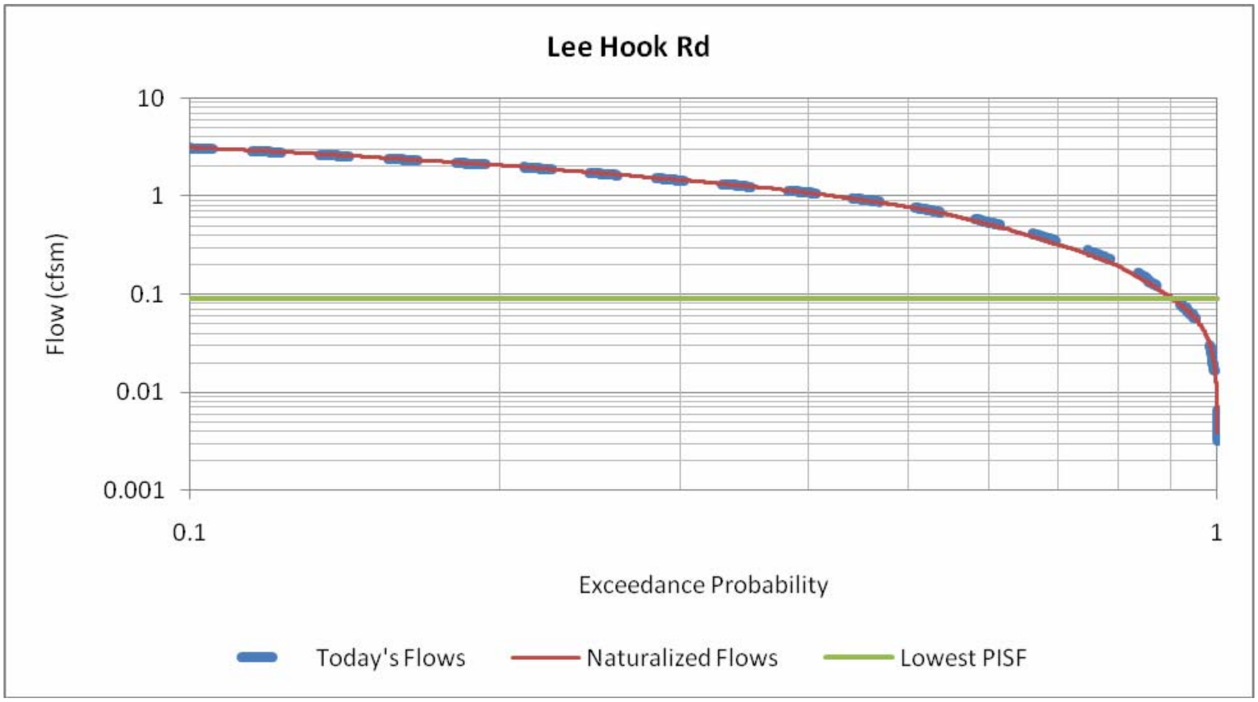


Figure D.2 – Comparison of the Withdrawals at Lee Hook Road.

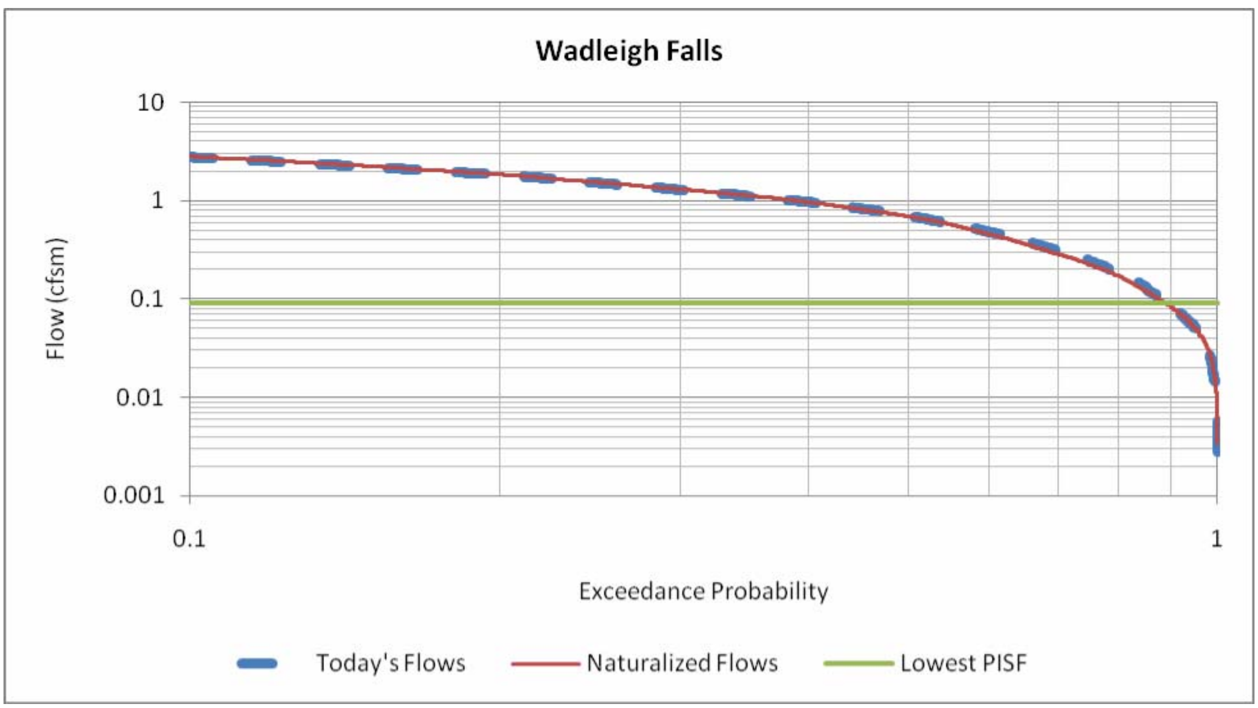


Figure D. 3 – Comparison of the Withdrawals at Wadleigh Falls.

When Are the Recommended Protected Flow Magnitudes Not Met?

The developed hydrographs at the three locations have been analyzed to see when violations in the PISFs occurred. For each location there are six bioperiods, for each of which there are three flow values and associated "drought" durations (consecutive durations below that flow value). These have all been analyzed and are presented in the following tables. The time periods looked at were the Last 30, Last 5, High 3, Average 3 and Low 3 years. The following tables are ordered first by location, then by time period, then by hydrograph. The first number listed is for the violations in flow. This number represents the total number of times the protected flow magnitude was not met during that bioperiod. The percentage below that number represents the total percentage of days the protected flow magnitude was not met during that bioperiod. The following two numbers below that are for violations in durations. These are the number of times the measured or calculated flow was below the stated allowable duration of days for that bioperiod. These numbers can be greater than the number of years in the analysis if the duration is short enough.

Table D.1 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Last 30 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Last 30 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	2408	440	1304	1276	461		280	
Violations of Common Flow (%)	85.39%	23.28%	53.01%	65.44%	33.41%		62.22%	
Violations of Allowable Duration	22	8	23	32	13		15	
Violations of Catastrophic Duration	9	1	5	2	2		0	
Violations of Critical Flow	801	123	460	381	109	878	16	102
Violations of Critical Flow (%)	28.40%	6.51%	18.70%	19.54%	7.90%	63.62%	3.56%	22.67%
Violations of Allowable Duration	15	1	10	13	6		2	
Violations of Catastrophic Duration	5	1	2	3	2		0	
Violations of Rare Flow	671	77	255	119	83	606	13	61
Violations of Rare Flow (%)	23.79%	4.07%	10.37%	6.10%	6.01%	43.91%	2.89%	13.56%
Violations of Allowable Duration	30	4	8	12	5		2	
Violations of Catastrophic Duration	12	2	2	4	2		1	
						Common shiner R&G	GRAF Spawning	

Table D.2 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Last 30 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Last 30 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	2408	595	1312	1230	459		280	
Violations of Common Flow (%)	85.39%	31.48%	53.33%	63.08%	33.26%		62.22%	
Violations of Allowable Duration	22	10	23	28	13		15	
Violations of Catastrophic Duration	9	1	5	2	1		0	
Violations of Critical Flow	797	248	483	280	109	881	16	103
Violations of Critical Flow (%)	28.26%	13.12%	19.63%	14.36%	7.90%	63.84%	3.56%	22.89%
Violations of Allowable Duration	15	5	11	8	6		2	
Violations of Catastrophic Duration	5	1	2	2	2		0	
Violations of Rare Flow	667	116	264	55	83	606	13	61
Violations of Rare Flow (%)	23.65%	6.14%	10.73%	2.82%	6.01%	43.91%	2.89%	13.56%
Violations of Allowable Duration	30	6	8	6	5		2	
Violations of Catastrophic Duration	12	3	2	1	2		1	

Common shiner R&G GRAF Spawning

Table D.3 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Last 5 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Last 5 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	412	107	264	228	39		26	
Violations of Common Flow (%)	87.66%	33.97%	64.39%	70.15%	16.96%		34.67%	
Violations of Allowable Duration	3	1	4	6	1		1	
Violations of Catastrophic Duration	2	1	2	0	1		0	
Violations of Critical Flow	167	72	123	86	7	185	0	27
Violations of Critical Flow (%)	35.53%	22.86%	30.00%	26.46%	3.04%	80.43%	0.00%	36.00%
Violations of Allowable Duration	2	1	2	4	1		0	
Violations of Catastrophic Duration	1	1	1	1	0		0	
Violations of Rare Flow	149	65	67	25	5	142	0	16
Violations of Rare Flow (%)	31.70%	20.63%	16.34%	7.69%	2.17%	61.74%	0.00%	21.33%
Violations of Allowable Duration	6	4	2	2	1		0	
Violations of Catastrophic Duration	2	2	1	1	0		0	
						Common shiner R&G	GRAF Spawning	

Table D.4 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Last 5 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Last 5 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	412	140	264	221	38		26	
Violations of Common Flow (%)	87.66%	44.44%	64.39%	68.00%	16.52%		34.67%	
Violations of Allowable Duration	3	2	4	6	1		1	
Violations of Catastrophic Duration	2	1	2	0	0		0	
Violations of Critical Flow	163	81	131	65	7	187	0	28
Violations of Critical Flow (%)	34.68%	25.71%	31.95%	20.00%	3.04%	81.30%	0.00%	37.33%
Violations of Allowable Duration	2	1	2	3	1		0	
Violations of Catastrophic Duration	1	1	1	0	0		0	
Violations of Rare Flow	147	70	65	7	5	142	0	16
Violations of Rare Flow (%)	31.28%	22.22%	15.85%	2.15%	2.17%	61.74%	0.00%	21.33%
Violations of Allowable Duration	6	4	2	1	1		0	
Violations of Catastrophic Duration	2	2	1	0	0		0	

Common shiner R&G   GRAF Spawning

Table D.5 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Highest Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the High 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	244	40	75	64	1		16	
Violations of Common Flow (%)	86.52%	21.16%	30.49%	32.82%	0.72%		35.56%	
Violations of Allowable Duration	3	1	1	2	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	81	8	17	12	0	133	0	18
Violations of Critical Flow (%)	28.72%	4.23%	6.91%	6.15%	0.00%	96.38%	0.00%	40.00%
Violations of Allowable Duration	2	0	0	0	0		0	
Violations of Catastrophic Duration	0	0	0	0	0		0	
Violations of Rare Flow	63	7	0	0	0	103	0	13
Violations of Rare Flow (%)	22.34%	3.70%	0.00%	0.00%	0.00%	74.64%	0.00%	28.89%
Violations of Allowable Duration	3	0	0	0	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.6 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Highest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the High 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	244	60	72	59	1		16	
Violations of Common Flow (%)	86.52%	31.75%	29.27%	30.26%	0.72%		35.56%	
Violations of Allowable Duration	3	1	1	2	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	81	20	21	9	0	133	0	18
Violations of Critical Flow (%)	28.72%	10.58%	8.54%	4.62%	0.00%	96.38%	0.00%	40.00%
Violations of Allowable Duration	2	0	1	0	0		0	
Violations of Catastrophic Duration	0	0	0	0	0		0	
Violations of Rare Flow	63	10	5	0	0	103	0	13
Violations of Rare Flow (%)	22.34%	5.29%	2.03%	0.00%	0.00%	74.64%	0.00%	28.89%
Violations of Allowable Duration	3	0	0	0	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.7 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Average Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Average 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	242	8	90	148	81		45	
Violations of Common Flow (%)	85.82%	4.23%	36.59%	75.90%	58.70%		100.00%	
Violations of Allowable Duration	1	0	1	4	2		3	
Violations of Catastrophic Duration	1	0	0	0	1		0	
Violations of Critical Flow	92	3	12	46	8	54	0	0
Violations of Critical Flow (%)	32.62%	1.59%	4.88%	23.59%	5.80%	39.13%	0.00%	0.00%
Violations of Allowable Duration	2	0	0	2	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	78	0	0	15	5	26	0	0
Violations of Rare Flow (%)	27.66%	0.00%	0.00%	7.69%	3.62%	18.84%	0.00%	0.00%
Violations of Allowable Duration	3	0	0	2	0		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.8 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Average Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Average 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	242	8	93	145	81		45	
Violations of Common Flow (%)	85.82%	4.23%	37.80%	74.36%	58.70%		100.00%	
Violations of Allowable Duration	1	0	1	4	2		3	
Violations of Catastrophic Duration	1	0	0	0	1		0	
Violations of Critical Flow	92	3	10	40	8	54	0	0
Violations of Critical Flow (%)	32.62%	1.59%	4.07%	20.51%	5.80%	39.13%	0.00%	0.00%
Violations of Allowable Duration	2	0	0	1	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	76	0	0	8	5	26	0	0
Violations of Rare Flow (%)	26.95%	0.00%	0.00%	4.10%	3.62%	18.84%	0.00%	0.00%
Violations of Allowable Duration	3	0	0	1	0		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.9 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Lowest Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Low 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	269	128	178	145	68		43	
Violations of Common Flow (%)	95.39%	67.72%	72.36%	74.36%	49.28%		95.56%	
Violations of Allowable Duration	3	3	3	4	3		3	
Violations of Catastrophic Duration	2	0	1	0	0		0	
Violations of Critical Flow	188	63	113	39	25	65	11	0
Violations of Critical Flow (%)	66.67%	33.33%	45.93%	20.00%	18.12%	47.10%	24.44%	0.00%
Violations of Allowable Duration	4	3	3	1	1		1	
Violations of Catastrophic Duration	3	0	1	1	1		0	
Violations of Rare Flow	176	15	60	0	21	23	9	0
Violations of Rare Flow (%)	62.41%	7.94%	24.39%	0.00%	15.22%	16.67%	20.00%	0.00%
Violations of Allowable Duration	7	1	4	0	1		1	
Violations of Catastrophic Duration	4	0	0	0	1		1	

Common shiner R&G GRAF Spawning

Table D.10 Violations of the Protected Instream Flow Criteria at the Packers Falls gage in the Lamprey Designated River for the Lowest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at the Packers Falls Gage in the Lamprey Designated River for the Low 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	183	183	183	183	183	183	183	183
Violations of Common Flow	275	144	178	137	68		43	
Violations of Common Flow (%)	97.52%	76.19%	72.36%	70.26%	49.28%		95.56%	
Violations of Allowable Duration	3	3	3	4	3		3	
Violations of Catastrophic Duration	2	0	1	0	0		0	
Violations of Critical Flow	188	108	111	23	25	65	11	0
Violations of Critical Flow (%)	66.67%	57.14%	45.12%	11.79%	18.12%	47.10%	24.44%	0.00%
Violations of Allowable Duration	4	3	3	0	1		1	
Violations of Catastrophic Duration	3	0	1	0	1		0	
Violations of Rare Flow	176	17	58	0	21	23	9	0
Violations of Rare Flow (%)	62.41%	8.99%	23.58%	0.00%	15.22%	16.67%	20.00%	0.00%
Violations of Allowable Duration	7	2	4	0	1		1	
Violations of Catastrophic Duration	4	0	0	0	1		1	

Common shiner R&G GRAF Spawning

Table D.11 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Last 30 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Last 30 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	2465	525	1456	1386	517		304	
Violations of Common Flow (%)	87.41%	27.78%	59.19%	71.08%	37.46%		67.56%	
Violations of Allowable Duration	22	8	24	39	17		15	
Violations of Catastrophic Duration	9	1	6	4	5		0	
Violations of Critical Flow	906	151	567	492	156	803	22	87
Violations of Critical Flow (%)	32.13%	7.99%	23.05%	25.23%	11.30%	58.19%	4.89%	19.33%
Violations of Allowable Duration	17	1	17	16	11		2	
Violations of Catastrophic Duration	8	1	4	5	2		1	
Violations of Rare Flow	801	79	300	168	120	510	16	52
Violations of Rare Flow (%)	28.40%	4.18%	12.20%	8.62%	8.70%	36.96%	3.56%	11.56%
Violations of Allowable Duration	40	4	11	15	11		2	
Violations of Catastrophic Duration	15	2	3	6	4		2	

Common shiner R&G GRAF Spawning

Table D.12 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Last 30 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Last 30 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	2465	660	1458	1359	515		304	
Violations of Common Flow (%)	87.41%	34.92%	59.27%	69.69%	37.32%		67.56%	
Violations of Allowable Duration	22	10	24	37	17		15	
Violations of Catastrophic Duration	9	1	6	4	4		0	
Violations of Critical Flow	904	287	590	403	156	804	22	87
Violations of Critical Flow (%)	32.06%	15.19%	23.98%	20.67%	11.30%	58.26%	4.89%	19.33%
Violations of Allowable Duration	17	6	17	13	11		2	
Violations of Catastrophic Duration	8	1	4	3	2		1	
Violations of Rare Flow	797	127	310	106	120	511	16	52
Violations of Rare Flow (%)	28.26%	6.72%	12.60%	5.44%	8.70%	37.03%	3.56%	11.56%
Violations of Allowable Duration	39	6	11	11	11		2	
Violations of Catastrophic Duration	15	3	2	4	4		2	

Common shiner R&G GRAF Spawning

Table D.13 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Last 5 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Last 5 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	418	125	274	240	45		31	
Violations of Common Flow (%)	88.94%	39.68%	66.83%	73.85%	19.57%		41.33%	
Violations of Allowable Duration	3	1	4	8	1		1	
Violations of Catastrophic Duration	2	1	2	1	1		0	
Violations of Critical Flow	187	77	144	114	14	177	0	23
Violations of Critical Flow (%)	39.79%	24.44%	35.12%	35.08%	6.09%	76.96%	0.00%	30.67%
Violations of Allowable Duration	2	1	3	4	1		0	
Violations of Catastrophic Duration	1	1	2	1	0		0	
Violations of Rare Flow	167	66	91	37	8	120	0	14
Violations of Rare Flow (%)	35.53%	20.95%	22.20%	11.38%	3.48%	52.17%	0.00%	18.67%
Violations of Allowable Duration	9	4	5	3	1		0	
Violations of Catastrophic Duration	2	2	1	1	0		0	

Common shiner R&G GRAF Spawning

Table D.14 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Last 5 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Last 5 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	418	152	277	235	44		31	
Violations of Common Flow (%)	88.94%	48.25%	67.56%	72.31%	19.13%		41.33%	
Violations of Allowable Duration	3	2	4	7	1		1	
Violations of Catastrophic Duration	2	1	2	1	0		0	
Violations of Critical Flow	185	85	151	93	14	177	0	23
Violations of Critical Flow (%)	39.36%	26.98%	36.83%	28.62%	6.09%	76.96%	0.00%	30.67%
Violations of Allowable Duration	2	1	3	4	1		0	
Violations of Catastrophic Duration	1	1	2	1	0		0	
Violations of Rare Flow	163	72	84	23	8	120	0	14
Violations of Rare Flow (%)	34.68%	22.86%	20.49%	7.08%	3.48%	52.17%	0.00%	18.67%
Violations of Allowable Duration	8	4	5	2	1		0	
Violations of Catastrophic Duration	2	2	1	1	0		0	

Common shiner R&G GRAF Spawning

Table D.15 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Highest Flow 3 years using Today’s Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the High 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	251	54	97	83	6		19	
Violations of Common Flow (%)	89.01%	28.57%	39.43%	42.56%	4.35%		42.22%	
Violations of Allowable Duration	3	1	2	3	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	94	9	24	14	0	125	0	16
Violations of Critical Flow (%)	33.33%	4.76%	9.76%	7.18%	0.00%	90.58%	0.00%	35.56%
Violations of Allowable Duration	3	0	1	0	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	81	7	1	0	0	98	0	10
Violations of Rare Flow (%)	28.72%	3.70%	0.41%	0.00%	0.00%	71.01%	0.00%	22.22%
Violations of Allowable Duration	4	0	0	0	0		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.16 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Highest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the High 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	251	65	94	77	6		19	
Violations of Common Flow (%)	89.01%	34.39%	38.21%	39.49%	4.35%		42.22%	
Violations of Allowable Duration	3	1	2	3	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	94	20	24	12	0	125	0	16
Violations of Critical Flow (%)	33.33%	10.58%	9.76%	6.15%	0.00%	90.58%	0.00%	35.56%
Violations of Allowable Duration	3	0	1	0	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	81	10	9	0	0	98	0	10
Violations of Rare Flow (%)	28.72%	5.29%	3.66%	0.00%	0.00%	71.01%	0.00%	22.22%
Violations of Allowable Duration	4	0	0	0	0		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	
						Common shiner R&G	GRAF Spawning	

Table D.17 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Average Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Average 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	248	9	121	157	86		45	
Violations of Common Flow (%)	87.94%	4.76%	49.19%	80.51%	62.32%		100.00%	
Violations of Allowable Duration	1	0	1	5	3		3	
Violations of Catastrophic Duration	1	0	0	0	2		0	
Violations of Critical Flow	103	3	20	63	17	45	2	0
Violations of Critical Flow (%)	36.52%	1.59%	8.13%	32.31%	12.32%	32.61%	4.44%	0.00%
Violations of Allowable Duration	2	0	1	2	1		0	
Violations of Catastrophic Duration	2	0	0	1	0		0	
Violations of Rare Flow	92	0	0	18	11	19	0	0
Violations of Rare Flow (%)	32.62%	0.00%	0.00%	9.23%	7.97%	13.77%	0.00%	0.00%
Violations of Allowable Duration	5	0	0	2	1		0	
Violations of Catastrophic Duration	2	0	0	1	0		0	

Common shiner R&G GRAF Spawning

Table D.18 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Average Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Average 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	248	11	121	156	86		45	
Violations of Common Flow (%)	87.94%	5.82%	49.19%	80.00%	62.32%		100.00%	
Violations of Allowable Duration	1	0	1	5	3		3	
Violations of Catastrophic Duration	1	0	0	0	2		0	
Violations of Critical Flow	103	3	19	51	17	45	2	0
Violations of Critical Flow (%)	36.52%	1.59%	7.72%	26.15%	12.32%	32.61%	4.44%	0.00%
Violations of Allowable Duration	2	0	1	2	1		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	
Violations of Rare Flow	92	0	0	15	11	19	0	0
Violations of Rare Flow (%)	32.62%	0.00%	0.00%	7.69%	7.97%	13.77%	0.00%	0.00%
Violations of Allowable Duration	5	0	0	2	1		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.19 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Lowest Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Low 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	273	133	192	164	73		44	
Violations of Common Flow (%)	96.81%	70.37%	78.05%	84.10%	52.90%		97.78%	
Violations of Allowable Duration	3	3	3	3	3		3	
Violations of Catastrophic Duration	2	0	1	1	0		0	
Violations of Critical Flow	199	70	115	53	27	52	12	0
Violations of Critical Flow (%)	70.57%	37.04%	46.75%	27.18%	19.57%	37.68%	26.67%	0.00%
Violations of Allowable Duration	4	4	3	1	1		1	
Violations of Catastrophic Duration	3	0	1	1	1		0	
Violations of Rare Flow	188	20	86	0	26	18	11	0
Violations of Rare Flow (%)	66.67%	10.58%	34.96%	0.00%	18.84%	13.04%	24.44%	0.00%
Violations of Allowable Duration	8	1	4	0	2		1	
Violations of Catastrophic Duration	4	1	0	0	1		1	
						Common shiner R&G	GRAF Spawning	

Table D.20 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Lowest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Lee Hook Rd in the Lamprey Designated River for the Low 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	161	161	161	161	161	161	161	161
Violations of Common Flow	276	150	192	157	73		44	
Violations of Common Flow (%)	97.87%	79.37%	78.05%	80.51%	52.90%		97.78%	
Violations of Allowable Duration	3	3	3	4	3		3	
Violations of Catastrophic Duration	2	1	1	0	0		0	
Violations of Critical Flow	199	111	114	41	27	52	12	0
Violations of Critical Flow (%)	70.57%	58.73%	46.34%	21.03%	19.57%	37.68%	26.67%	0.00%
Violations of Allowable Duration	4	3	3	1	1		1	
Violations of Catastrophic Duration	3	0	1	0	1		0	
Violations of Rare Flow	188	29	87	1	26	18	11	0
Violations of Rare Flow (%)	66.67%	15.34%	35.37%	0.51%	18.84%	13.04%	24.44%	0.00%
Violations of Allowable Duration	8	2	4	0	2		1	
Violations of Catastrophic Duration	4	1	0	0	1		1	
						Common shiner R&G	GRAF Spawning	

Table D.21 Violations of the Protected Instream Flow Criteria at Wadleigh in the Lamprey Designated River for the Last 30 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 30 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	2519	598	1621	1500	600		323	
Violations of Common Flow (%)	89.33%	31.64%	65.89%	76.92%	43.48%		71.78%	
Violations of Allowable Duration	22	10	26	42	17		16	
Violations of Catastrophic Duration	9	1	7	6	8		0	
Violations of Critical Flow	1061	184	689	614	196	724	31	77
Violations of Critical Flow (%)	37.62%	9.74%	28.01%	31.49%	14.20%	52.46%	6.89%	17.11%
Violations of Allowable Duration	18	2	18	21	13		2	
Violations of Catastrophic Duration	10	1	8	9	5		1	
Violations of Rare Flow	906	83	355	226	161	449	22	44
Violations of Rare Flow (%)	32.13%	4.39%	14.43%	11.59%	11.67%	32.54%	4.89%	9.78%
Violations of Allowable Duration	46	3	11	22	12		2	
Violations of Catastrophic Duration	17	1	3	6	6		2	

Common shiner R&G GRAF Spawning

Table D.22 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 30 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 30 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	2518	733	1618	1469	599		323	
Violations of Common Flow (%)	89.29%	38.78%	65.77%	75.33%	43.41%		71.78%	
Violations of Allowable Duration	22	13	26	40	17		16	
Violations of Catastrophic Duration	9	2	8	5	8		0	
Violations of Critical Flow	1054	335	691	515	196	725	30	77
Violations of Critical Flow (%)	37.38%	17.72%	28.09%	26.41%	14.20%	52.54%	6.67%	17.11%
Violations of Allowable Duration	18	6	18	16	13		2	
Violations of Catastrophic Duration	10	1	8	7	5		1	
Violations of Rare Flow	904	146	365	153	161	454	22	44
Violations of Rare Flow (%)	32.06%	7.72%	14.84%	7.85%	11.67%	32.90%	4.89%	9.78%
Violations of Allowable Duration	45	7	12	14	12		2	
Violations of Catastrophic Duration	17	2	3	5	6		2	

Common shiner R&G GRAF Spawning

Table D.23 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 5 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 5 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	428	139	301	247	56		37	
Violations of Common Flow (%)	91.06%	44.13%	73.41%	76.00%	24.35%		49.33%	
Violations of Allowable Duration	3	2	4	8	1		1	
Violations of Catastrophic Duration	2	1	2	1	1		0	
Violations of Critical Flow	222	83	183	134	16	164	0	21
Violations of Critical Flow (%)	47.23%	26.35%	44.63%	41.23%	6.96%	71.30%	0.00%	28.00%
Violations of Allowable Duration	3	1	5	5	1		0	
Violations of Catastrophic Duration	2	1	2	3	1		0	
Violations of Rare Flow	187	67	103	50	14	108	0	12
Violations of Rare Flow (%)	39.79%	21.27%	25.12%	15.38%	6.09%	46.96%	0.00%	16.00%
Violations of Allowable Duration	10	3	4	5	1		0	
Violations of Catastrophic Duration	2	1	1	1	1		0	

Common shiner R&G GRAF Spawning

Table D.24 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 5 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Last 5 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	427	161	300	242	56		37	
Violations of Common Flow (%)	90.85%	51.11%	73.17%	74.46%	24.35%		49.33%	
Violations of Allowable Duration	3	3	4	8	1		1	
Violations of Catastrophic Duration	2	1	3	1	1		0	
Violations of Critical Flow	216	90	179	121	16	164	0	21
Violations of Critical Flow (%)	45.96%	28.57%	43.66%	37.23%	6.96%	71.30%	0.00%	28.00%
Violations of Allowable Duration	3	1	4	4	1		0	
Violations of Catastrophic Duration	2	1	2	2	1		0	
Violations of Rare Flow	185	76	97	35	14	109	0	12
Violations of Rare Flow (%)	39.36%	24.13%	23.66%	10.77%	6.09%	47.39%	0.00%	16.00%
Violations of Allowable Duration	9	4	4	3	1		0	
Violations of Catastrophic Duration	2	1	1	1	1		0	

Common shiner R&G GRAF Spawning

Table D.25 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Highest Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the High 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	255	60	129	107	14		23	
Violations of Common Flow (%)	90.43%	31.75%	52.44%	54.87%	10.14%		51.11%	
Violations of Allowable Duration	3	1	3	4	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	109	12	28	22	0	120	0	15
Violations of Critical Flow (%)	38.65%	6.35%	11.38%	11.28%	0.00%	86.96%	0.00%	33.33%
Violations of Allowable Duration	3	0	1	1	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	94	7	8	4	0	91	0	9
Violations of Rare Flow (%)	33.33%	3.70%	3.25%	2.05%	0.00%	65.94%	0.00%	20.00%
Violations of Allowable Duration	5	0	0	0	0		0	
Violations of Catastrophic Duration	3	0	0	0	0		0	

Common shiner R&G   GRAF Spawning

Table D.26 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Highest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the High 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	255	74	128	98	14		23	
Violations of Common Flow (%)	90.43%	39.15%	52.03%	50.26%	10.14%		51.11%	
Violations of Allowable Duration	3	1	3	3	0		1	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Critical Flow	109	27	28	16	0	120	0	15
Violations of Critical Flow (%)	38.65%	14.29%	11.38%	8.21%	0.00%	86.96%	0.00%	33.33%
Violations of Allowable Duration	3	0	1	0	0		0	
Violations of Catastrophic Duration	1	0	0	0	0		0	
Violations of Rare Flow	94	10	15	0	0	92	0	9
Violations of Rare Flow (%)	33.33%	5.29%	6.10%	0.00%	0.00%	66.67%	0.00%	20.00%
Violations of Allowable Duration	5	0	1	0	0		0	
Violations of Catastrophic Duration	3	0	0	0	0		0	

Common shiner R&G　GRAF Spawning

Table D.27 Violations of the Protected Instream Flow Criteria at Lee Hook Road in the Lamprey Designated River for the Average Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Average 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	251	9	143	162	94		45	
Violations of Common Flow (%)	89.01%	4.76%	58.13%	83.08%	68.12%		100.00%	
Violations of Allowable Duration	1	0	1	4	3		3	
Violations of Catastrophic Duration	1	0	0	1	2		0	
Violations of Critical Flow	111	3	23	78	31	38	4	0
Violations of Critical Flow (%)	39.36%	1.59%	9.35%	40.00%	22.46%	27.54%	8.89%	0.00%
Violations of Allowable Duration	2	0	1	3	2		0	
Violations of Catastrophic Duration	1	0	0	1	0		0	
Violations of Rare Flow	103	0	3	29	20	15	2	0
Violations of Rare Flow (%)	36.52%	0.00%	1.22%	14.87%	14.49%	10.87%	4.44%	0.00%
Violations of Allowable Duration	4	0	0	3	1		0	
Violations of Catastrophic Duration	2	0	0	1	0		0	

Common shiner R&G GRAF Spawning

Table D.28 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Average Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Average 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	251	18	144	160	94		45	
Violations of Common Flow (%)	89.01%	9.52%	58.54%	82.05%	68.12%		100.00%	
Violations of Allowable Duration	1	0	1	5	3		3	
Violations of Catastrophic Duration	1	0	0	0	2		0	
Violations of Critical Flow	111	3	22	63	31	38	4	0
Violations of Critical Flow (%)	39.36%	1.59%	8.94%	32.31%	22.46%	27.54%	8.89%	0.00%
Violations of Allowable Duration	2	0	1	2	2		0	
Violations of Catastrophic Duration	1	0	0	1	0		0	
Violations of Rare Flow	103	0	0	17	20	16	2	0
Violations of Rare Flow (%)	36.52%	0.00%	0.00%	8.72%	14.49%	11.59%	4.44%	0.00%
Violations of Allowable Duration	4	0	0	2	1		0	
Violations of Catastrophic Duration	2	0	0	0	0		0	

Common shiner R&G GRAF Spawning

Table D.29 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Lowest Flow 3 years using Today's Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Low 3 years of Today's Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	275	138	199	181	88		45	
Violations of Common Flow (%)	97.52%	73.02%	80.89%	92.82%	63.77%		100.00%	
Violations of Allowable Duration	3	3	3	5	3		3	
Violations of Catastrophic Duration	2	1	1	1	1		0	
Violations of Critical Flow	214	81	116	61	30	40	13	0
Violations of Critical Flow (%)	75.89%	42.86%	47.15%	31.28%	21.74%	28.99%	28.89%	0.00%
Violations of Allowable Duration	5	4	3	2	2		1	
Violations of Catastrophic Duration	3	0	1	2	1		0	
Violations of Rare Flow	199	28	98	8	27	11	12	0
Violations of Rare Flow (%)	70.57%	14.81%	39.84%	4.10%	19.57%	7.97%	26.67%	0.00%
Violations of Allowable Duration	9	2	4	1	2		1	
Violations of Catastrophic Duration	4	1	0	0	1		1	
						Common shiner R&G	GRAF Spawning	

Table D.30 Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Lowest Flow 3 years using Naturalized Hydrology.

Violations of the Protected Instream Flow Criteria at Wadleigh Falls in the Lamprey Designated River for the Low 3 years of Naturalized Flows								
Bioperiod	**Rearing & Growth**	**Salmon Spawning**	**Overwintering**	**Spring Flood**	**Clupeid Spawning**		**GRAF Spawning**	
Approximate start date	7/5	10/7	12/9	3/1	5/5		6/20	
Approximate end date	10/6	12/8	2/28	5/4	6/19		7/4	
Days	94	63	82	65	46		15	
Indicator	Common Shiner	Atlantic Salmon	Flow	Flow	Min	Max	Min	Max
Watershed area (mi^2)	135	135	135	135	135	135	135	135
Violations of Common Flow	277	151	199	174	88		45	
Violations of Common Flow (%)	98.23%	79.89%	80.89%	89.23%	63.77%		100.00%	
Violations of Allowable Duration	3	3	3	5	3		3	
Violations of Catastrophic Duration	2	1	1	0	1		0	
Violations of Critical Flow	214	116	115	52	30	40	13	0
Violations of Critical Flow (%)	75.89%	61.38%	46.75%	26.67%	21.74%	28.99%	28.89%	0.00%
Violations of Allowable Duration	5	4	3	2	2		1	
Violations of Catastrophic Duration	3	0	1	0	1		0	
Violations of Rare Flow	199	49	98	2	27	11	12	0
Violations of Rare Flow (%)	70.57%	25.93%	39.84%	1.03%	19.57%	7.97%	26.67%	0.00%
Violations of Allowable Duration	9	2	4	0	2		1	
Violations of Catastrophic Duration	4	1	0	0	1		1	
						Common shiner R&G	GRAF Spawning	

Appendix E

2009 Pawtuckaway Lake Fall Drawdown Hydrograph

2009 Pawtuckaway Lake Fall Drawdown Hydrograph

During the October, 2009 annual fall lake drawdown at Pawtuckaway, the hydrograph data was studied to understand how releases at Pawtuckaway will be transformed when they show up at the designated reach. This investigation was to support the understanding of relief flows. Water began to be released at Pawtuckaway at 11:15 AM on 13 October 2009. As observed in Figure E.1, flow was recorded at the USGS gages on the Lamprey River at both Langford Road in Raymond (upstream of where the Pawtuckaway flows enter the Lamprey River) and at Packers falls in Newmarket. The Langford gage indicates that there was no rainfall runoff occurring during this event, as the flow is nearly constant. The Packers Falls gage demonstrates that in 2009 the water released from Pawtuckaway started to show up in about 24 hours.

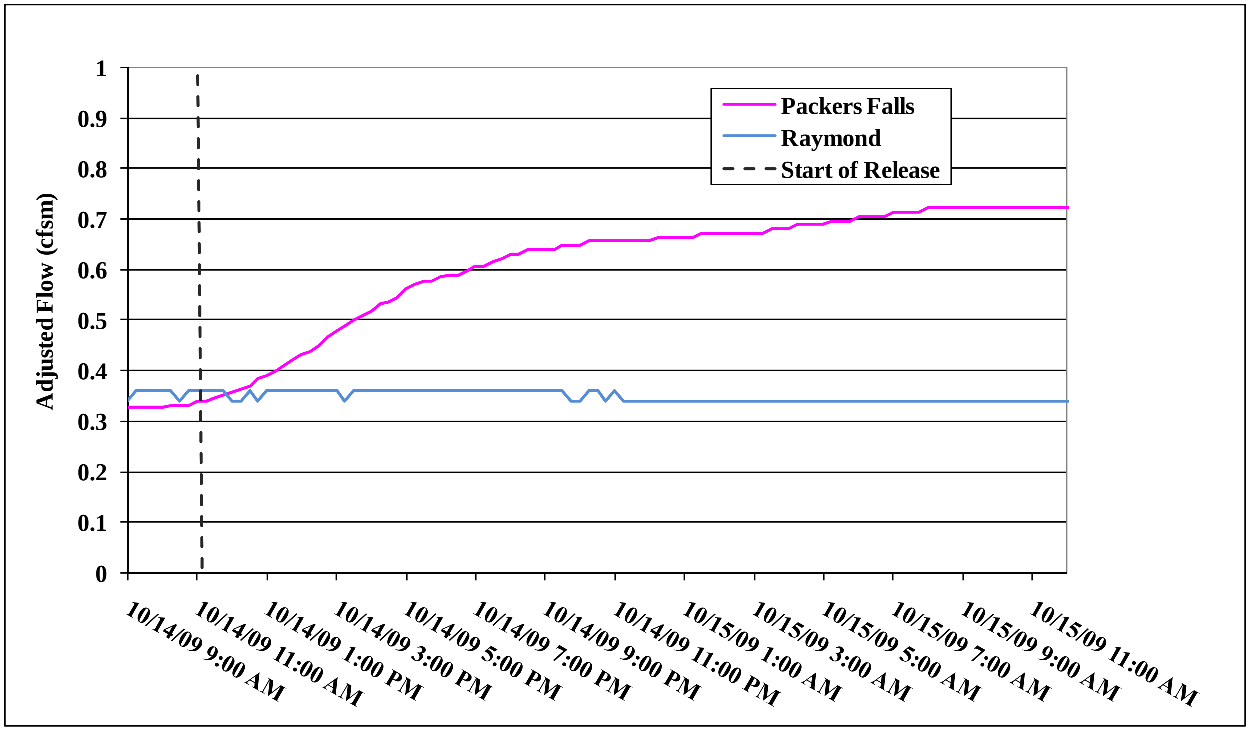


Figure E.1. October 13, 2009 Lamprey River hydrographs.

The annual, 7-foot, fall drawdown of Pawtuckaway Lake started October 13, 2009. Stoplogs were removed from Dolloff Dam or Drowns Dam. NH Dam Bureau reported that on October 6, 2009 the lake was at full pool (25 feet) with no flow over the spillways. The drawdown period lasted until November 30, approximately 50 days, with approximately 7 flow changes generally occurring every 8 to 10 days, but sometimes only a day apart.

Appendix F

Probability Distributions of the Two-Day Water Volumes to Create Relief Flows

Lamprey River Water Management Plan

August 2013

Probability Distributions of the Two-Day Water Volumes to Create Relief Flows

The plots in this Appendix were developed from the 30-year daily flow data sets used to develop the protected instream flows. The analysis in this case calculated the volume of water necessary to increase the river flow from the reading up to the protected instream flow (common, critical, rare), for the two days immediately after the catastrophic duration occurred. To read the plots in this Appendix, they are organized by bioperiod and 30-year flow record (Naturalized, formerly referred to as the pre-Colonial, and modern, referred to herein as "Today"): Today's Flows are those measured at the Packers Falls gage today, and the Naturalized/Pre-Colonial flows are Today's Flows with the effects of dam operations and withdrawals removed from the records. In addition, the Appendix F figures are presented at three locations along the Lamprey Designated River: Wadleigh Falls, Lee Hook Road, and Packers Falls. In each plot, the lower horizontal axis is the water volume for rare and critical protected instream flows (in acre-feet), the upper horizontal axis is the water volume for the common protected instream flows (in acre-feet), and the vertical axis is the non-exceedance probability (basically, the percent of time that volume is needed to provide relief flows).

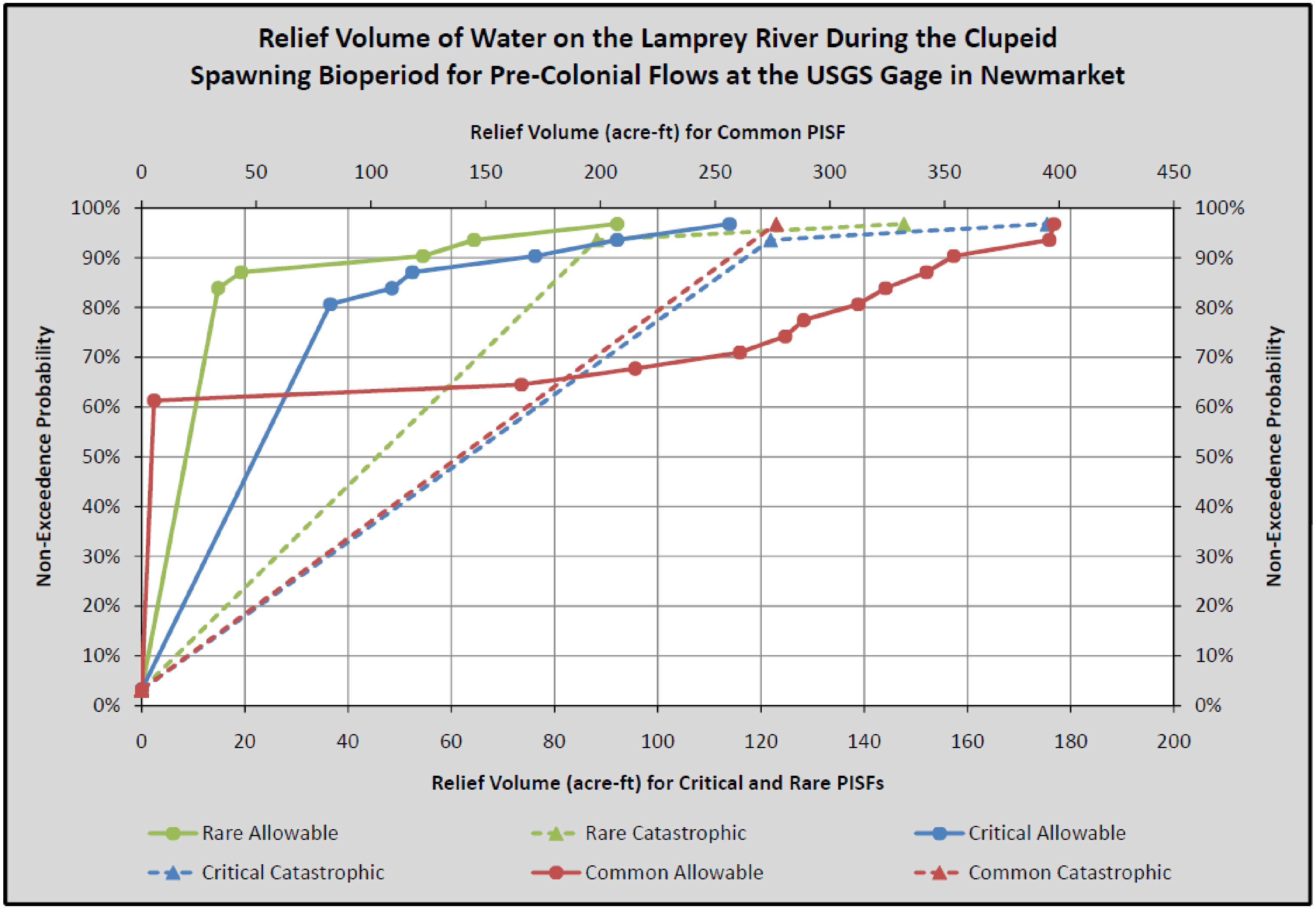


Figure F.1. Relief Water Volume During Clupeid Spawning Bioperiod For Naturalized Flows at Packers Falls.

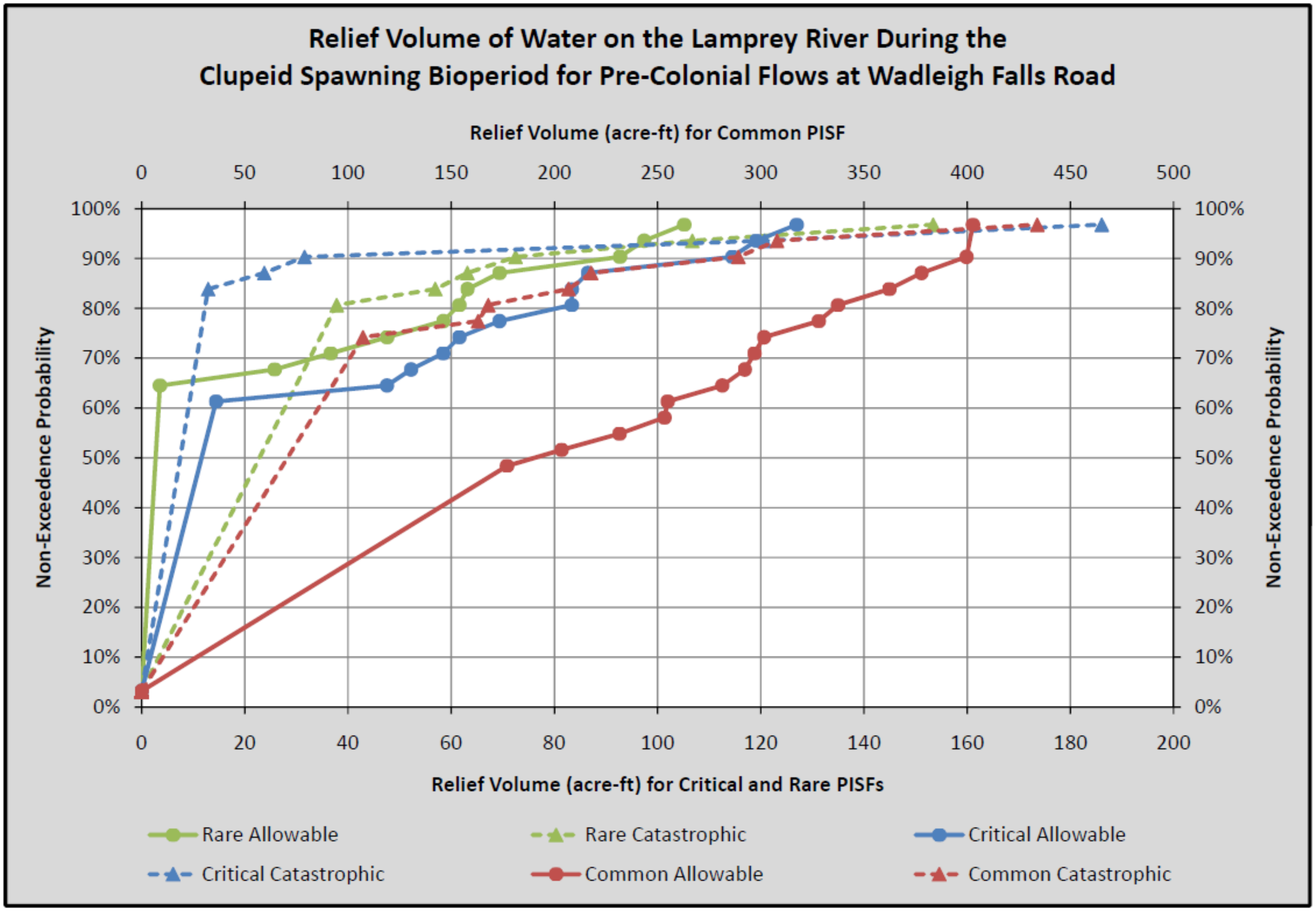


Figure F.2. Relief Water Volume During Clupeid Spawning Bioperiod For Naturalized Flows at Wadleigh Falls

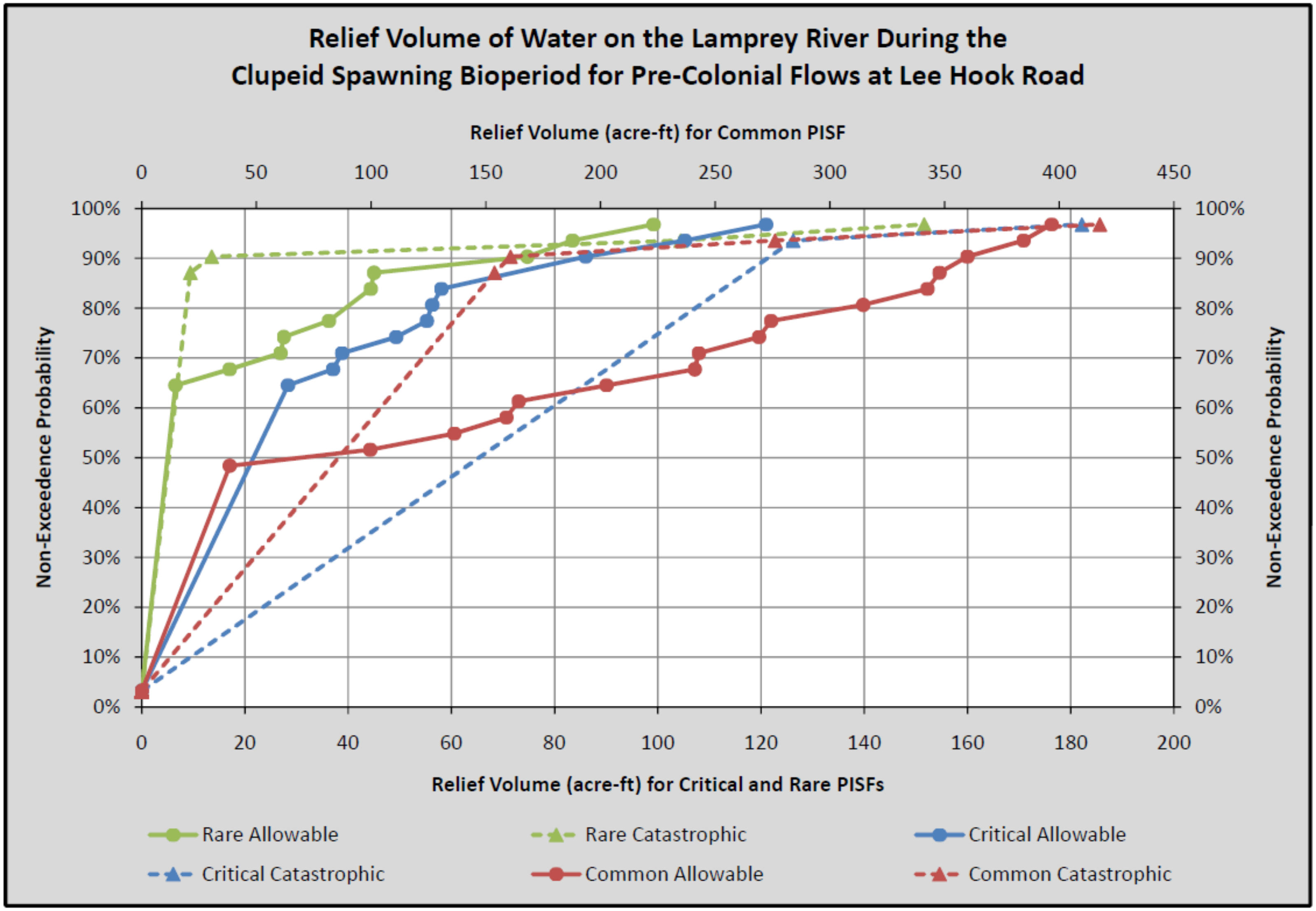


Figure F.3. Relief Water Volume During Clupeid Spawning Bioperiod For Naturalized Flows at Lee Hook Road.

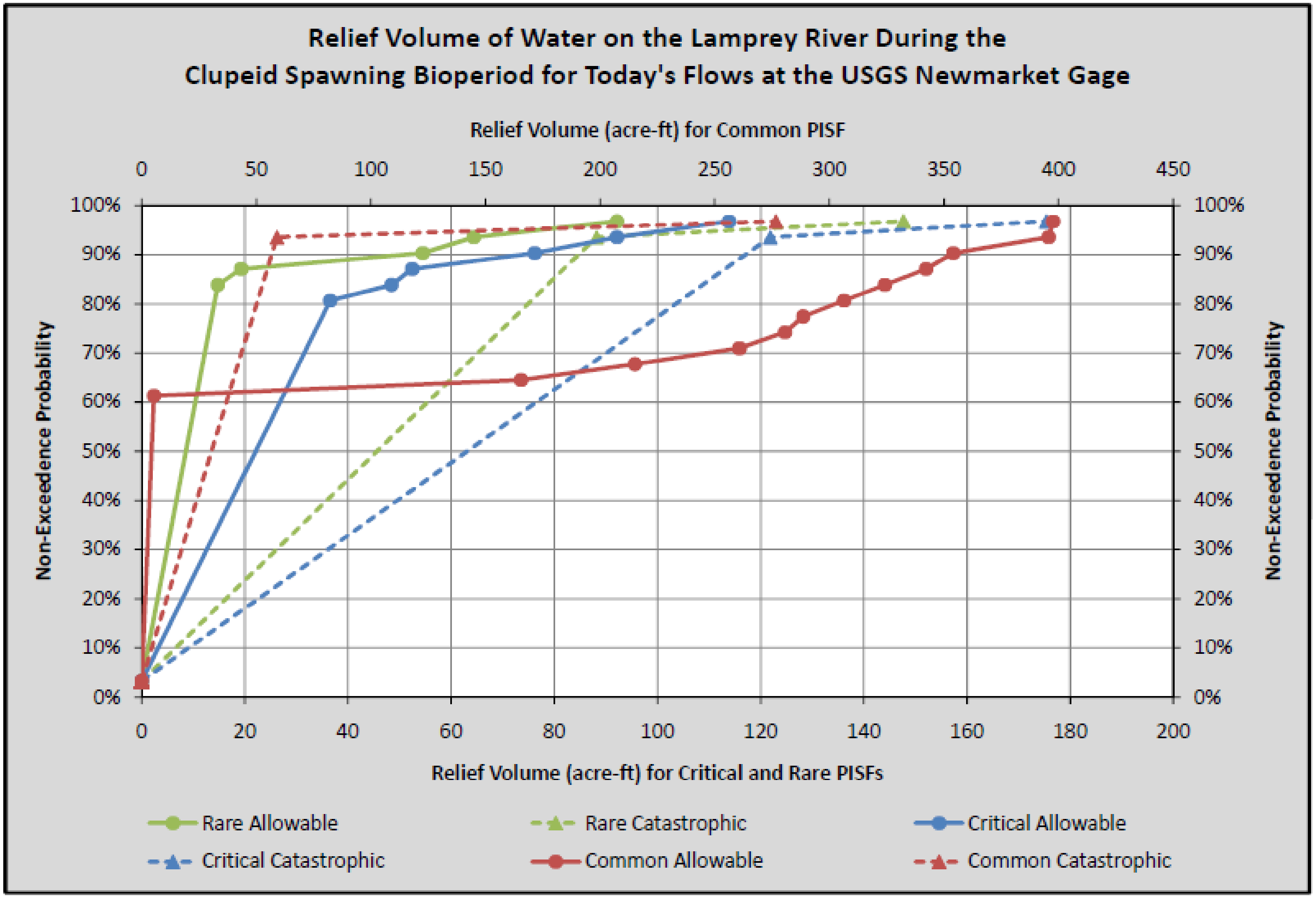


Figure F.4. Relief Water Volume During Clupeid Spawning Bioperiod For Today's Hydrology at Packers Falls.

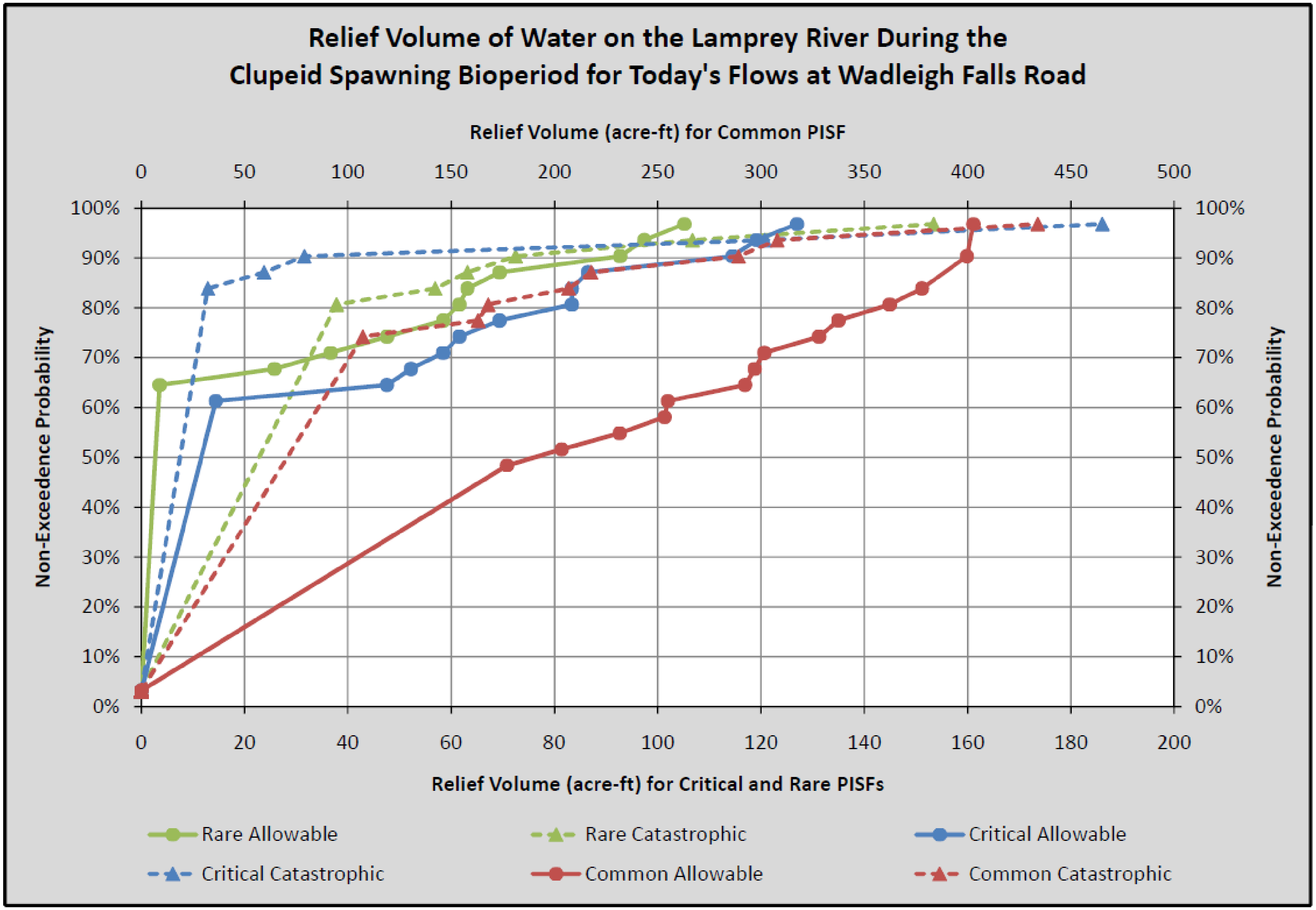


Figure F.5. Relief Water Volume During Clupeid Spawning Bioperiod For Today's Hydrology at Wadleigh Falls.

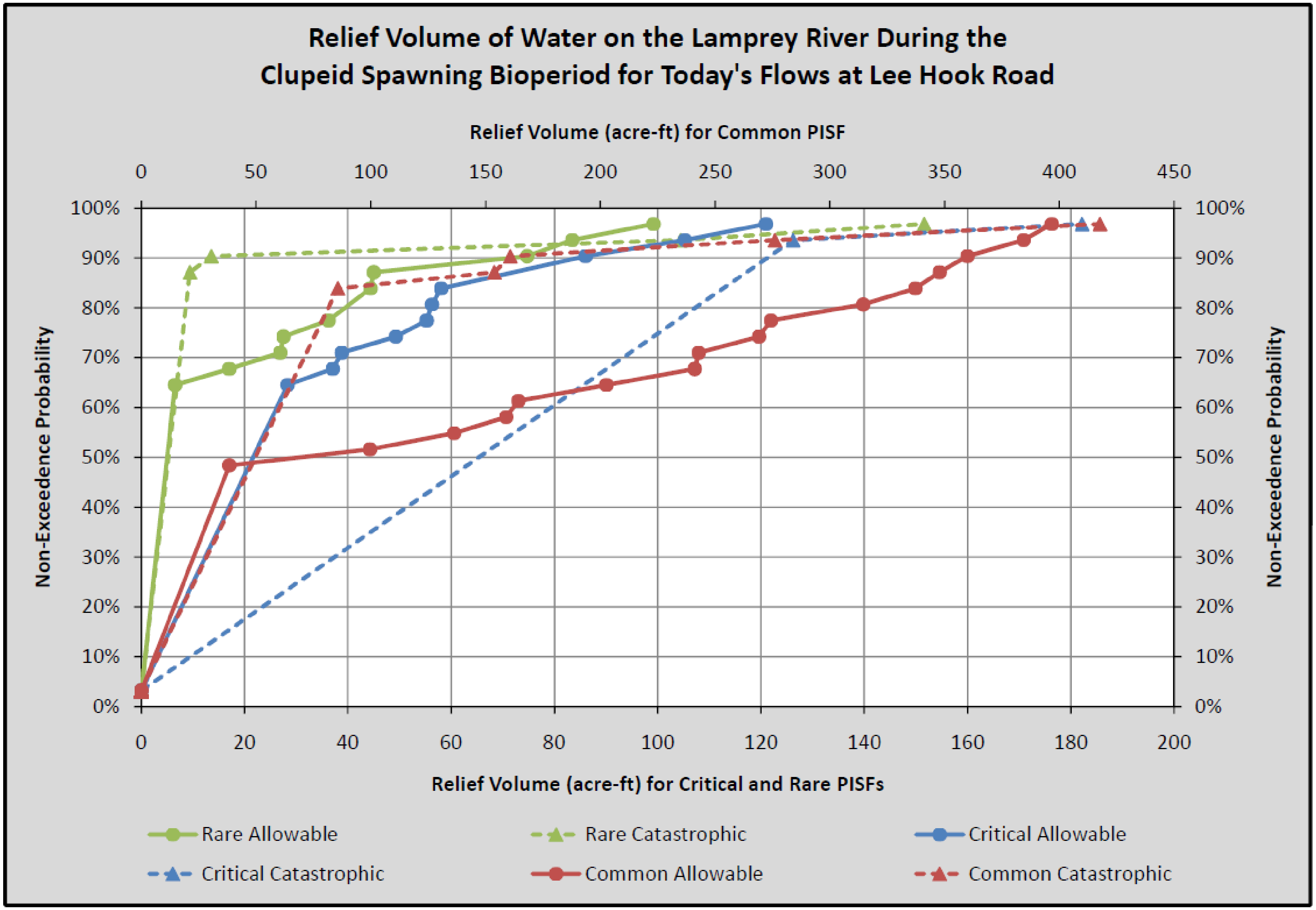


Figure F.6. Relief Water Volume During Clupeid Spawning Bioperiod For Today's Hydrology at Lee Hook Road.

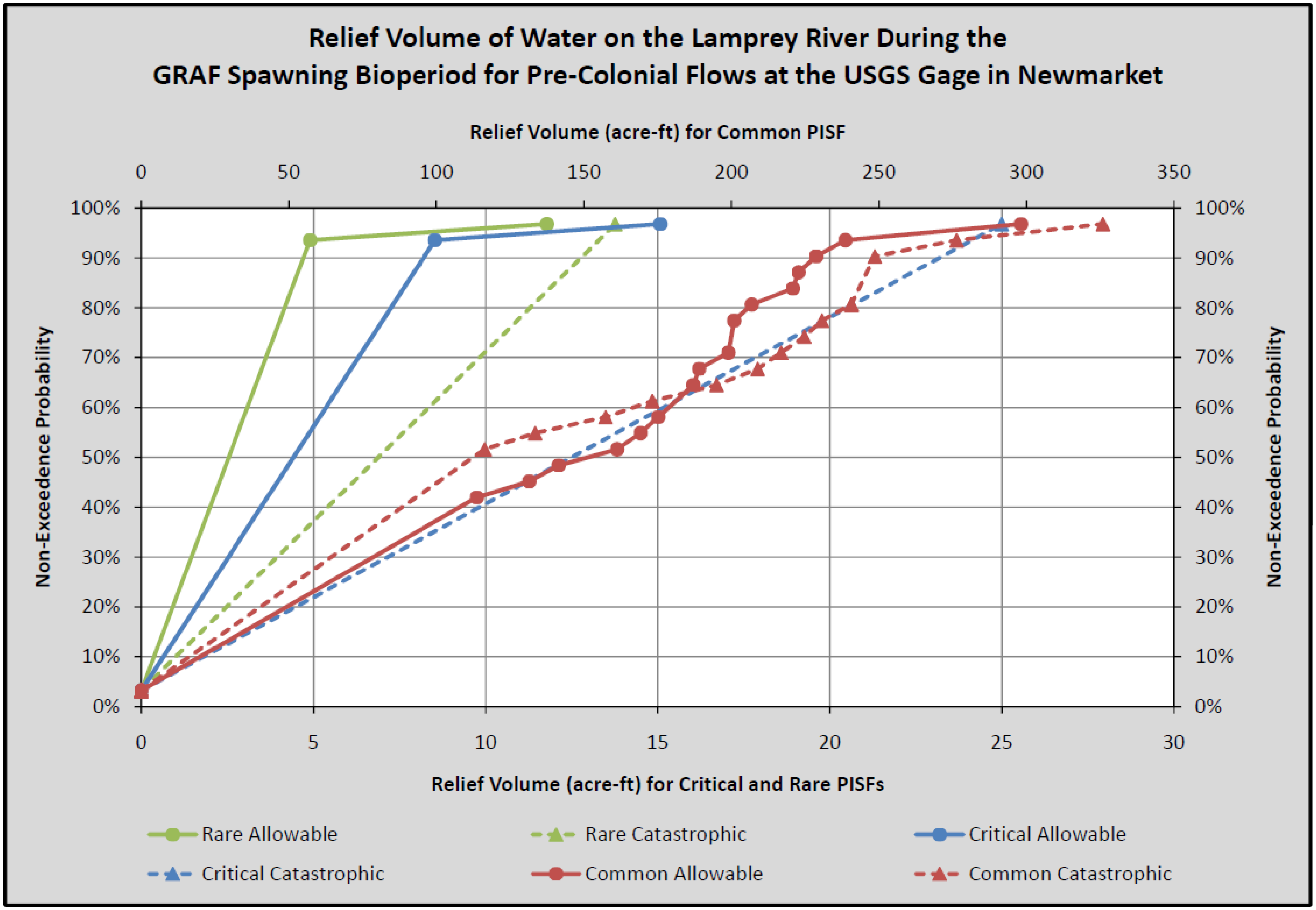


Figure F.7. Relief Water Volume During GRAF Spawning Bioperiod For Naturalized Flows at Packers Falls.

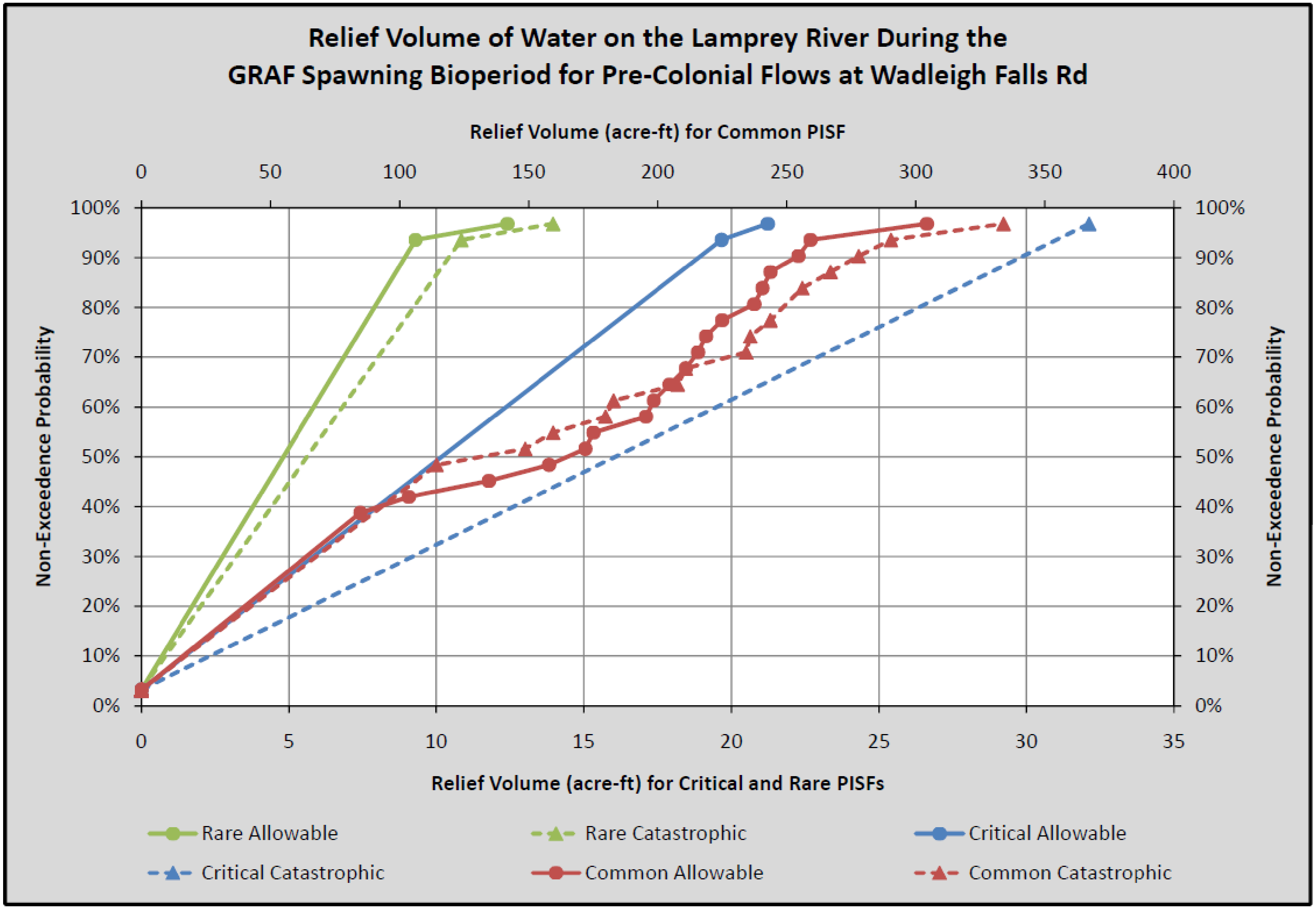


Figure F.8. Relief Water Volume During GRAF Spawning Bioperiod For Naturalized Flows at Wadleigh Falls

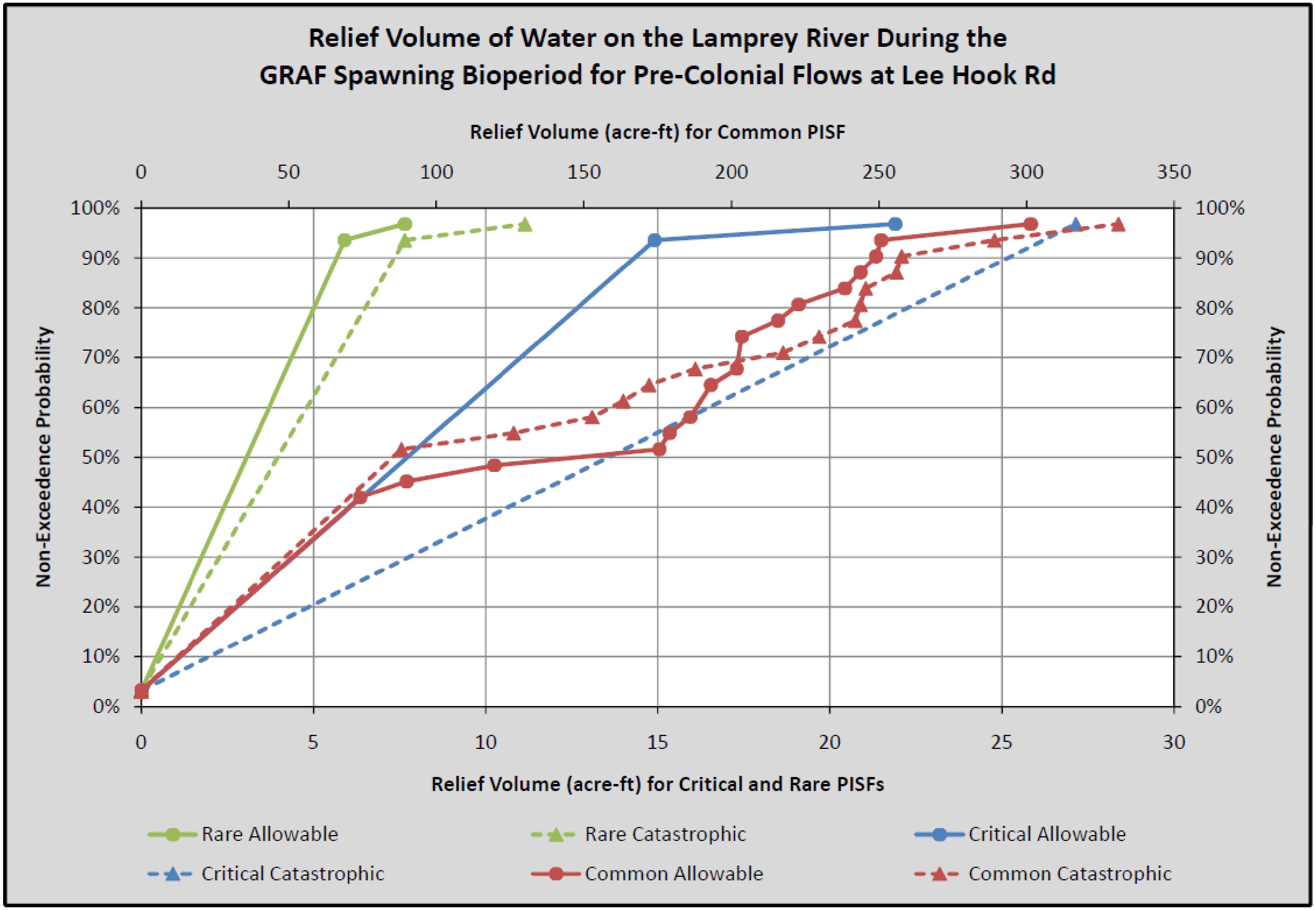


Figure F.9. Relief Water Volume During GRAF Spawning Bioperiod For Naturalized Flows at Lee Hook Road.

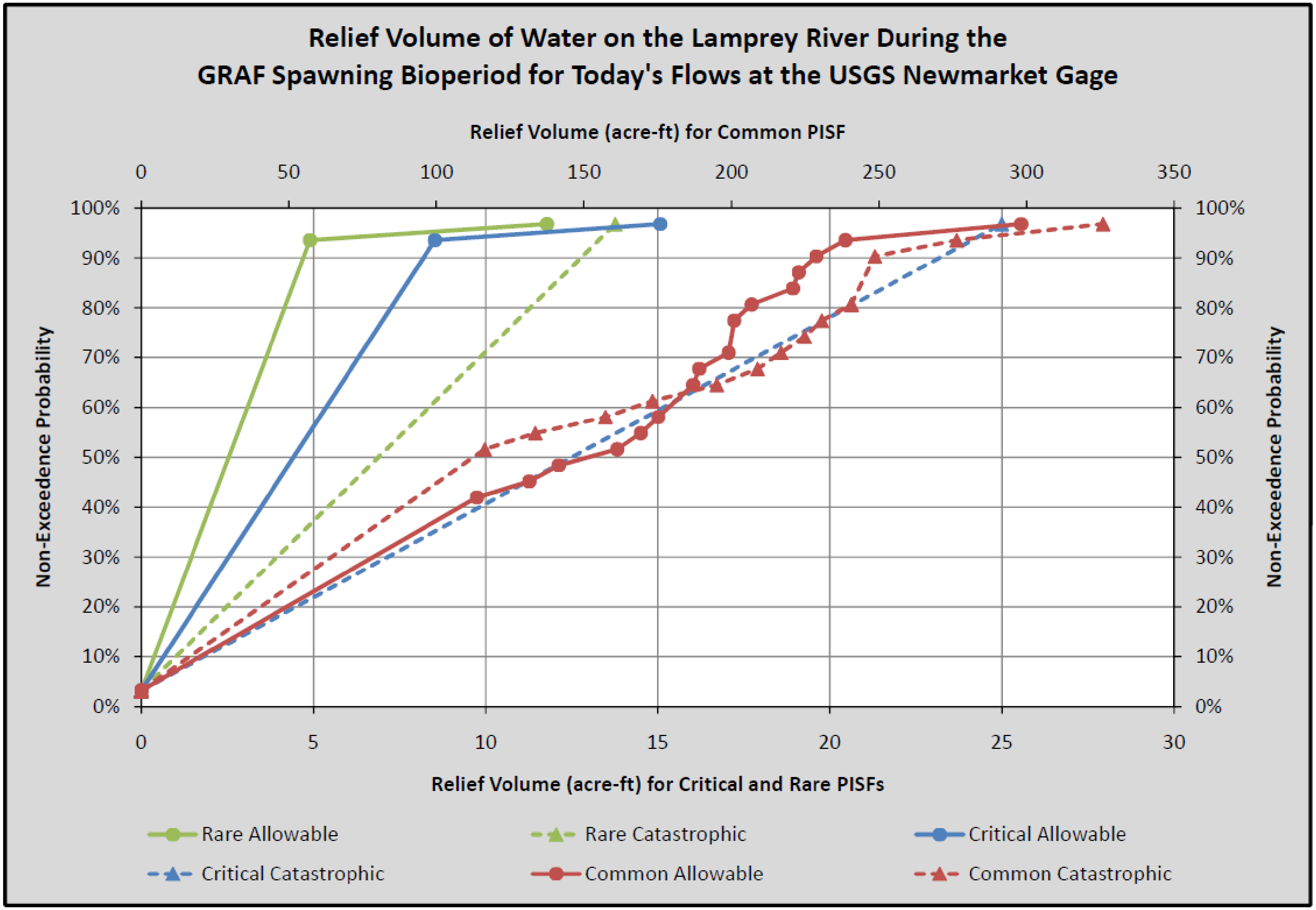


Figure F.10. Relief Water Volume During GRAF Spawning Bioperiod For Today's Hydrology at Packers Falls.

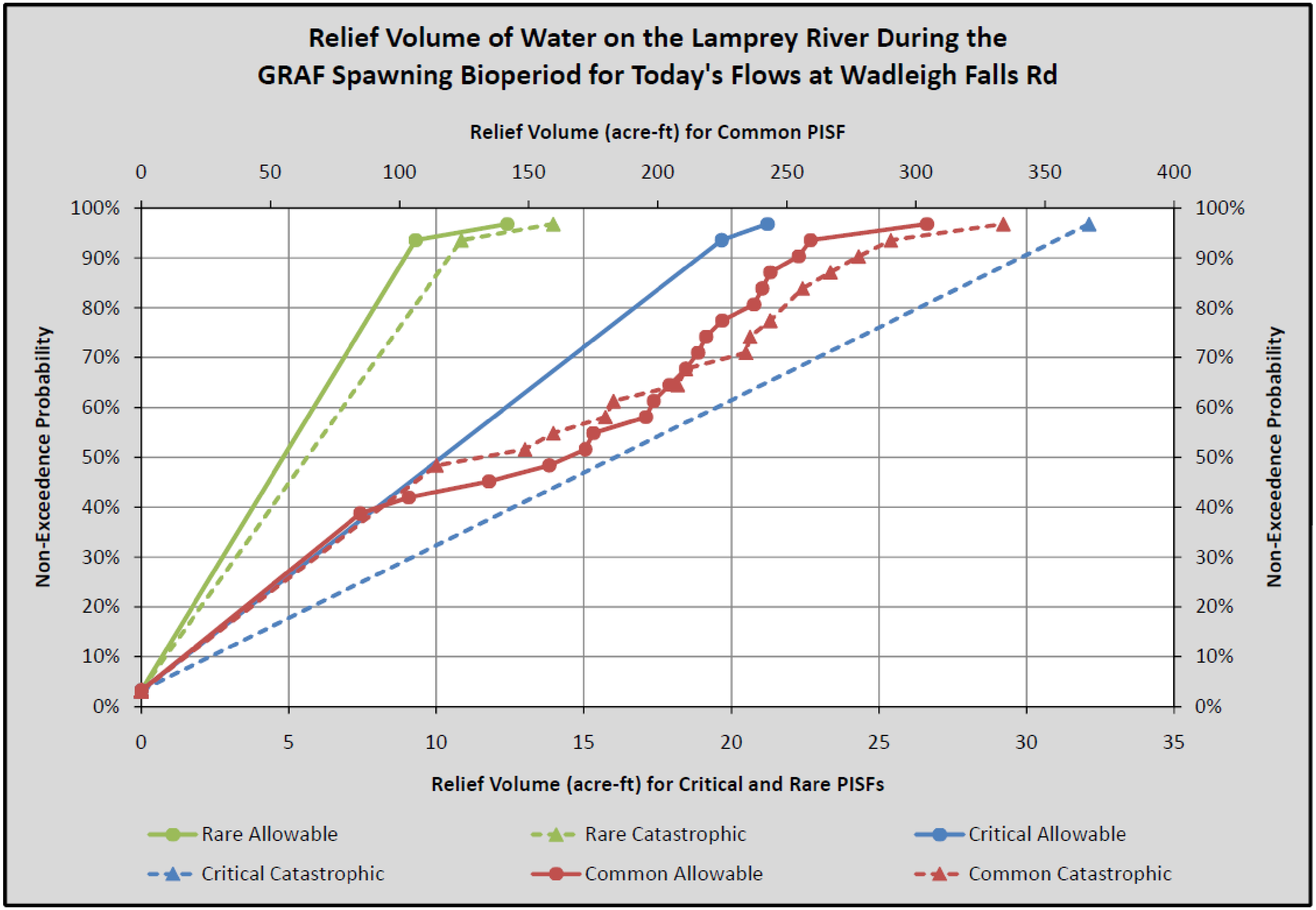


Figure F.11. Relief Water Volume During GRAF Spawning Bioperiod For Today's Hydrology at Wadleigh Falls.

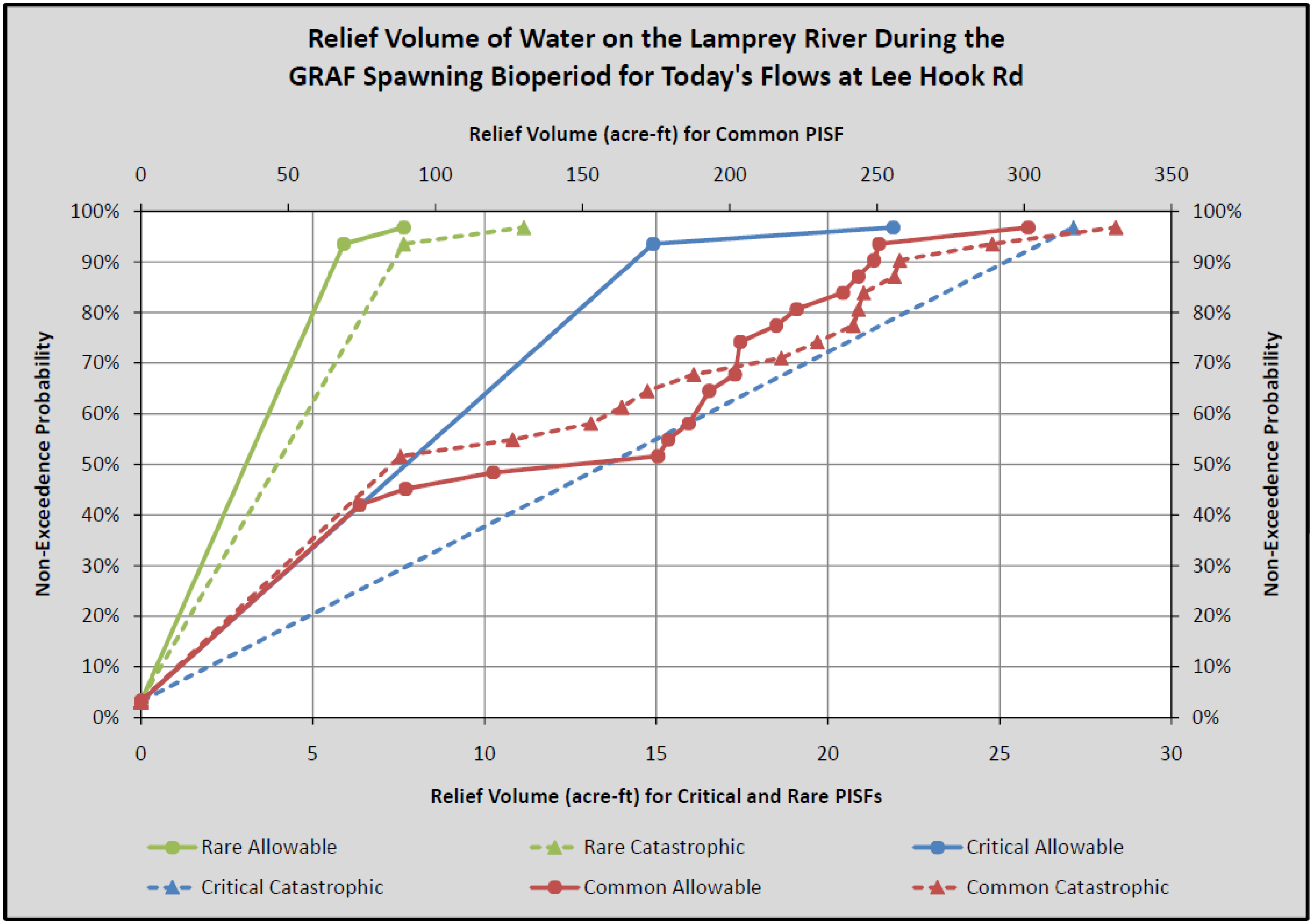


Figure F.12. Relief Water Volume During GRAF Spawning Bioperiod For Today's Hydrology at Lee Hook Road.

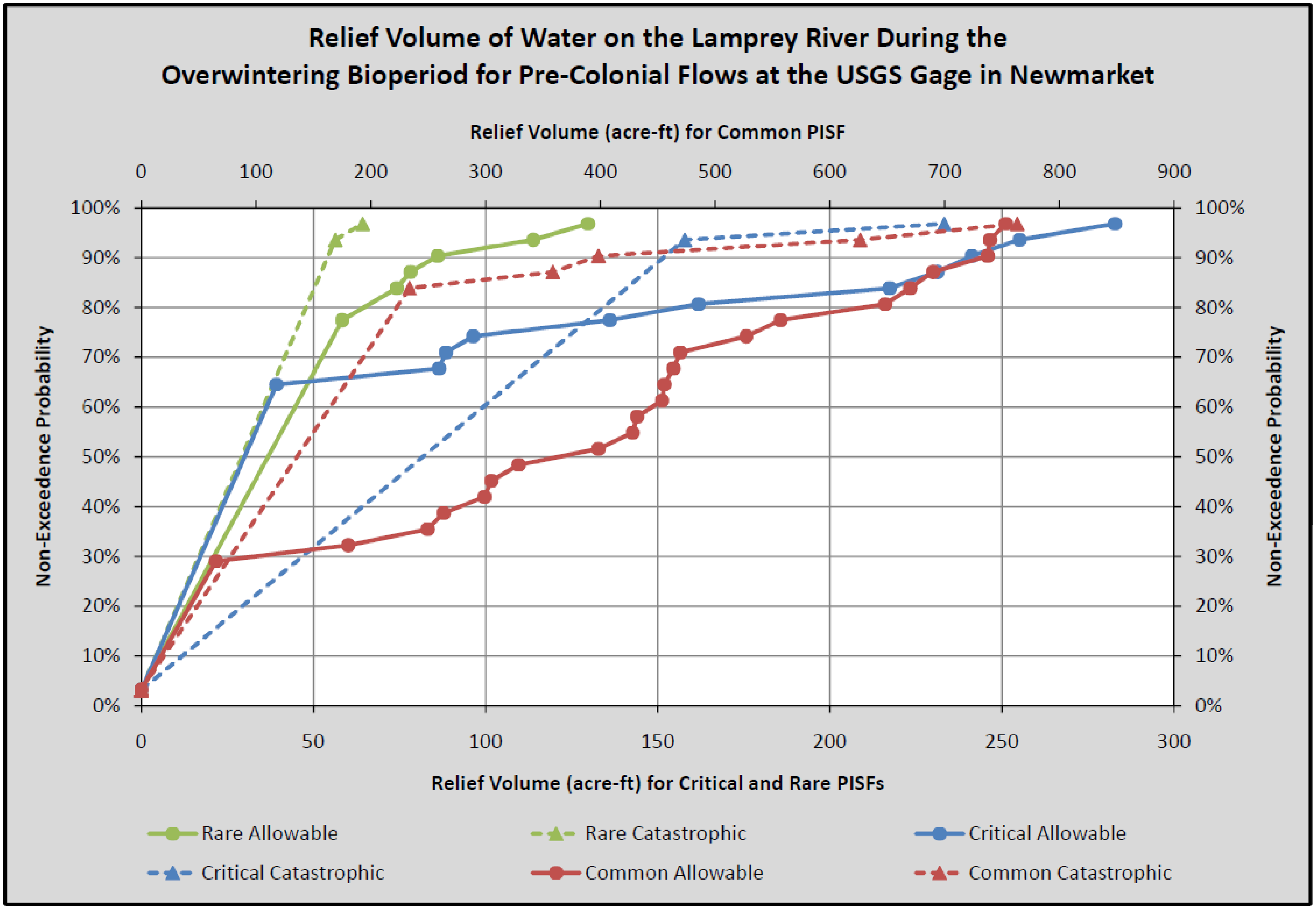


Figure F.13. Relief Water Volume During Overwintering Bioperiod For Naturalized Flows at Packers Falls.

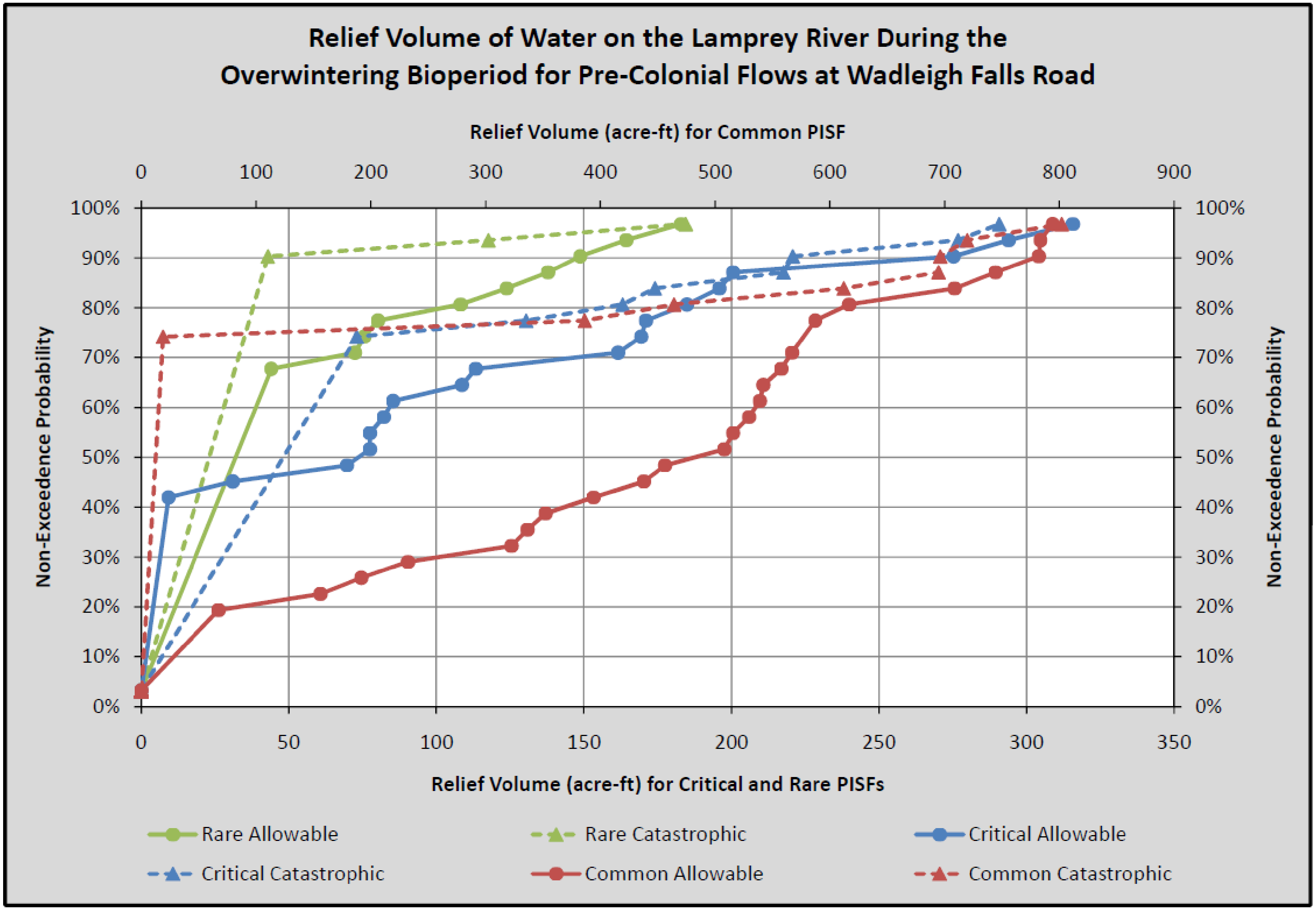


Figure F.14. Relief Water Volume During Overwintering Bioperiod For Naturalized Flows at Wadleigh Falls.

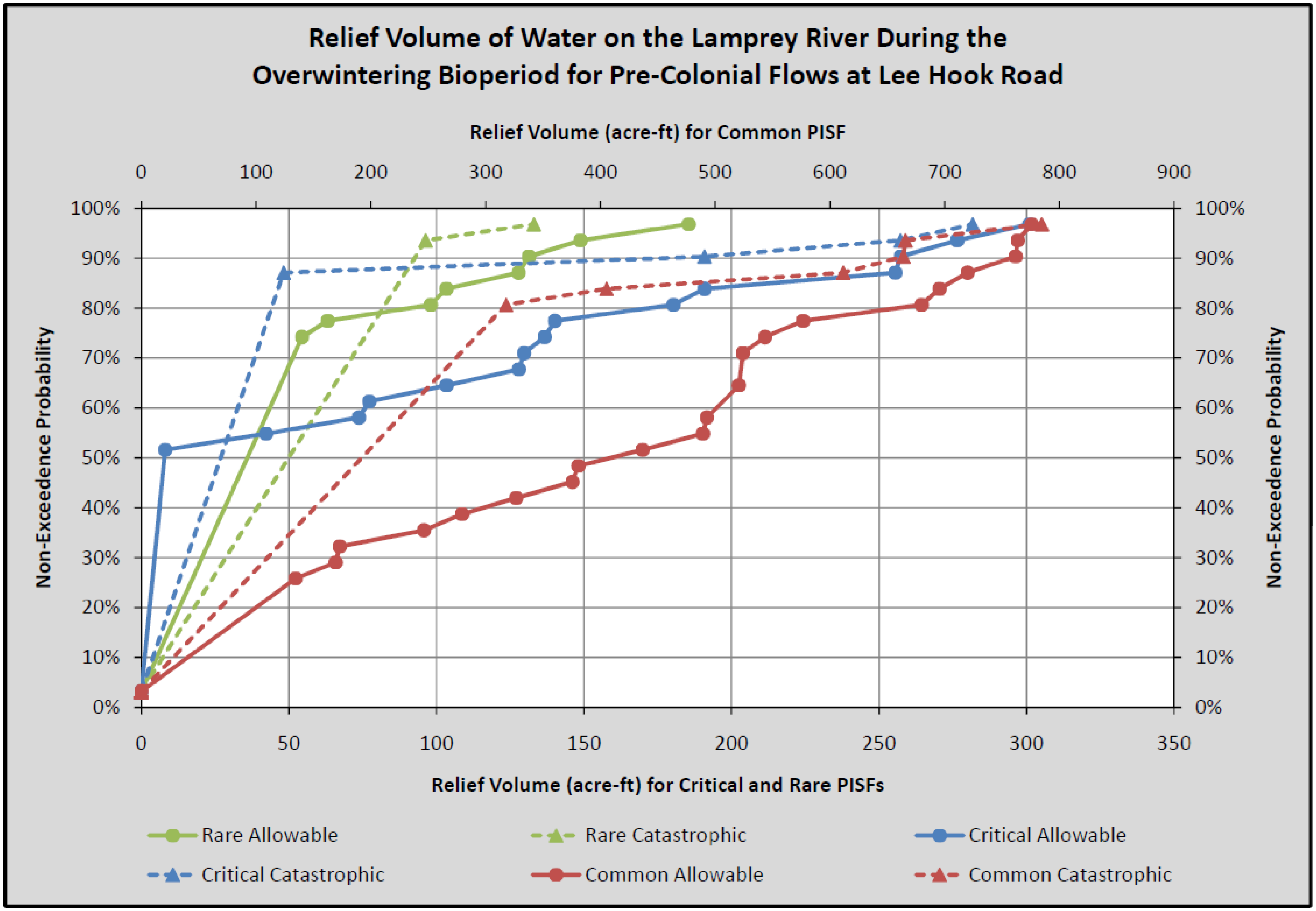


Figure F.15. Relief Water Volume During Overwintering Bioperiod For Naturalized Flows at Lee Hook Road.

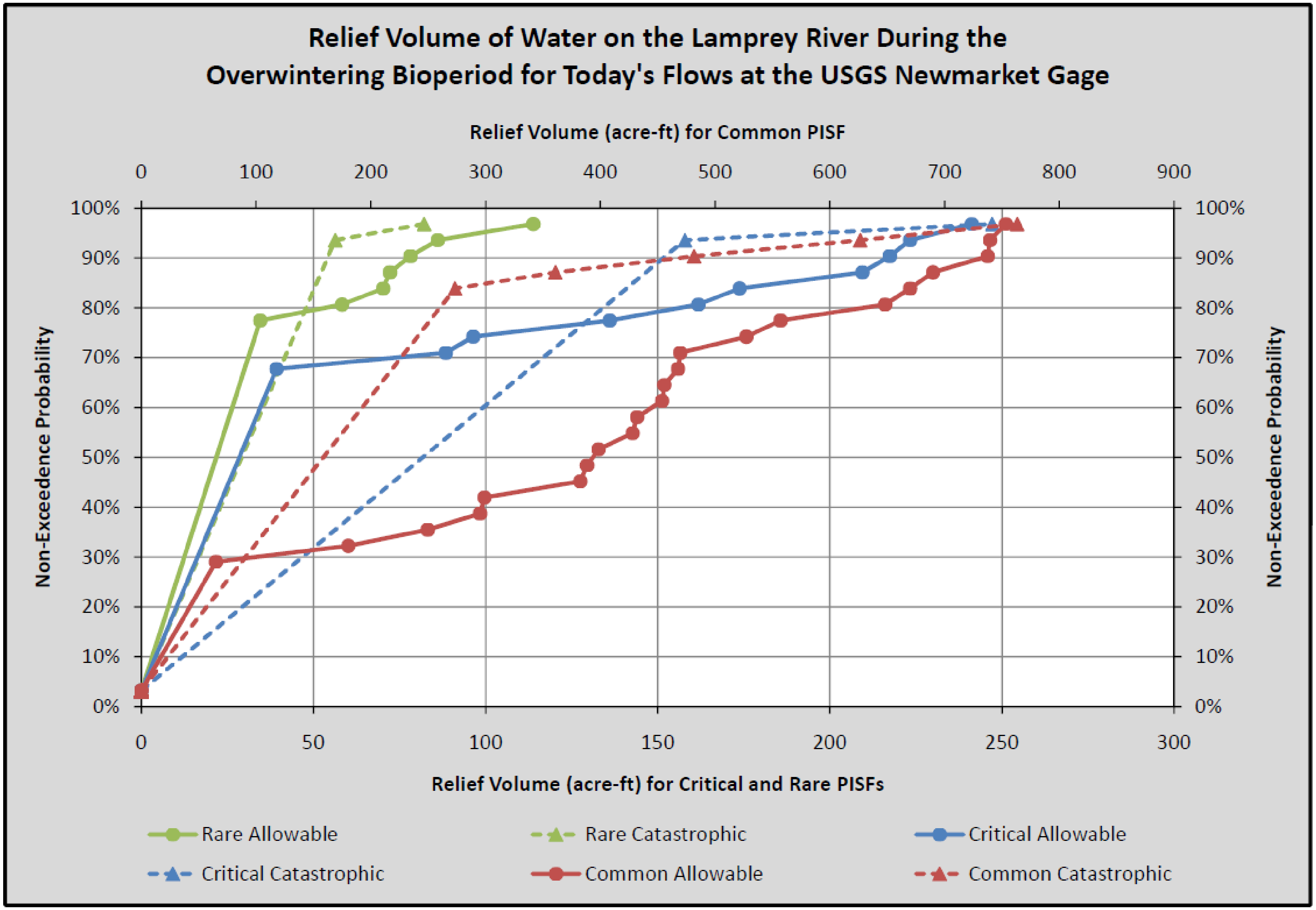


Figure F.16. Relief Water Volume During Overwintering Bioperiod For Today's Hydrology at Packers Falls.

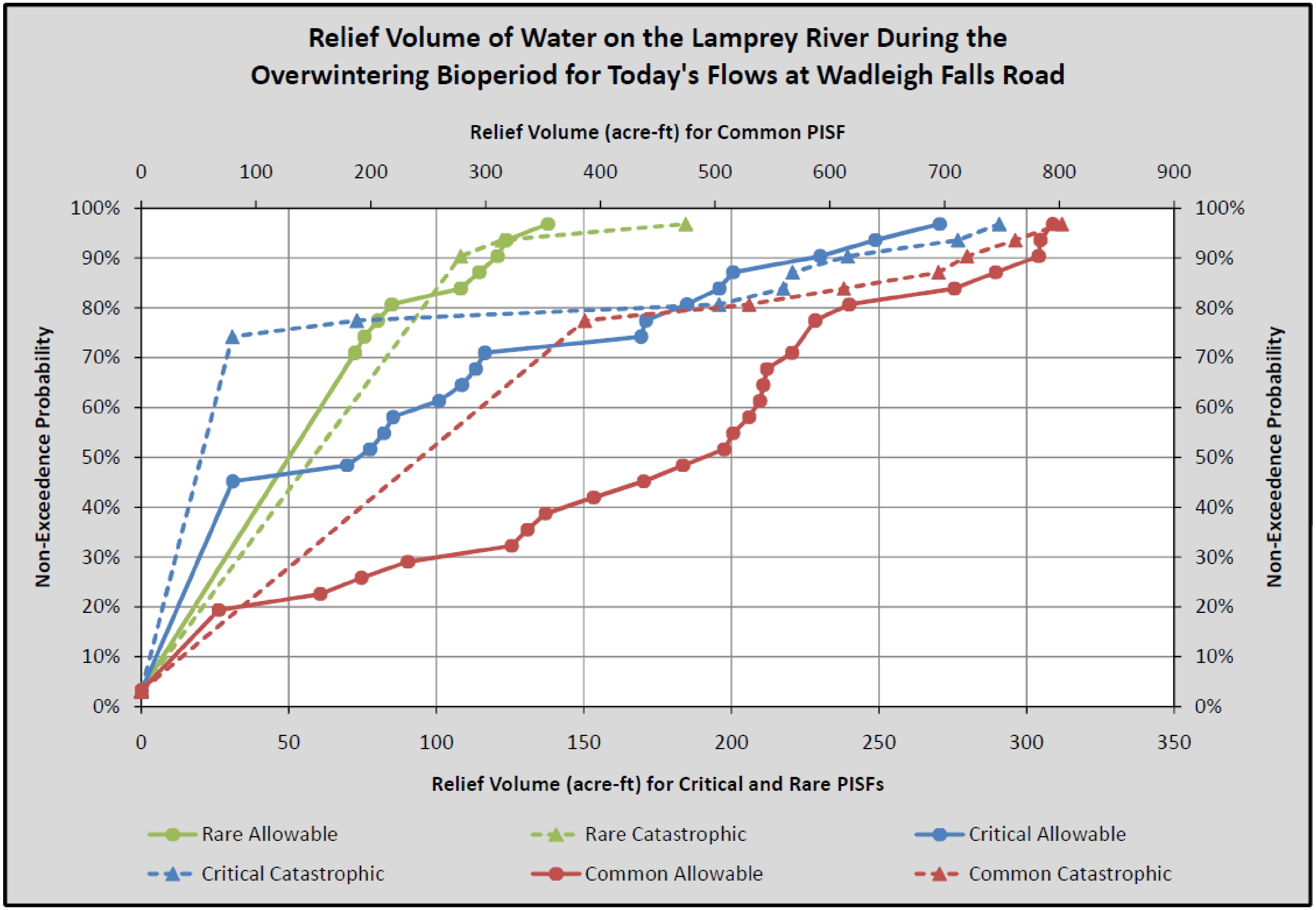


Figure F.17. Relief Water Volume During Overwintering Bioperiod For Today's Hydrology at Wadleigh Falls

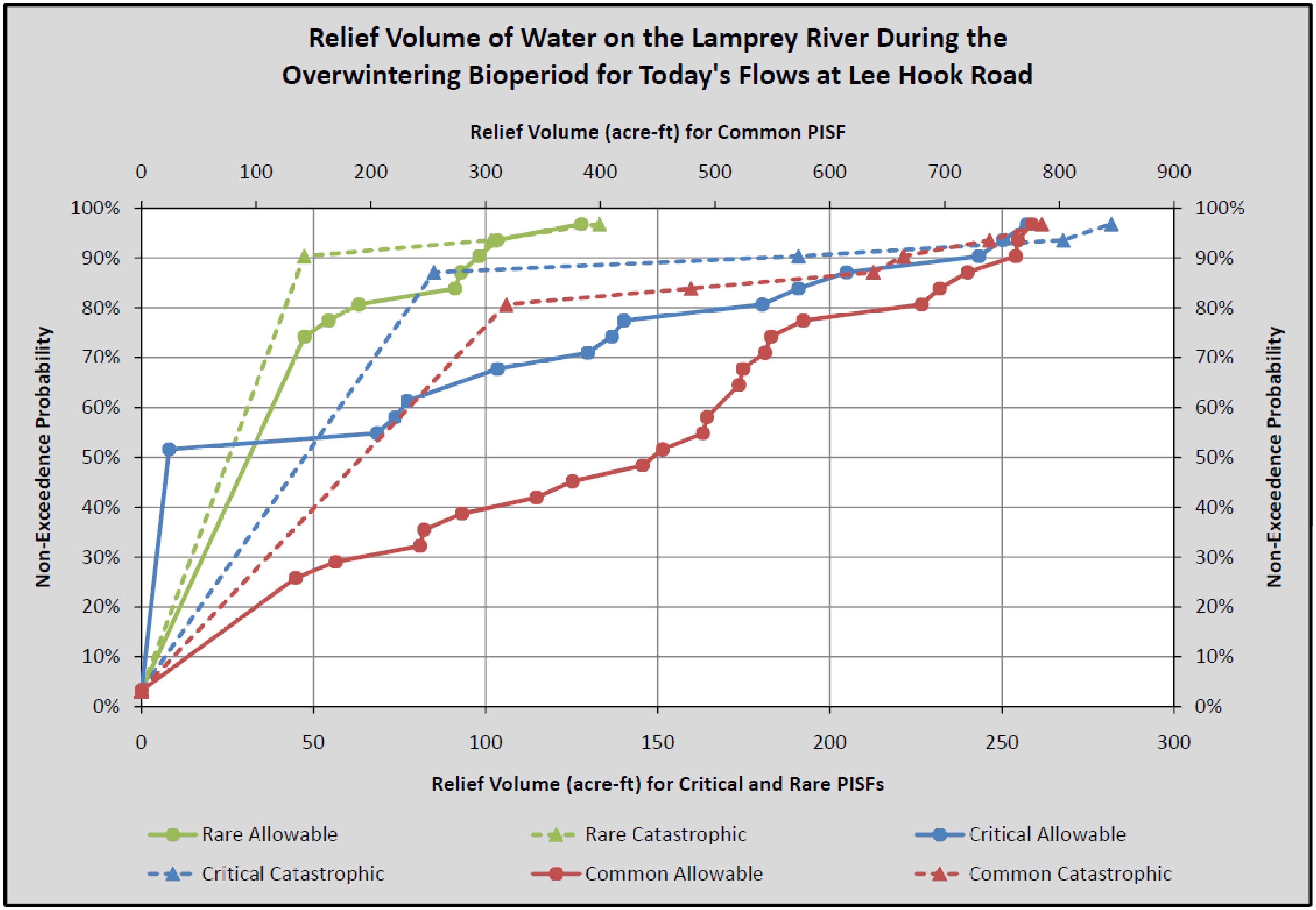


Figure F.18. Relief Water Volume During Overwintering Bioperiod For Today's Hydrology at Lee Hook Road.

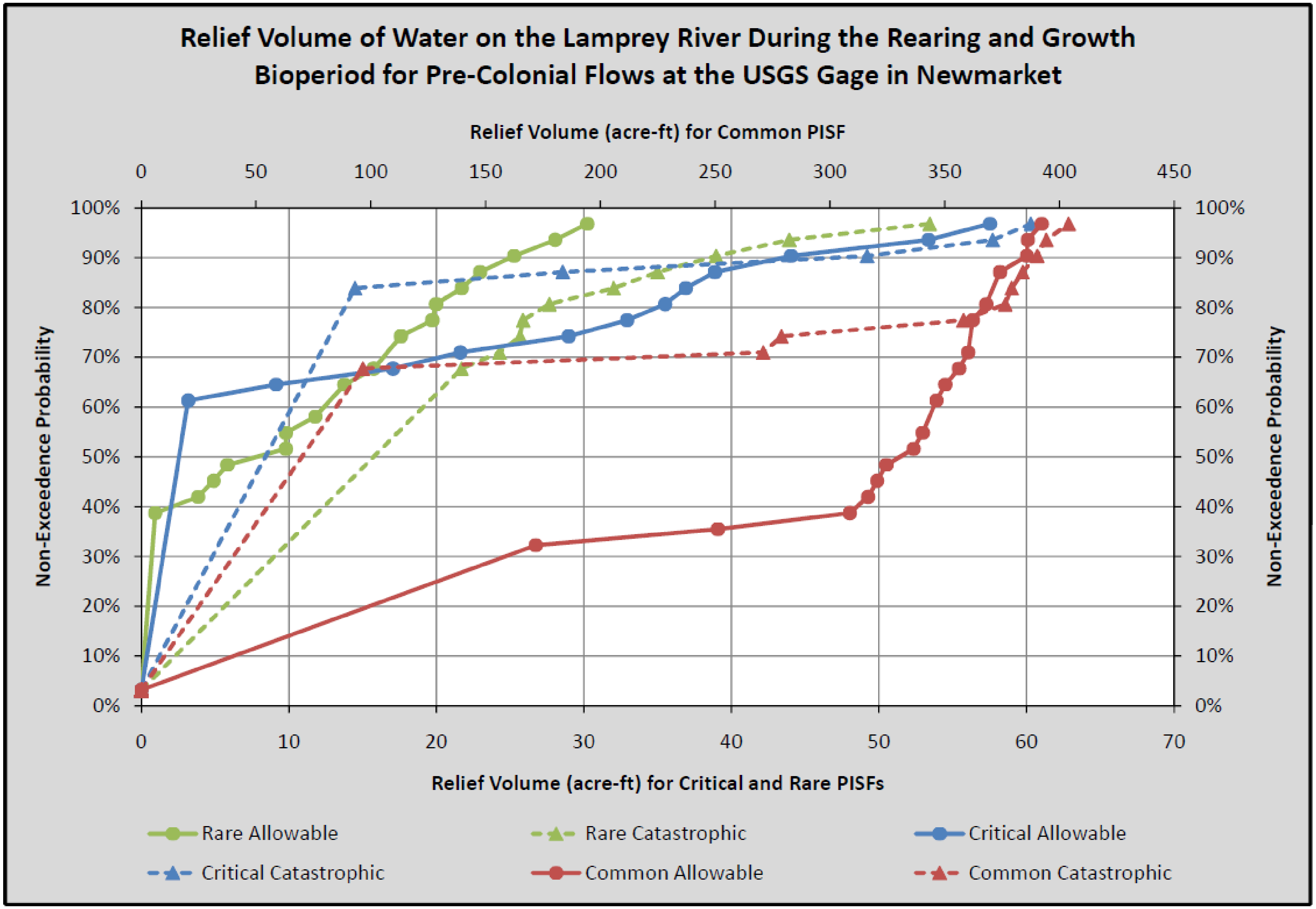


Figure F.19. Relief Water Volume During Rearing and Growth Bioperiod For Naturalized Flows at Packers Falls.

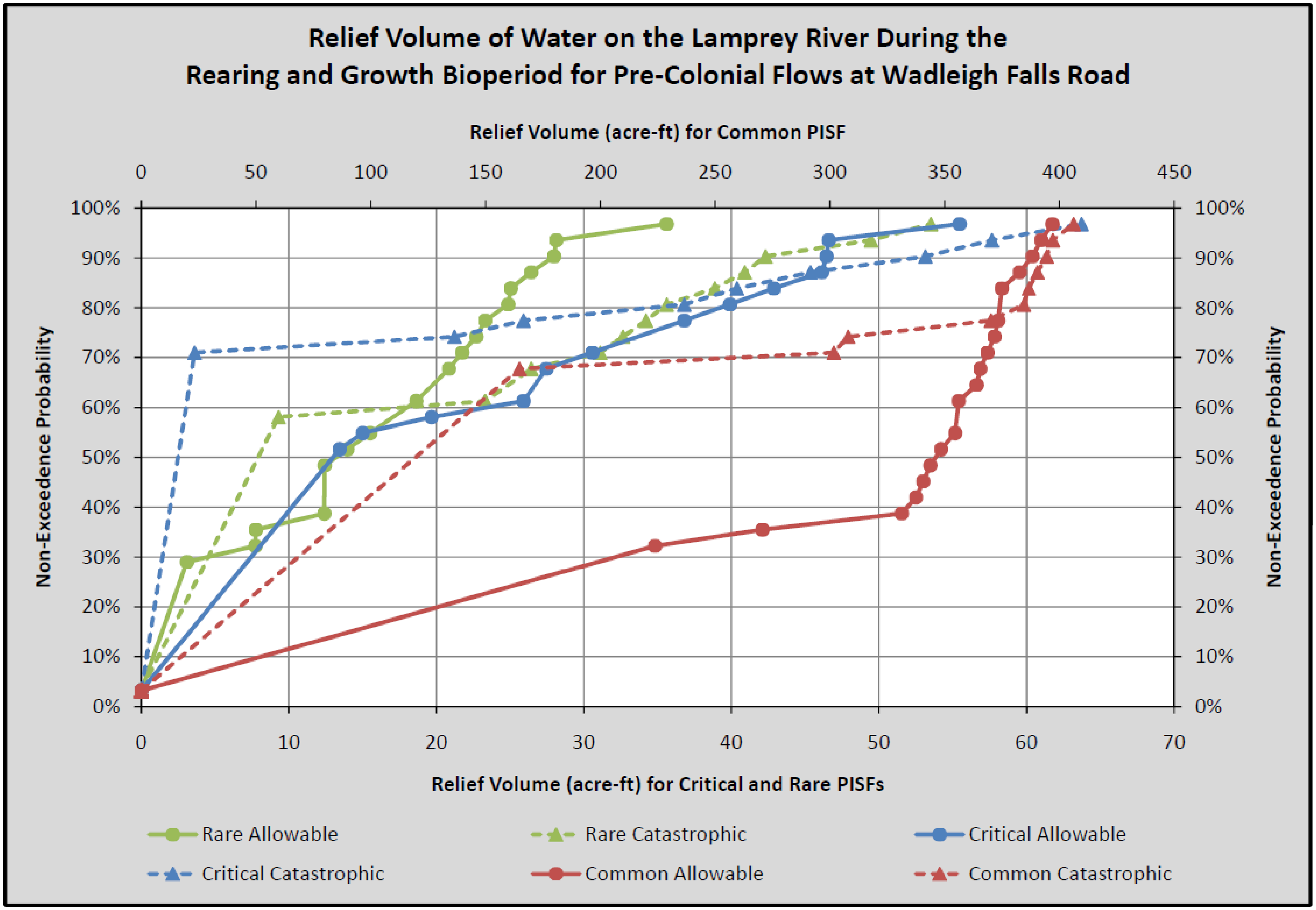


Figure F.20. Relief Water Volume During Rearing and Growth Bioperiod For Naturalized Flows at Wadleigh Falls.

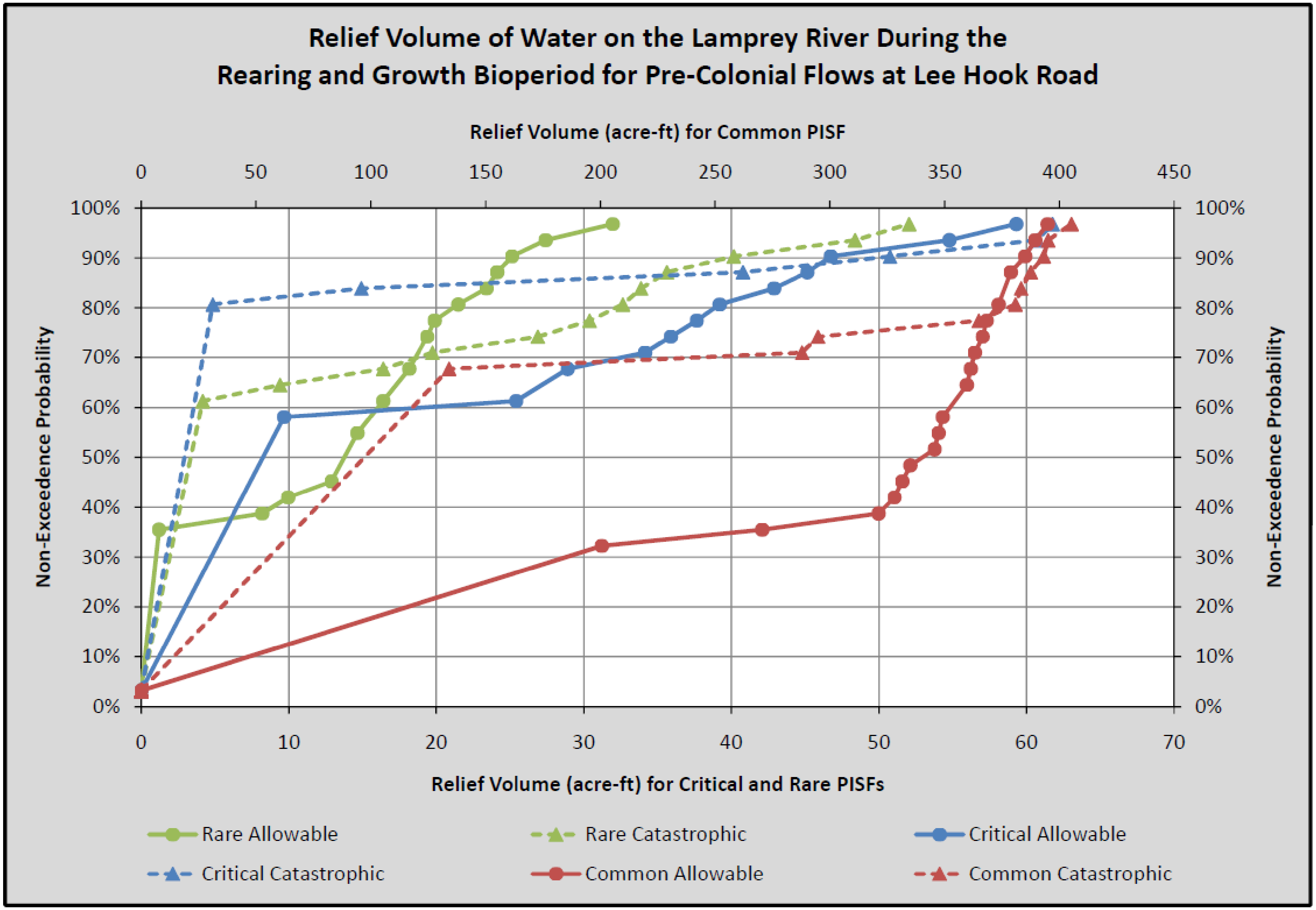


Figure F.21. Relief Water Volume During Rearing and Growth Bioperiod For Naturalized Flows at Lee Hook Road.

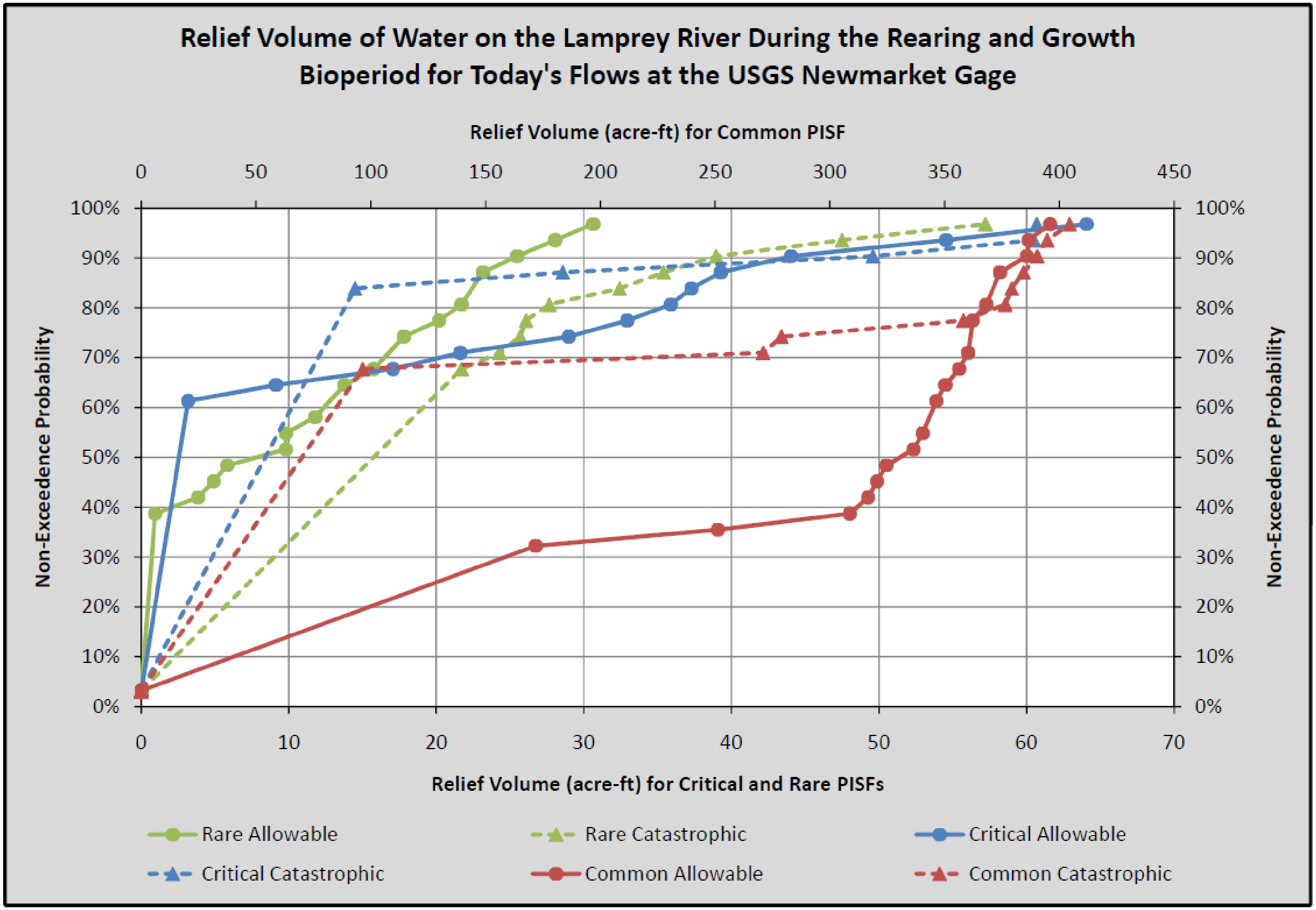


Figure F.22. Relief Water Volume During Rearing and Growth Bioperiod For Today's Hydrology at Packers Falls.

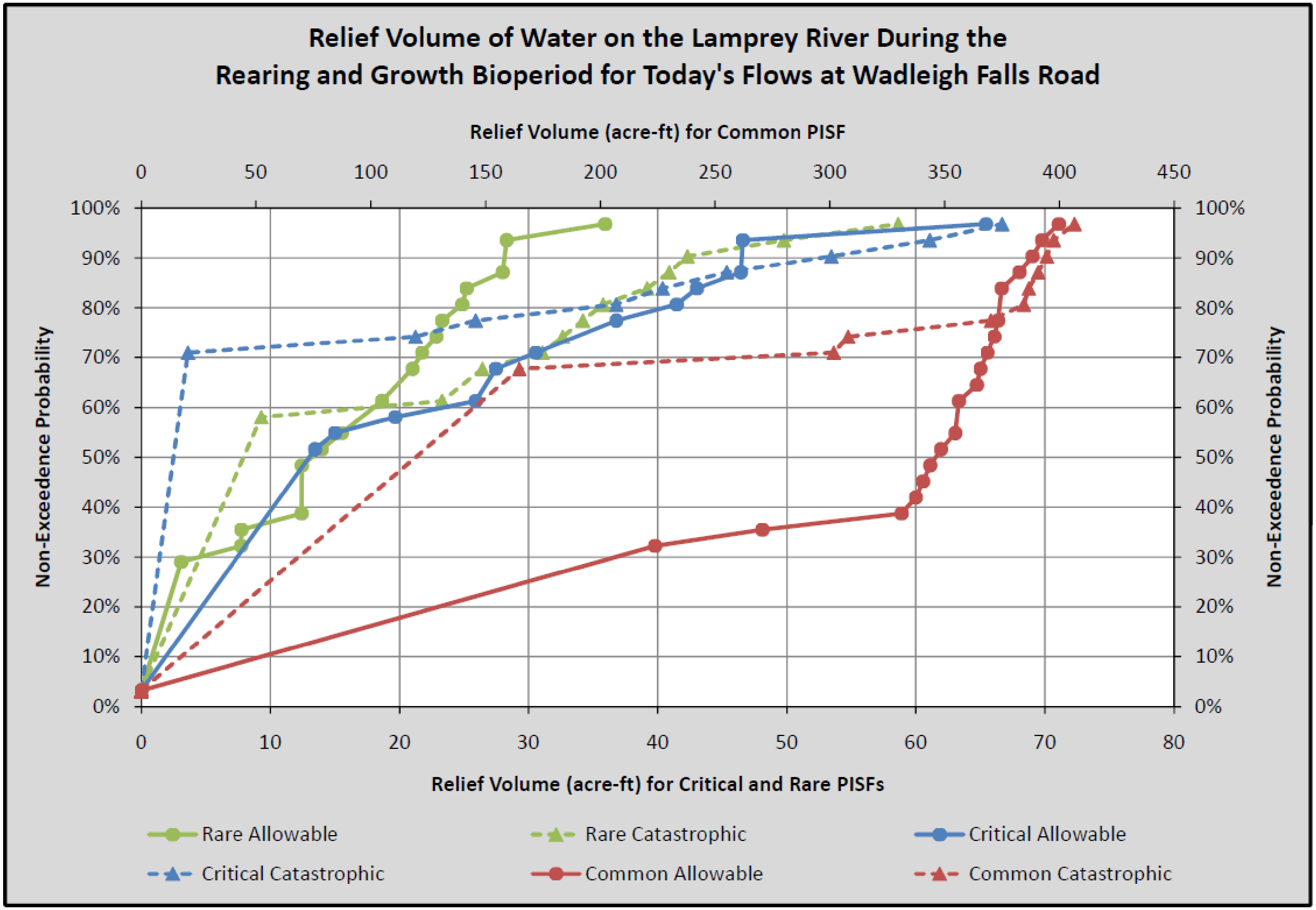


Figure F.23. Relief Water Volume During Rearing and Growth Bioperiod For Today's Hydrology at Wadleigh Falls.

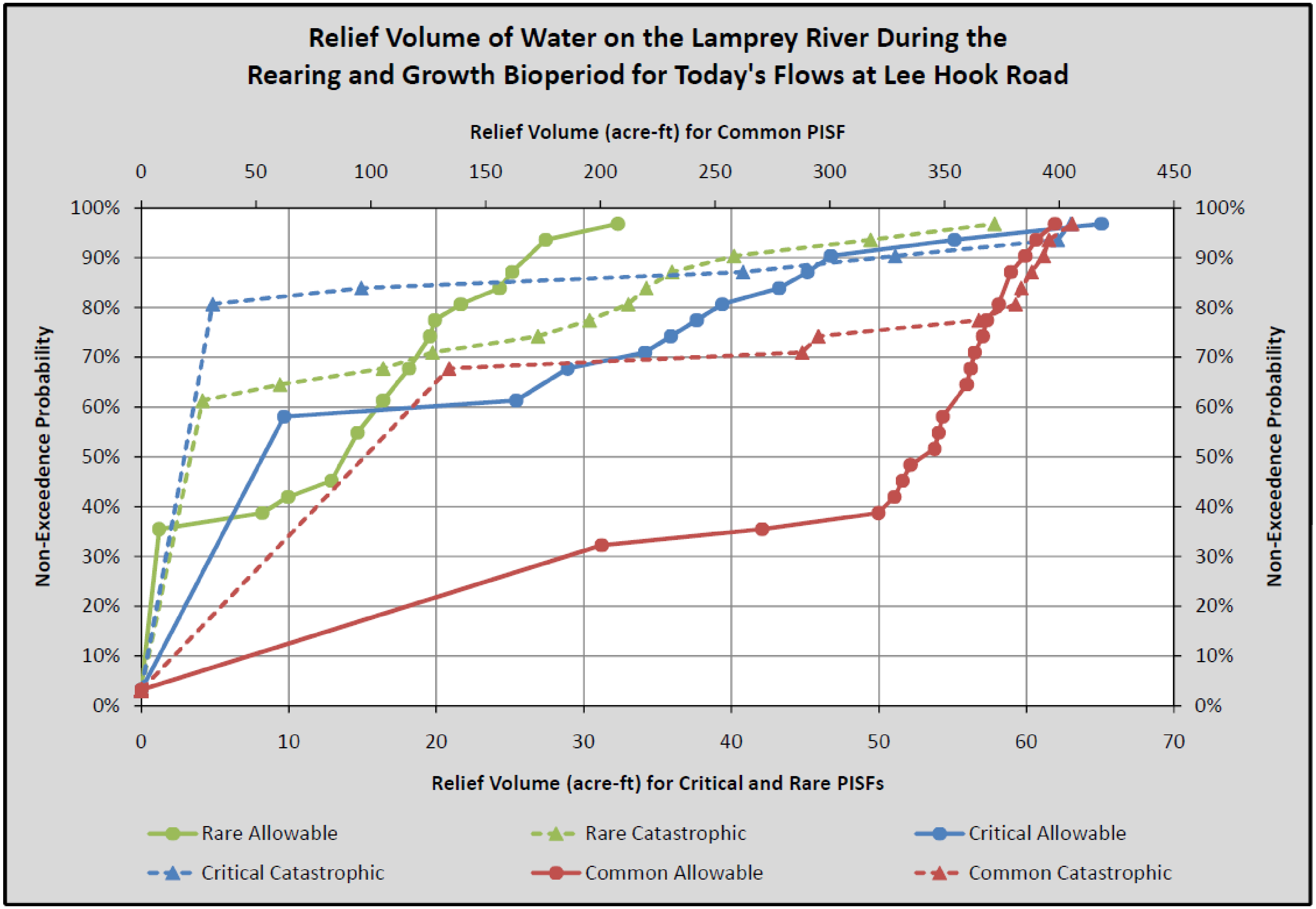


Figure F.24. Relief Water Volume During Rearing and Growth Bioperiod For Today's Hydrology at Lee Hook Road.

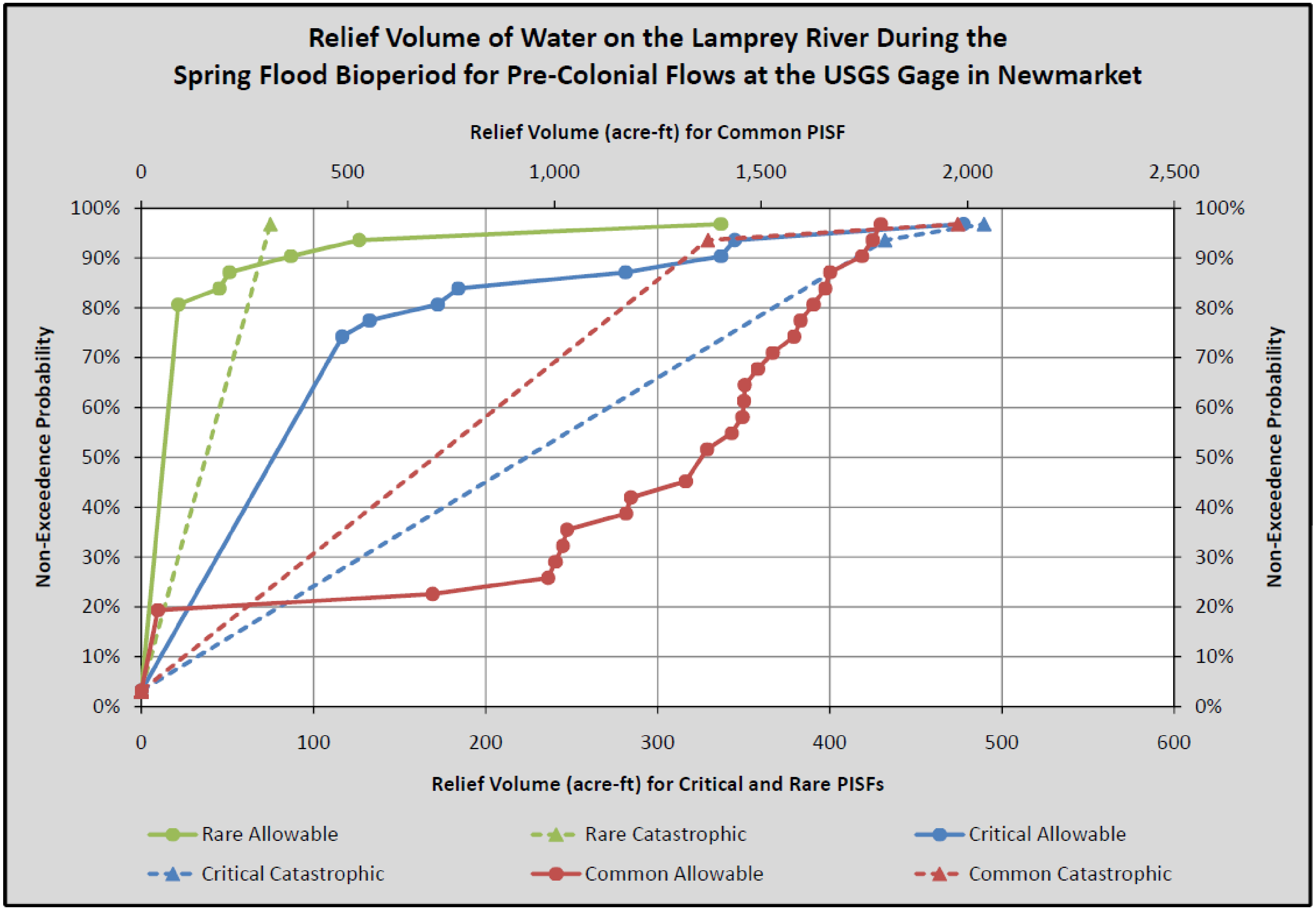


Figure F.25. Relief Water Volume During Spring Flood Bioperiod For Naturalized Flows at Packers Falls.

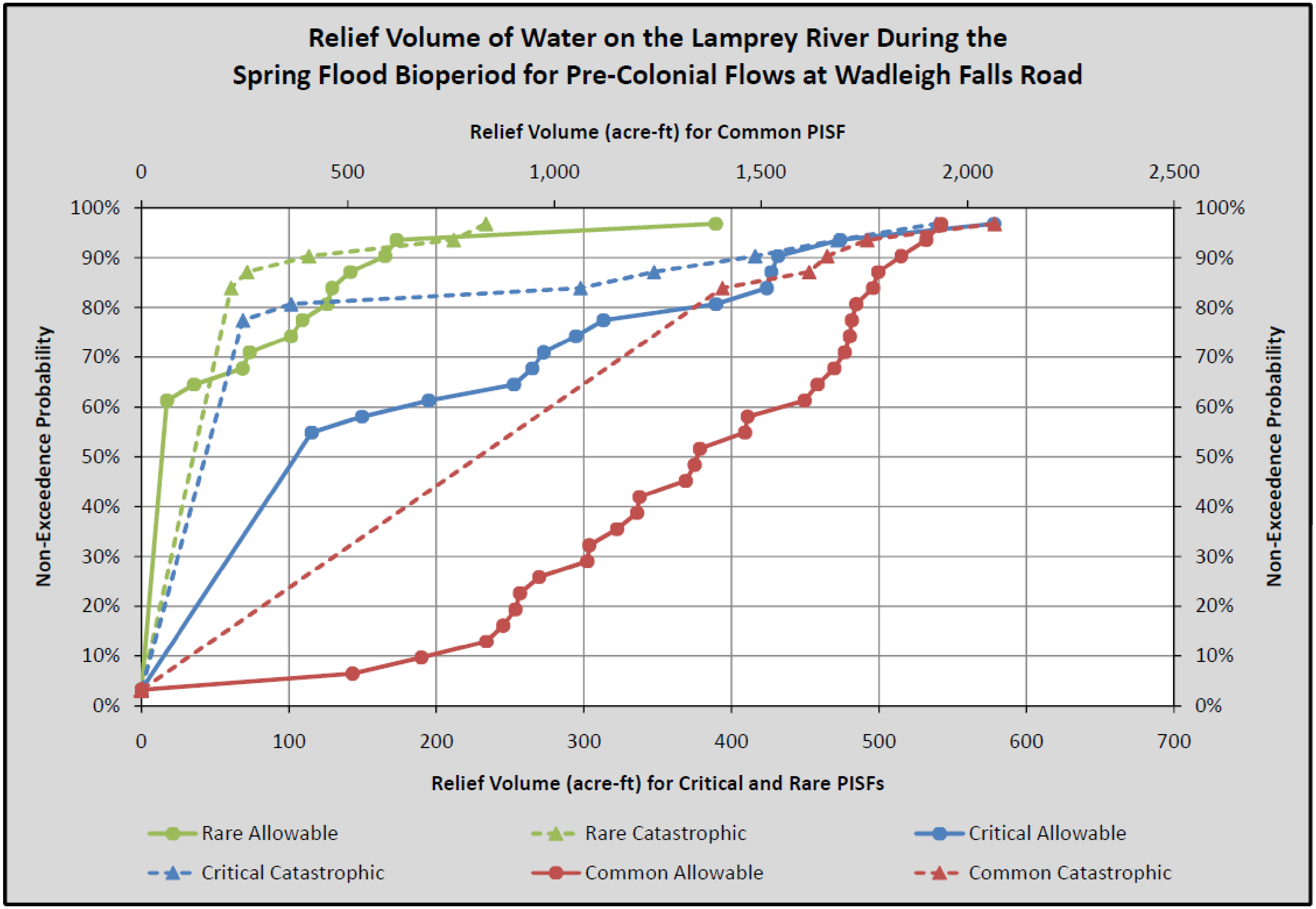


Figure F.26. Relief Water Volume During Spring Flood Bioperiod For Naturalized Flows at Wadleigh Falls.

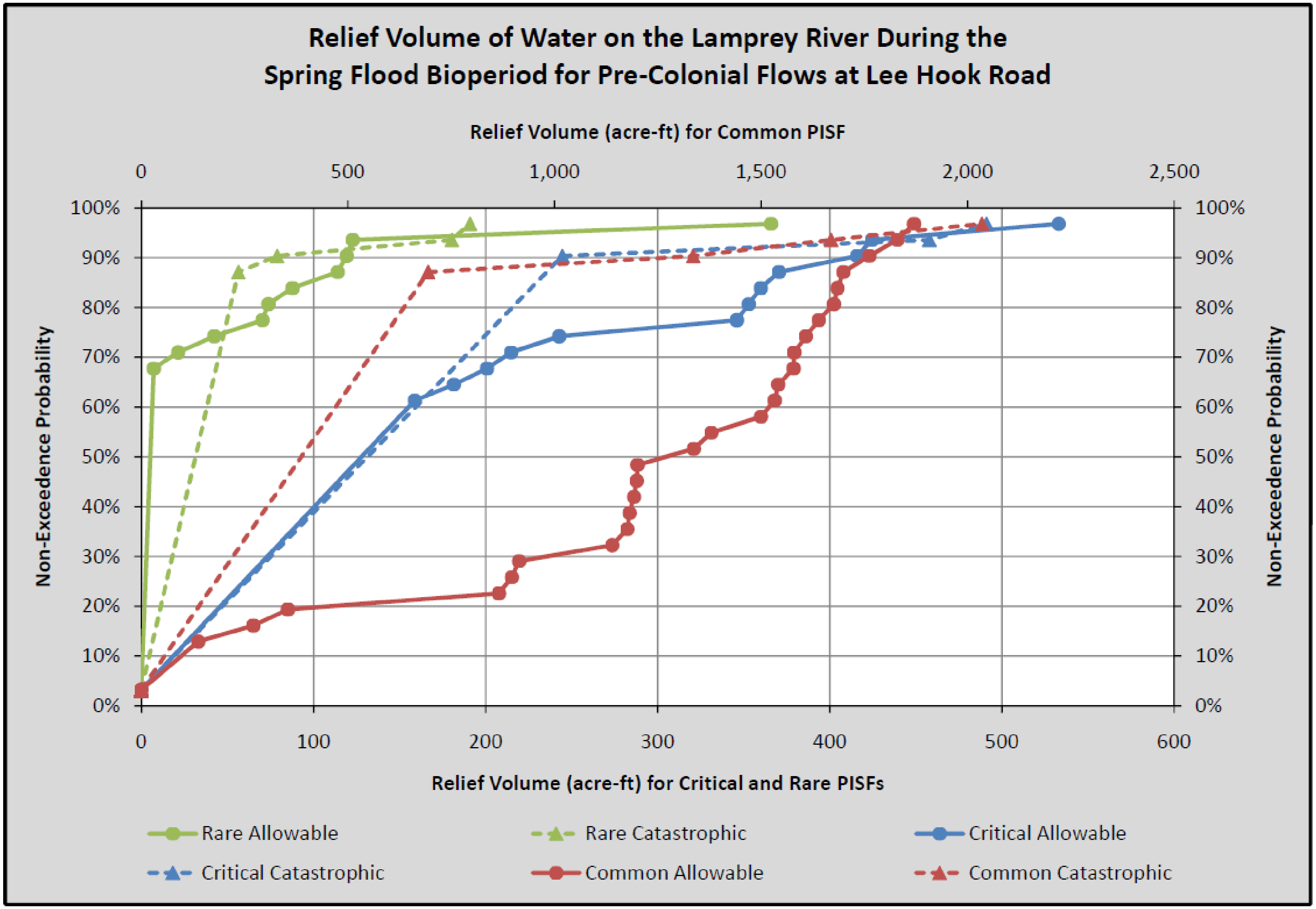


Figure F.27. Relief Water Volume During Spring Flood Bioperiod For Naturalized Flows at Lee Hook Road.

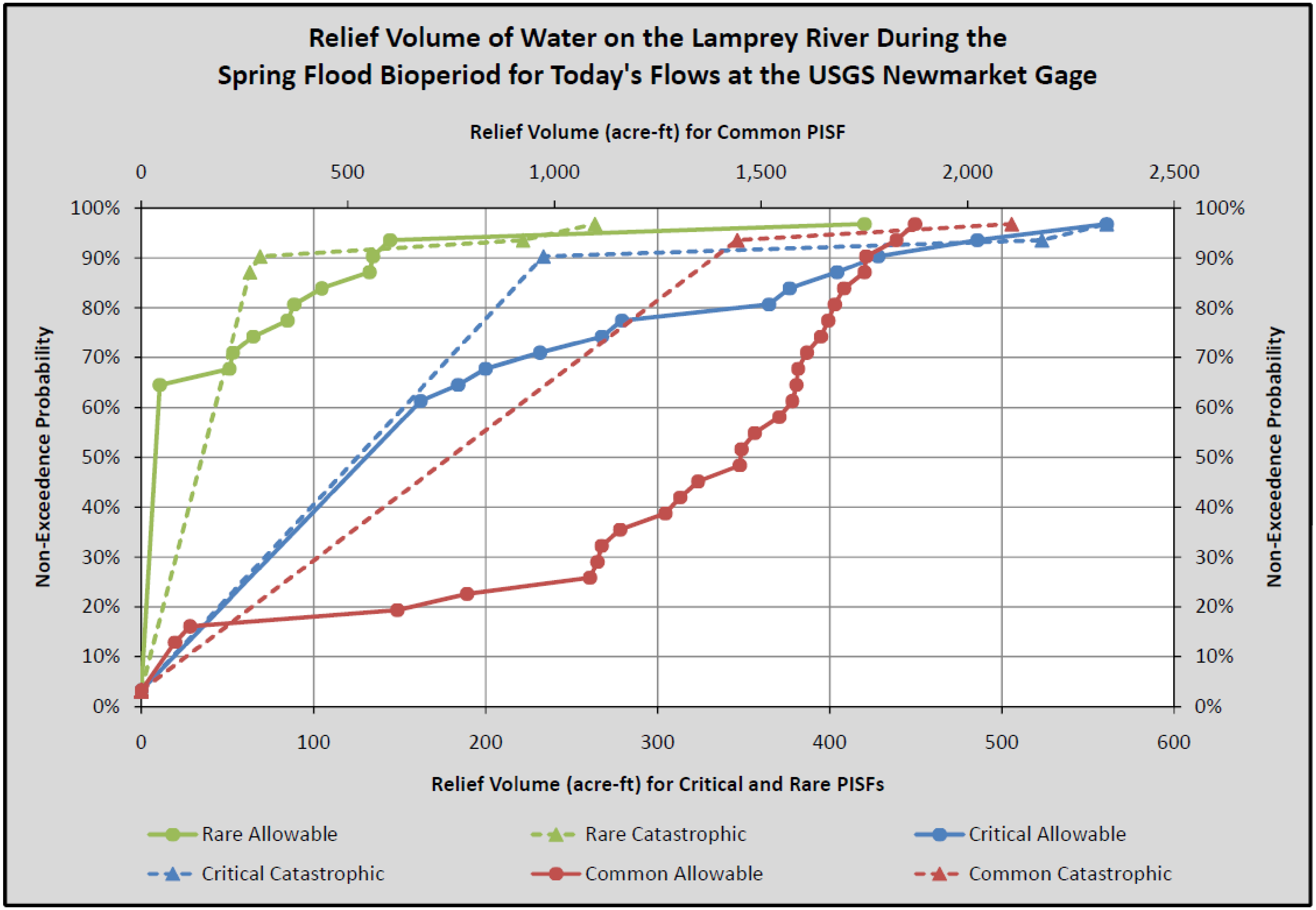


Figure F.28. Relief Water Volume During Spring Flood Bioperiod For Today's Hydrology at Packers Falls.

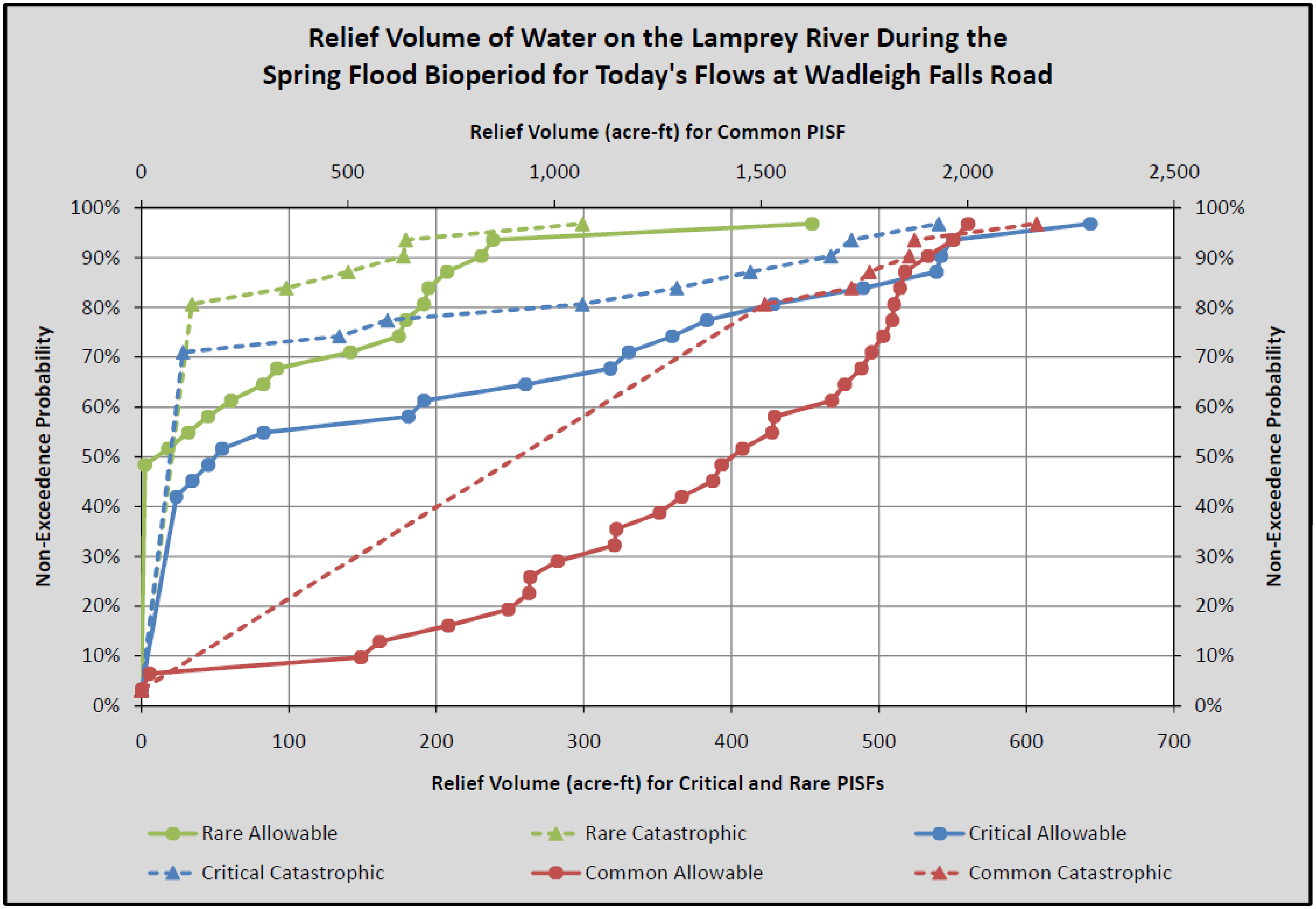


Figure F.29. Relief Water Volume During Spring Flood Bioperiod For Today's Hydrology at Wadleigh Falls

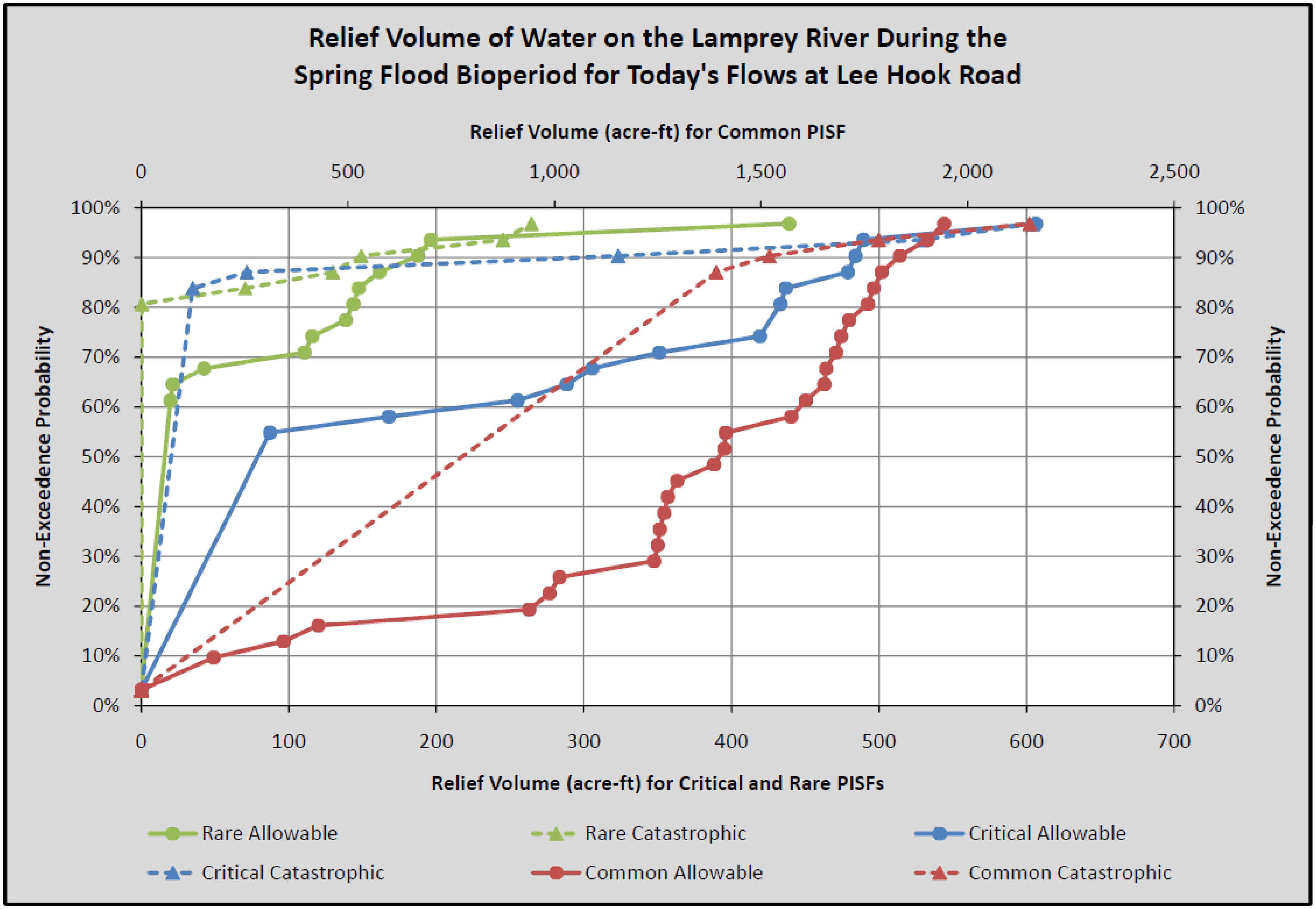


Figure F.30. Relief Water Volume During Spring Flood Bioperiod For Today's Hydrology at Lee Hook Road.

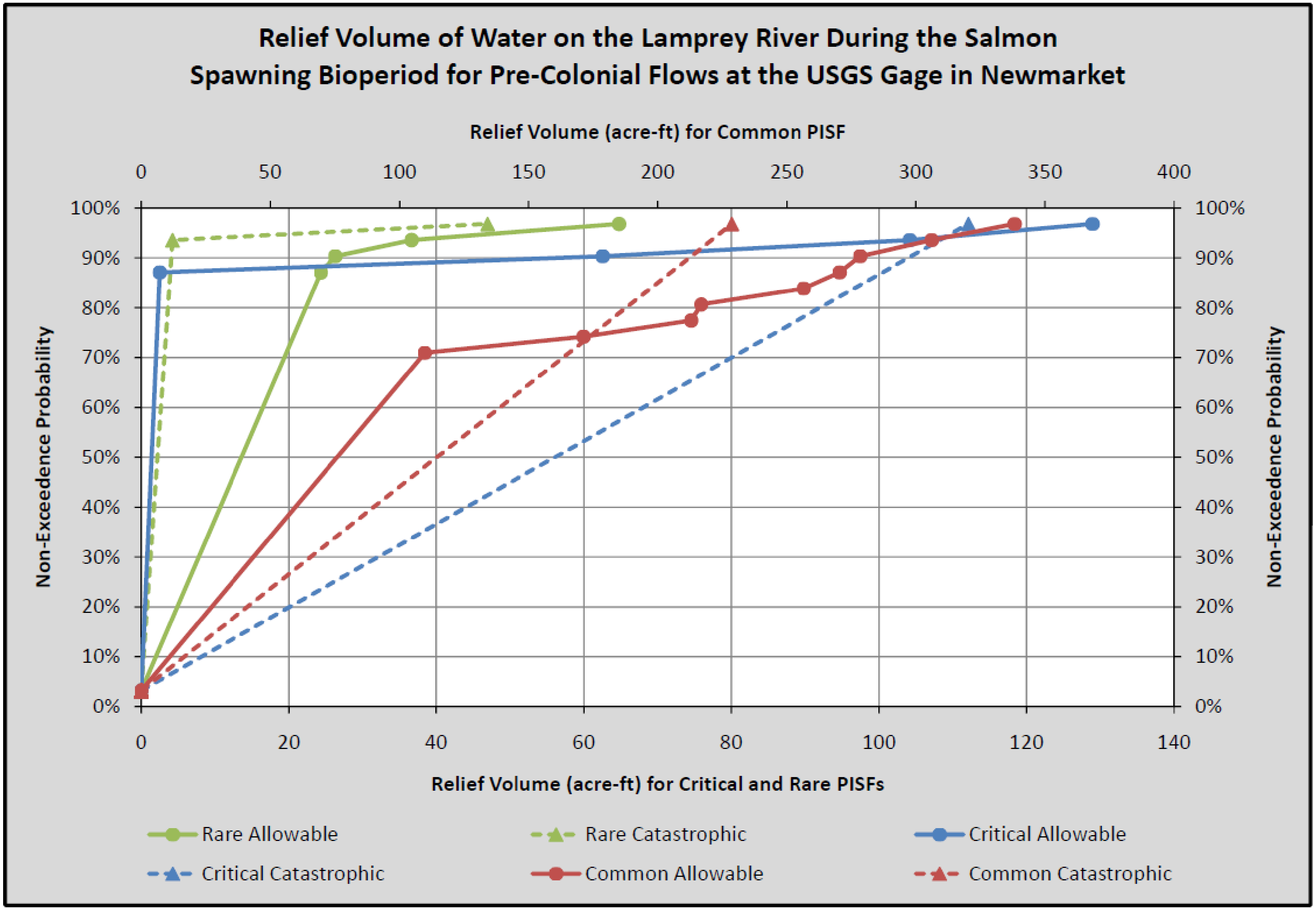


Figure F.31. Relief Water Volume During Salmon Spawning Bioperiod For Naturalized Flows at Packers Falls.

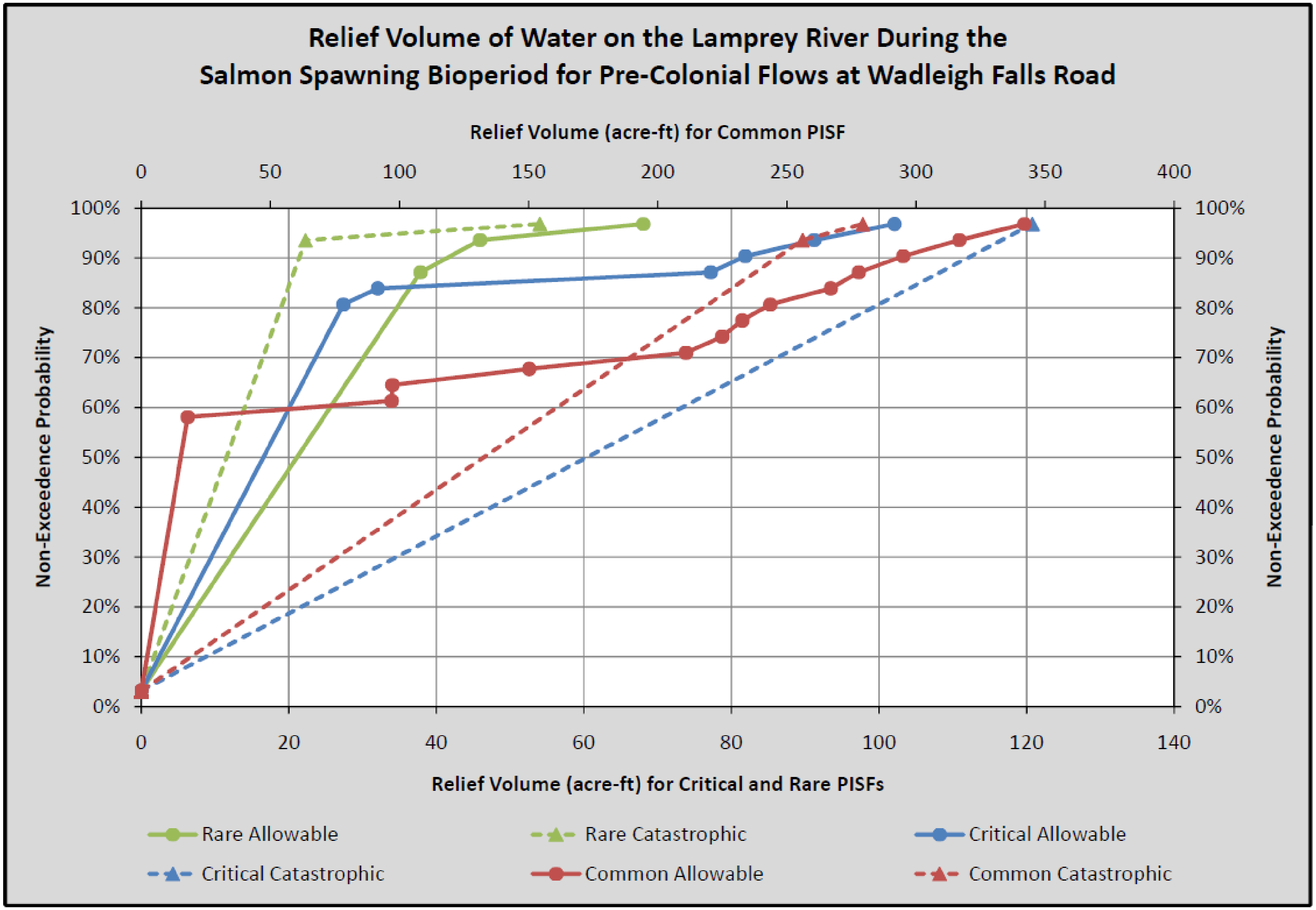


Figure F.32. Relief Water Volume During Salmon Spawning Bioperiod For Naturalized Flows at Wadleigh Falls.

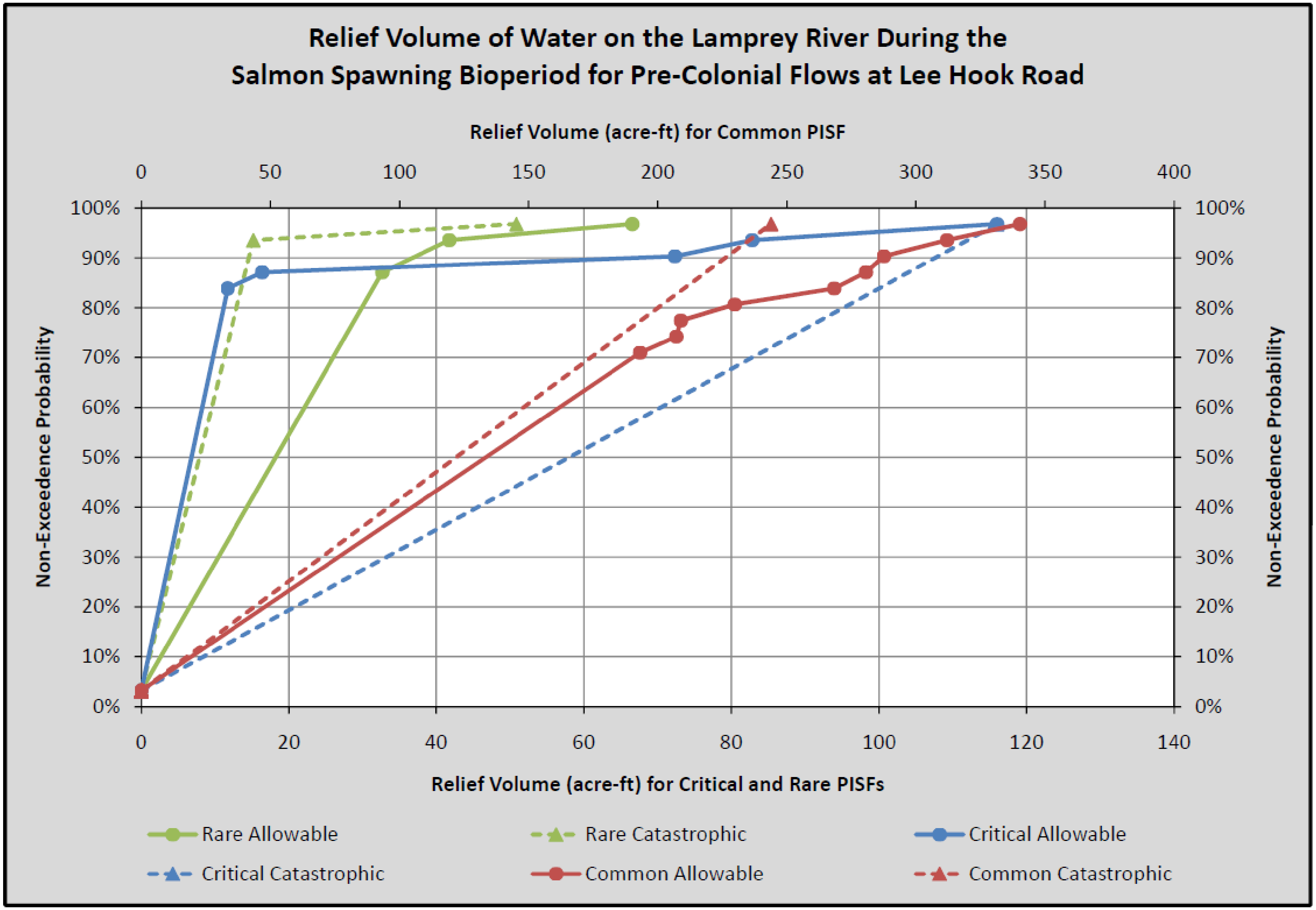


Figure F.33. Relief Water Volume During Salmon Spawning Bioperiod For Naturalized Flows at Lee Hook Road.

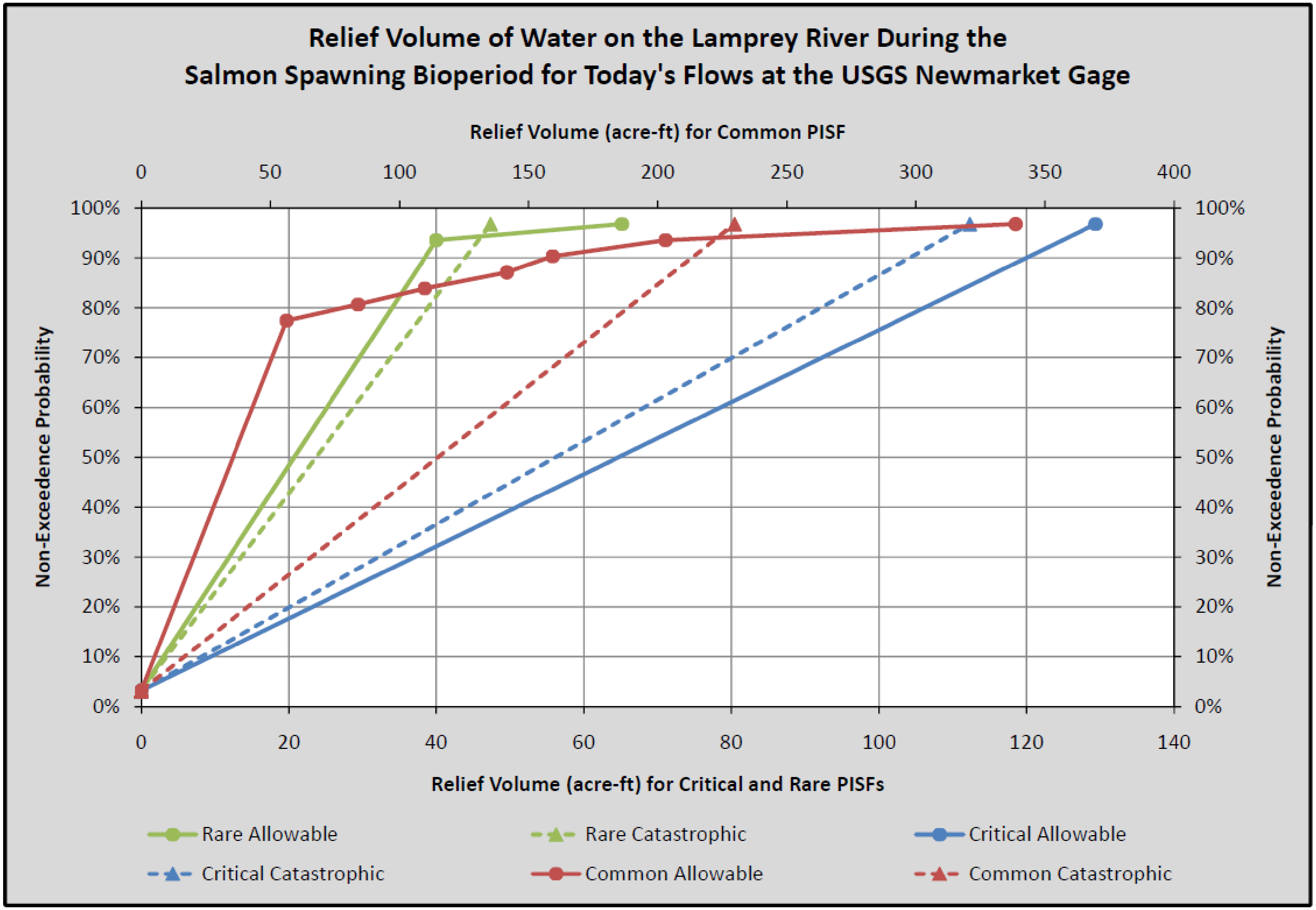


Figure F.34. Relief Water Volume During Salmon Spawning Bioperiod For Today's Hydrology at Packers Falls.

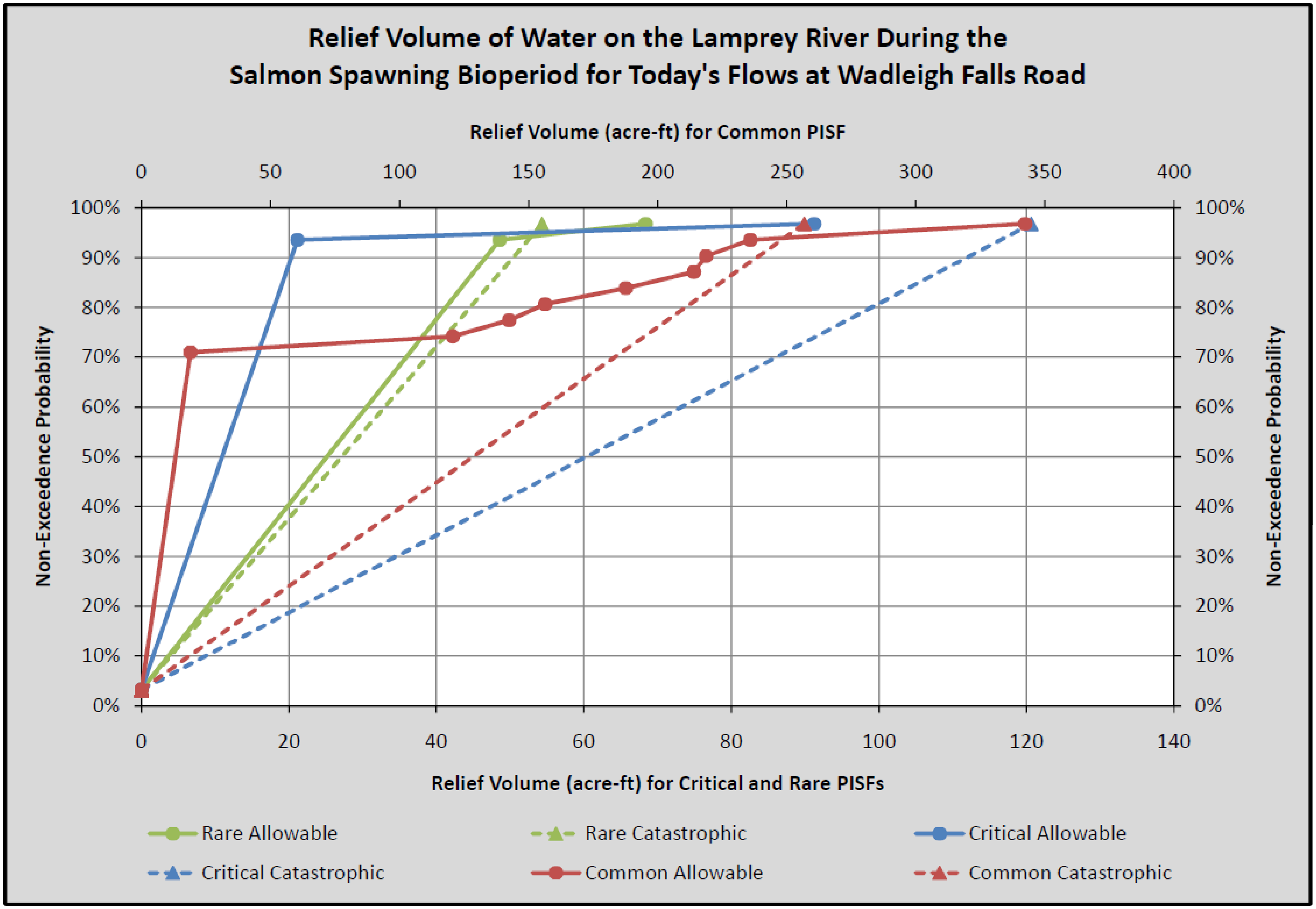


Figure F.35. Relief Water Volume During Salmon Spawning Bioperiod For Today's Hydrology at Wadleigh Falls.

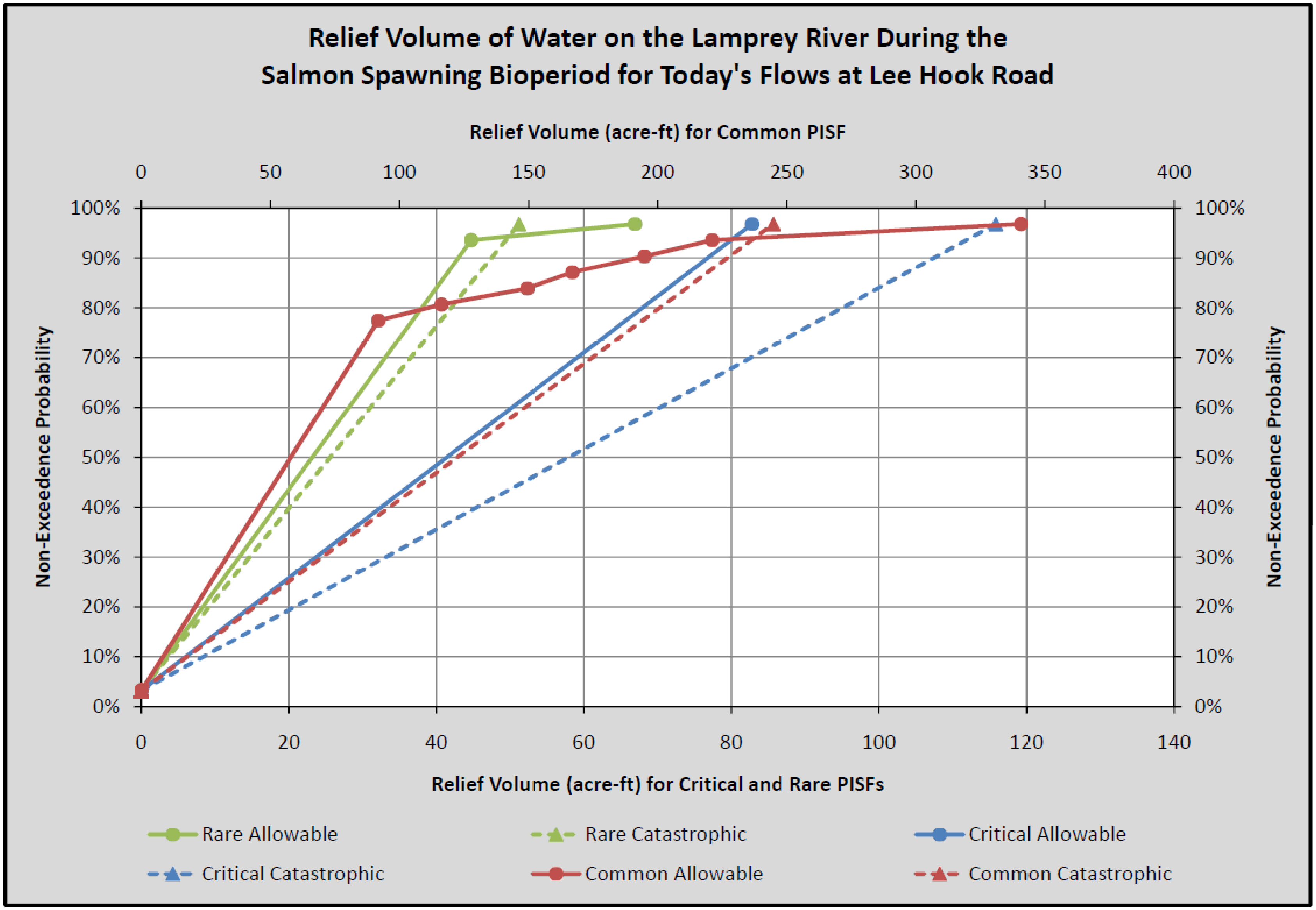


Figure F.36. Relief Water Volume During Salmon Spawning Bioperiod For Today's Hydrology at Lee Hook Road.

Appendix G

Potential Funding Sources for Affected Water Users

Lamprey River Water Management Plan

August 2013

NHDES Instream Flow Program Potential Funding Sources for Affected Water Users (as of June 2010)						
Applicable Water Users	**Funding Source**	**Funding Type**	**Amount Available for 2010**	**Application Date**	**Detail**	**Contact Information**
Agriculture	USDA, Natural Resources Conservation Services (NRCS), Conservation Stewardship Program (CSP).	Grant, no match required.	$1,000 to $40,000 annually per person/entity.	Annually	Through CSP, NRCS will provide financial and technical assistance to eligible producers **to conserve and enhance** soil, **water,** air, and related natural resources on their land on which resource concerns related to agricultural production could be addressed.	NH NRCS State Office Federal Building, 2 Madbury Road, Durham, NH 03824-2043; 603-868-7581
Agriculture	USDA, Natural Resources Conservation Services, Conservation Innovation Grant (CIG)	Grant, 50% non-federal match required.	$80,000 to $168,000 available annually in NH. Up to $75,000 per person/entity.	Annually	Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and **adoption of innovative conservation approaches and technologies** while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, Environmental Quality Incentives Program (EQIP) funds are used to award competitive grants to non-Federal governmental or non-governmental organizations, Tribes, or individuals.	NH NRCS State Office Federal Building, 2 Madbury Road, Durham, NH 03824-2043; 603-868-7581

Agriculture	USDA, Natural Resources Conservation Services, Agricultural Management Assistance (AMA)	Grant, 25% match required.	Up to $50,000 per person/entity annually.	Unknown	Agricultural Management Assistance (AMA) provides cost share assistance to agricultural producers **to voluntarily address issues such as water management, water quality**, and erosion control by incorporating conservation into their farming operations. **Producers may construct or improve water management structures or irrigation structures**; plant trees for windbreaks or improve water quality; and mitigate risk through production diversification or resource conservation practices, including soil erosion control, integrated pest management, or transition to organic farming.	NH NRCS State Office Federal Building, 2 Madbury Road, Durham, NH 03824-2043; 603-868-7581
Varied	NH Dept. of Environmental Services (DES), Watershed Assistance Section, Nonpoint Source Local Initiatives Grants (Section 319 Grants)	Grant, 40% non-federal match required		Annually	For watershed management efforts. Grants given to associations, organizations, agencies.	Eric Williams, 29 Hazen Drive, Concord, NH 03301, (603) 271-2358, eric.williams@des.nh.gov

Varied	NH Dept. of Environmental Services (DES), Watershed Assistance Section, Watershed Restoration Grants (Section 319 Restoration Grants)	Grant, 40% non-federal match required		Annually	Grants can be given to farmers, watershed associations, conservation districts, non-profit organizations, regional planning agencies, and municipalities to implement practices that help restore impaired waters.	Eric Williams, 29 Hazen Drive, Concord, NH 03301, (603) 271-2358, eric.williams@des.nh.gov
Water Suppliers	NH Dept. of Environmental Services (DES), Drinking Water & Groundwater Bureau, Local Source Water Protection Grants (Drinking Water Source Protection)	Grant. No match is required, but projects receive higher ranking for local match funds.	Up to $20,000 per project.	Annually	To protect public drinking water sources. Water suppliers, municipalities, conservation districts, and non-profits can apply.	Johanna McKenna 29 Hazen Drive, Concord, NH 03301, (603) 271-7017, johanna.mckenna@des.nh.gov
Varied	NH State Conservation Committee, Moose Plate Conservation Grants	Grant. Two tiers of under $5,000 and over $5,000 projects.	$200,000 available in 2009. Varies based on Moose Plate sales and	Annually	Conservation Grants shall be made available for planning and carrying out projects that enhance New Hampshire's environment by promoting the sustainability of the state's public and private land, air, and water resources to prevent their pollution or	Dea Brickner-Wood, Grants Administrator, at 603.868.6112 or via email at bluesky24@com

		No match required, but encouraged.	renewals		degradation	cast.net
Varied	NH Dept. of Environmental Services, Lakes and Rivers Programs, Water Quality Planning Grants (604b Grants)	Grant. No match is required.	Up to $80,000 available annually. Projects usually only awarded up to $20,000 per Regional Planning Commission.	Annually	These grants are available to Regional Planning Commissions and/or the Connecticut River Joint Commissions for water quality planning purposes. Funding priority is given to projects developing and implementing river corridor/ river watershed plans.	Laura Weit-Marcum 29 Hazen Drive, Concord, NH 0330, 603-271-8811, laura.weit-marcum@des.nh.gov
Recreation	NH Dept. of Resources and Economic Development (DRED), Land and Water Conservation Fund Program	Grant, 50% non-federal match required	Unknown	Annually	The Land and Water Conservation Fund (LWCF) was enacted to create and maintain a nationwide legacy of high quality, outdoor recreation areas and facilities. Emphasis for awarding LWCF grants is placed on projects with the greatest possible impact – projects that: cover a broad geographic scope, include service to special needs populations, increase recreational areas and facilities, protect critical natural or cultural resources, and provide access to water-based, public recreation opportunities.	Gail Wolek, DRED - Division of Parks and Recreation, PO Box 1856, Concord, NH 03302-1856, 603-271-3556

Public Water Systems	NH Dept. of Environmental Services, Drinking Water and Groundwater Bureau, Record Drawing Grant Program	Grant, 50% match required.	Up to $1,500 per water system	Annually	The New Hampshire Department of Environmental Services (DES) is pleased to announce the Public Water System Record Drawing Grant program. This grant is intended to assist small community water systems prepare or update your record drawings (a.k.a. as builts), to accurately reflect the location of critical system infrastructure, especially underground facilities.	Susan Willoughby, 29 Hazen Drive, Concord, NH 03301, 603-271-5447, susan.willoughby@des.nh.gov
Public Water Systems	NH Dept. of Environmental Services, Drinking Water and Groundwater Bureau, Capacity Assurance Program-Regional Water System Grant	Grant, 75% match required	Unknown	Annually	This grant program provides 25 percent reimbursement of costs for planning, design and construction of piping, pumping, and source improvements associated with interconnection of two or more public water systems.	
Varied	NH Land and Community Heritage Investment Program (LCHIP)	Grant, 50% match required.	None for 2010. Funds availability varies annually based on state budget allocation.	None	Eligible applicants may apply for grant funds for the protection of natural resources, including riverine, lakes, farmland, and existing a potential water supply land for resource inventories and planning that can demonstrate linkage to the permanent protection of eligible resources;	

Varied	USDA, Natural Resources Conservation Service, Watershed Surveys and Planning Program	Unknown	None for 2010.	None	This appropriation supports and benefits the NRCS Mission Goal of Clean and Abundant Water in two ways. First, the funds help improve and maintain surface waters and ground water to protect human health, support a healthy environment, and encourage a productive landscape. Second, the program funds help conserve and protect water to ensure a reliable water supply for the Nation.	NH NRCS State Office Federal Building, 2 Madbury Road, Durham, NH 03824-2043; 603-868-7581
Water Suppliers	NH Dept. of Environmental Services, Drinking Water and Groundwater Bureau, Drinking Water State Revolving Fund	Loan	Approximately $9 million available annually with 1-3% interest rates between 5-20 year periods.		The Drinking Water State Revolving Fund (DWSRF) was created to provide assistance in the form of low interest loans to public water systems to finance the cost of drinking water infrastructure. Public water systems eligible for this program include all community public water systems and non-transient non-profit public water systems. In addition, funds are used to promote proactive drinking water measures such as source water protection, operator certification, small system technical assistance/capacity development, and program administration.	Dave Kelly, 29 Hazen Drive, Concord, NH 03301, 603-271-2472, david.kelly@des.nh.gov
Snowmaking Operations	National Ski Area Association (NSAA), Sustainable Slopes Grant	Grant	Up to $20,000 for 2-3 projects demonstrating merit and financial need.	Annually	The Environmental Charter, commonly known as Sustainable Slopes, was adopted in June 2000 and revised in 2006 as a collection of environmental best practices for ski area owners and operators (visit www.nsaa.org for information on the Environmental Charter). The purpose of the new Sustainability Grant Program is to spark innovation and increase resorts’	THE BRENDLE GROUP, INC. (970) 207-0058/FAX (970) 207-0059 226 S. Remington St., #3 Fort Collins, CO

					progress in implementing the Environmental Principles of the Charter. Projects under this grant include water use for snowmaking and water quality management activities.	80524 jdorsey@brendlegroup.com http://www.nsaa.org/nsaa/environment
Varied	NH Dept. of Environmental Services, Wetlands Bureau, Aquatic Resources Mitigation Program	Grant. No match required, but encouraged.	Varies based on in-lieu fees collected by watershed.	Varied by Watershed.	The DES Aquatic Resource Mitigation (ARM) Fund provides an in-lieu fee payment alternative for permit applicants to consider when striving to meet state and federal wetland mitigation requirements. Grants are offered for activities that restore or protect aquatic resources, including but not limited to the following: 1) Development of final wetland restoration, enhancement, or creation plans. 2) Construction costs for wetland restoration, enhancement, or creation such as site clearing and excavation, construction management, consulting fees, permit costs, wetland grading and soil augmentation, disposal costs of excavated materials, planting, and monitoring and maintenance of wetland restoration or creation sites to reduce risk of failure. 3) Acquisition of land or conservation easements that help protect high conservation value wetlands in perpetuity and associated costs including property surveys, appraisals, legal costs, closing costs, and subdivision fees.	Lori Sommer, Wetlands Bureau PO Box 95 Concord, NH 03302-0095(603) 271-4059 or lori.sommer@des.nh.gov.

					4) Acquisition of conservation interests after a qualified grantee has been identified. 5) Stewardship of a conservation interest. 6) Other aquatic resource improvement or protection projects, such as water quality improvement projects, tidal wetland restoration projects, dam removal projects, stream or river restoration projects, or activities that provide habitat improvement including culvert replacement or removal.	

Appendix H

Relief Pulse Routed Through Wiswall Reservoir and Stop Log Operation

Lamprey River Water Management Plan

August 2013

Relief Pulse Routed Through Wiswall Reservoir and Stop Log Operation

The Wiswall Reservoir storage-outflow-stage relationship as well as the Wiswall Dam outflow rating curve for the new stop log spillway were supplied by the Town of Durham. To study the potential operation during a relief pulse, the Lamprey River flow was assumed to be 10 cfs during the summer when the rare PISF is 16 cfs. The Wiswall Reservoir was assumed to be at a water level two inches below the spillway and flow is, therefore, occurring over the notched spillway with stop logs. Prior to the relief flow, inflow equals outflow for the Wiswall Reservoir.

The relief flow pulse is assumed to reach the upstream end of the Wiswall Reservoir and increase linearly over 14 hours. The relief flow from Pawtuckaway Lake/Mendums Pond is 14 cfs. Therefore, at the start of the relief flow reaching Wiswall Reservoir, flow starts at 10 cfs and then linearly increases to 24 cfs. After 25 hours at 24 cfs, the inflow relief pulse linearly reduces back to the original flow of 10 cfs. This is conceptual and may not be how operations are conducted. It may be necessary to release water more rapidly over a shorter period to offset attenuation in flow. This will require testing.

Figure H.1 demonstrates the routing (movement) of the relief pulse through and out of the Wiswall reservoir. No stop logs are removed for the Figure H.1 analysis. In this case, 18 hours after the relief pulse first enters Wiswall Reservoir, the outflow exceeds the PISF of 16 cfs, then the outflow remains above the 16 cfs for another 41 hours. Over this hydrograph, although 46 acre-feet of relief flow water entered Wiswall reservoir, only 43 acre-feet flowed out, meaning that 3 acre-feet remained in the reservoir. Although for this example the PISF were met for 41 hours, this strategy of not removing a stop log will not be successful when the river flow is lower. In addition, by not removing a stop log, the relief flow delay is exacerbated by reservoir routing. For this reason, river flow monitoring at or upstream of Hook Island is strongly recommended in order to ensure that the arrival of the relief flow is recognized and stop log operations commence in a timely fashion.

Figure H.2 is the same as Figure H.1, except that it also includes the time history of the water level behind the dam. If the accuracy of measuring the water level is only one tenth of a foot (about one inch), then 10 hours would have to pass before it could be determined that the water level was indeed rising.

Figure H.3 demonstrates the same initial conditions and inflow hydrograph as the first case. Here, one stop log is pulled 10 hours after the relief flows first enter the Wiswall Reservoir. As soon as the stop log is pulled, the flow rate out of the spillway exceeds the PISF of 16 cfs. The outflow stays above 16 cfs for 49 hours. However, because a stop log was pulled, the reservoir continues to drain. In this case, 6.7 acre-feet more water flowed out than flowed in. Therefore, at some point after the effects of the relief flow occur downstream, the stop log should be replaced.

In Figure H.4, the stop log is removed 4 hours after the relief flows first reach the Wiswall Reservoir, and 40 hours later, the stop log is replaced. The outflow from the spillway remains above the 16 cfs PISF for 40 hours. In this case, 1.7 acre-feet of the relief flow is retained behind the dam after the relief flow event.

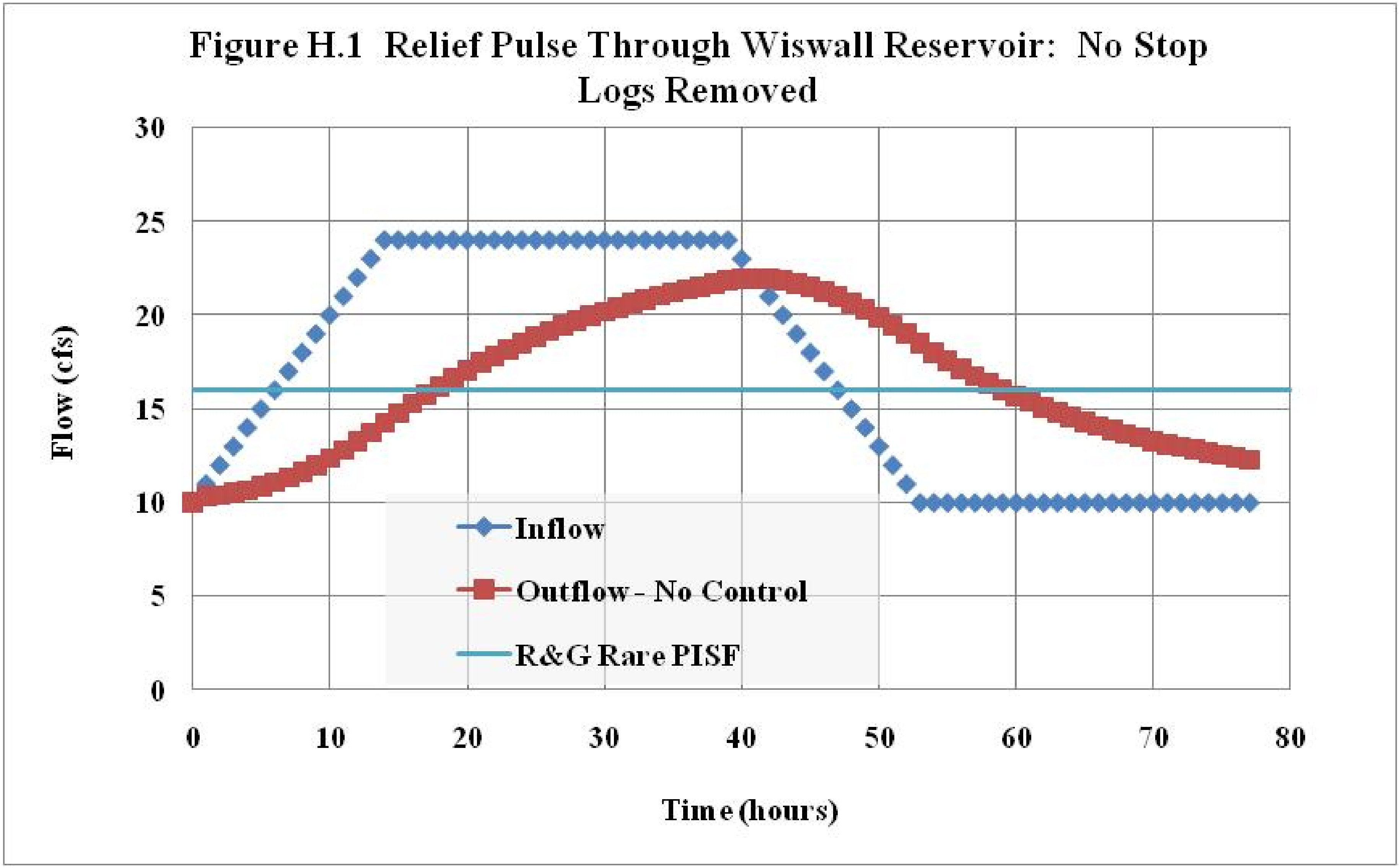
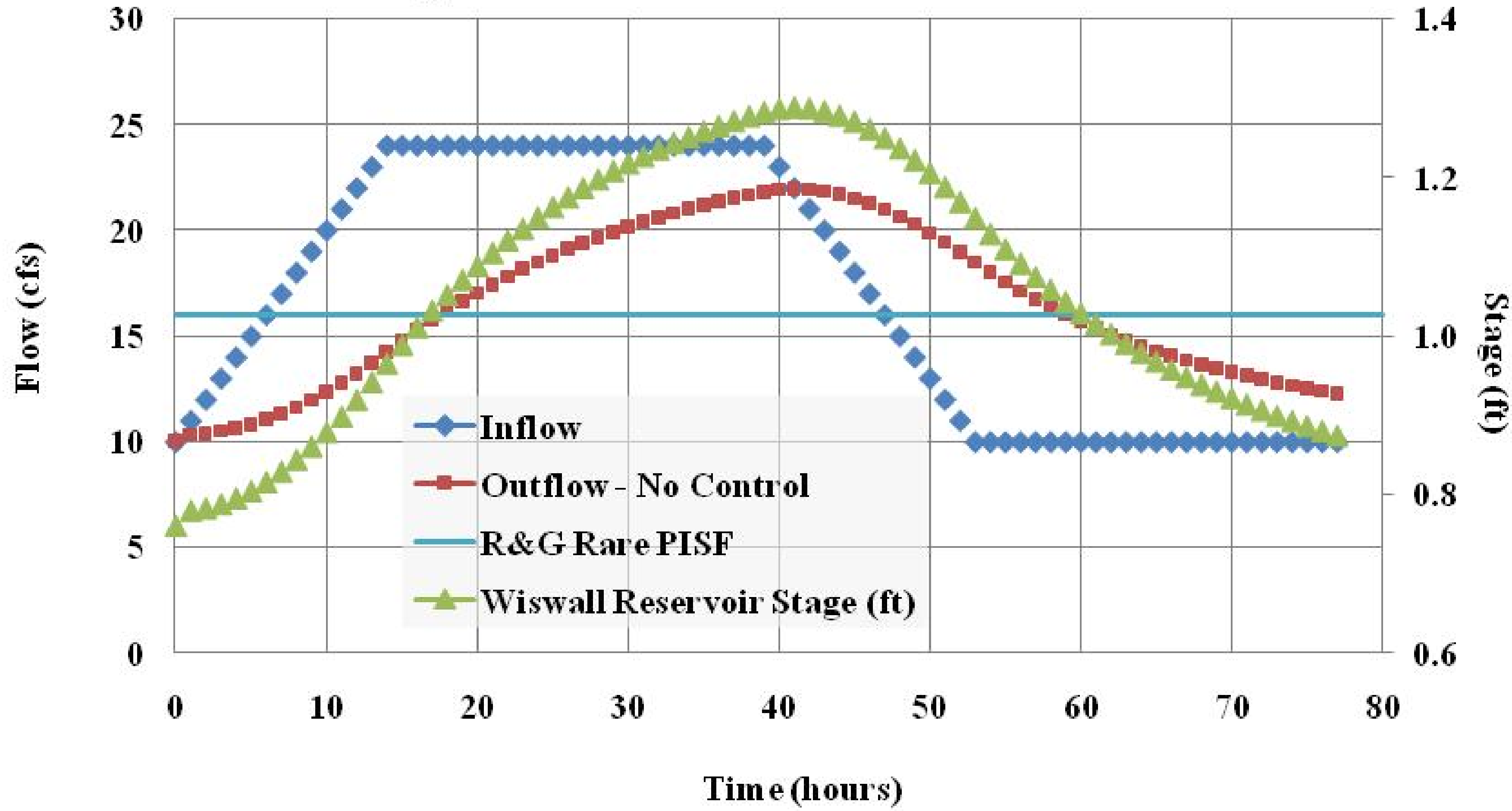


Figure H.1 Relief Pulse Through Wiswall Reservoir: No Stop Logs Removed
30
25
20
15
10
5
0
Flow (cfs)
0
10
20
30
40
50
60
70
80
Time (hours)
Inflow
Outflow - No Control
R&G Rare PISF

Figure H.2. Relief Pulse Through Wiswall Reservoir: No Stop Log Removed and Effect on Water Level



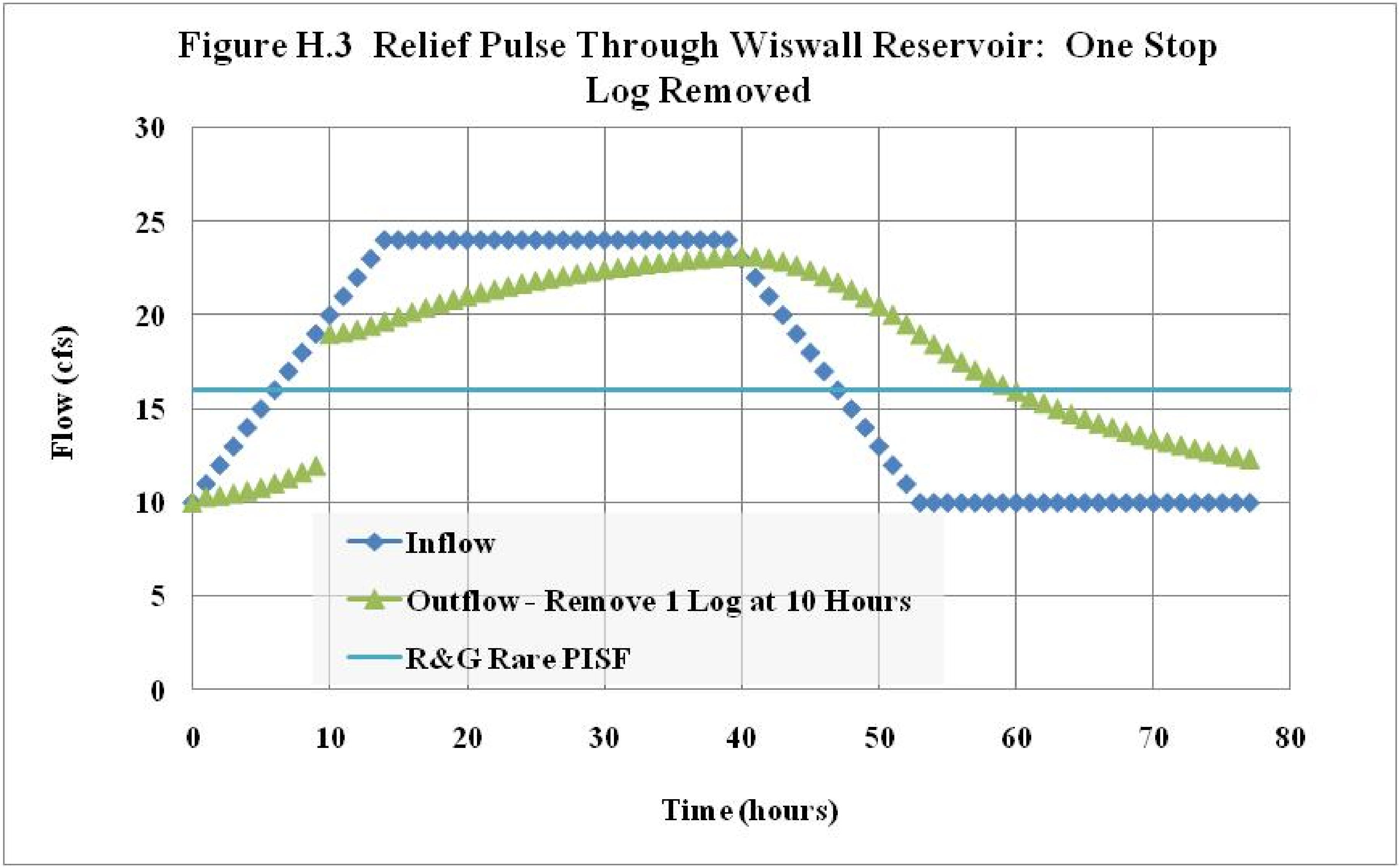


Figure H.3 Relief Pulse Through Wiswall Reservoir: One Stop Log Removed
Flow (cfs)
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
Time (hours)
Inflow
Outflow - Remove 1 Log at 10 Hours
R&G Rare PISF

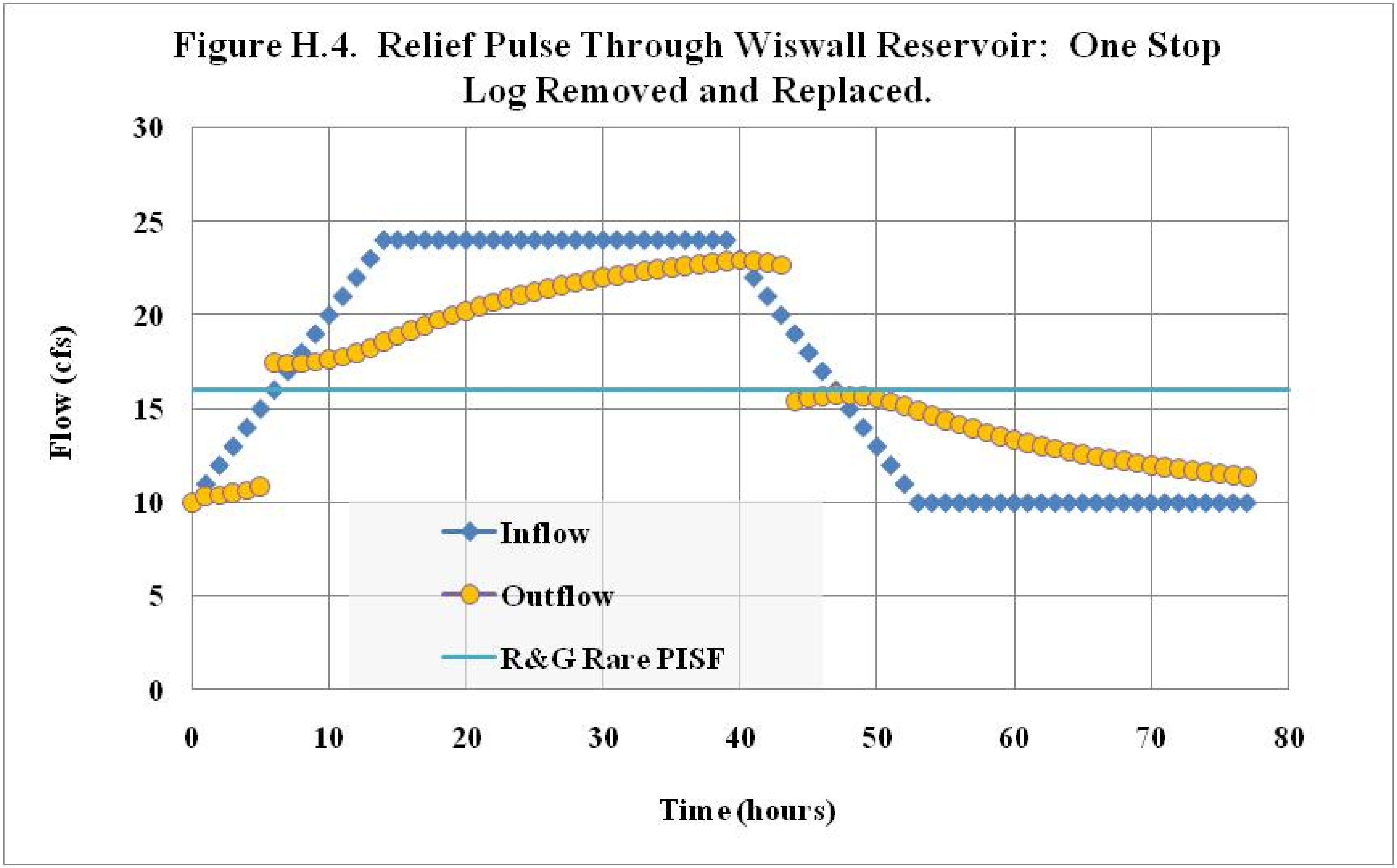


Figure H.4. Relief Pulse Through Wiswall Reservoir: One Stop Log Removed and Replaced.
Flow (cfs)
Time (hours)
Inflow
Outflow
R&G Rare PISF
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80

Appendix I

Responses to Comments on the DRAFT Water Management Plan

Lamprey River Water Management Plan

August 2013

This appendix summarizes the comments received on the Draft Lamprey River Water Management Plan Report (11 April 2011). Due to the large number of comments and questions received, they were summarized and grouped into categories. The major categories of comments pertain to: Pawtuckaway Lake; Mendums Pond; the Lamprey River; the University of New Hampshire/Town of Durham Water System (UDWS); the overall Plan, and, public policy and other. Several of the categories are further subdivided into specific issues that received repeated comments. Each comment summary includes a response. Copies of the original comments (emails or documents sent by mail or email) are also included in this Appendix.

In order to minimize the length of this response Appendix, when commenters pointed out simple requests for punctuation, grammar, or spelling modifications, by and large the appropriate edits were made but are not documented here.

Comments were received from the following individuals, federal or state agencies, educational institutions, groups, local and state government representatives:

- Ralph Abele, United States Environmental Protection Agency (EPA)
- Lee Bartlett
- Doug Bechtel, The Nature Conservancy
- Claire Boudreau
- James Breen
- Dennis Byrne, Campus Recreation, University of New Hampshire
- Sara Callaghan, Lamprey River Advisory Committee (LRAC)
- Frank G. Case, NH State Representative (Candia, Deerfield, Northwood and Nottingham)
- David Cedarholm, P.E. and Paul Chamberlin, P.E., UNH/Durham Water System
- Lauren E. Chaurette
- John Cooley, Jr., Loon Preservation Committee
- Gary and Lynn Cox
- Eleanor Crow
- Michele L. Daley, NH Water Resources Research Center
- Donna Danis
- Eric Danis
- John Decker
- Tom Duffy, Pawtuckaway Lake Improvement Association (PLIA)
- John K. Edwards
- Jamie Fosburgh, National Park Service (NPS)
- David Galpin
- Jim Hadley, Neighborhood Guardians
- Paul Herald
- Kevin Jordan
- James Patrick Kelly
- Pamela D. Kelly
- Donna King
- Edward T. Kotowski
- Elizabeth S. Kotowski

- Andrea LaMoreaux, NH Lakes Association
- Andrea Lawson
- Victor Maslov
- Glenn Normandeau, New Hampshire Fish and Game Department (NHF&GD)
- Town of Nottingham Selectmen: Gary A. Anderson, Mary L. Bonser and Hal W. Rafter
- Jim Rohrer
- James Rosborough
- Thad Russell
- Rydeen
- Stephen Soreff, MD
- Carl F. Spang, Lamprey River Watershed Association (LRWA)
- Dennis Stephens, PE
- Therese Thompson
- Marguerite Tucker
- Duane and Pam Walker

1. Pawtuckaway Lake: Specific Comments and Questions

The vast majority of the comments and questions on the Draft Lamprey River Water Management Plan Report were associated with Pawtuckaway Lake. Commenters expressed concern regarding the scope and validity of the Plan and the consideration and evaluation of the impact of the proposed Plan actions on Pawtuckaway Lake. Because many of the comments and concerns related similar perspectives, they were grouped into categories for response. Major concerns included:

- The perceived precedence of the Lamprey River over Pawtuckaway Lake and its use as a storage impoundment
- The impacts of the proposed management strategies on fall drawdown and winter water levels
- The frequency and maximum amount of summer drawdowns and the impact of reduced water levels in Pawtuckaway Lake on fish, wildlife, recreation, property values and the local economy
- Water quality and cyanobacteria
- Reference to and use of the survey results presented in the Notice of Decision on Determination of Lake Level dated December 19, 2000 to support proposed lake level changes in the Plan
- The notification of property owners of any water releases
- Property rights and property values
- Impacts of recent Legislative designation of additional portions of the Lamprey River under the Rivers Management and Protection Program
- Recommendations and requests for further study
- Public input and outreach

Precedence of Lamprey River over Pawtuckaway Lake and its use as a Storage Impoundment

Issue: Several comments received asked why the health and the protected entities of the lower Lamprey River take precedence over Pawtuckaway Lake and why DES would consider using Pawtuckaway Lake as a storage impoundment.

Response: The Lamprey River WMP strives to balance the values of Pawtuckaway Lake and the health of the Lamprey River. Water is held back in Pawtuckaway Lake for recreational purposes. During low-flow summer days, flow to the rivers from Pawtuckaway Lake (if any) is much less than inflow. Small releases of the water held in lakes to protect the ecosystem health of the river downstream have little impact on the lake and large benefits for the river. The summertime water level changes in the lakes being managed under this plan are within the natural variation for lakes and well within the range of existing human influences. A two day pulse of stored water that may be released reestablishes the natural pattern of stream flows for the river downstream without depleting the lake or compromising its recreational uses.

In the development of strategies to create relief flows to support the protected instream flows on the Lamprey Designated River (Lee-Durham segment), DES assessed all Affected Dams and their associated impoundments in the Lamprey River Water Management Planning Area. However, when considering the distance of each dam to the Lamprey Designated River, their operational capabilities, watershed areas and storage volumes, the list of 19 potential sites was quickly winnowed to Pawtuckaway Lake and Mendums Pond.

First and foremost in the overall concept of the water management plan development for the Lamprey Designated River is that the needs of all water users along the river and its tributaries are intended to be met as best as possible. Because there are competing uses when water availability is low, sometimes choices have to be made: sometimes preference is given to meet human uses and at other times ecosystem needs are given preference. The relief flows are part of this strategy to protect ecosystem needs.

Historical and current operations change stream flow patterns affecting river health. The Water Management Plan adds changes to the current management approach to better support river health. Pawtuckaway Lake was developed as a water storage reservoir in 1842 and continues to be a managed water body. Pawtuckaway Lake began as a natural lake that was further impounded to serve the mills in Newmarket and the original dam was upgraded in 1972. In 1955, the State of New Hampshire began operating the impoundment for recreation: saving water in the spring, holding water over the summer, and releasing water in the fall.

Figure I.1 shows the median monthly river flow of the Lamprey River at the USGS gaging station on the river near Newmarket, NH. What the figure clearly shows is how the June through September river flows have been maintained much lower since 1955 (to almost one third of the pre-1955 data) as well as the increase in flows in October and November. Changes in the management of Pawtuckaway Lake are not the sole cause of reduced Lamprey River summer stream flow but these are among the most significant. (Note: The volumes of each impoundment in and upstream of the Lamprey Designated River, Lee-Durham segment, are presented in Table 6 in the Report. Pools with the largest surface area have the largest volume per unit depth at the surface.)

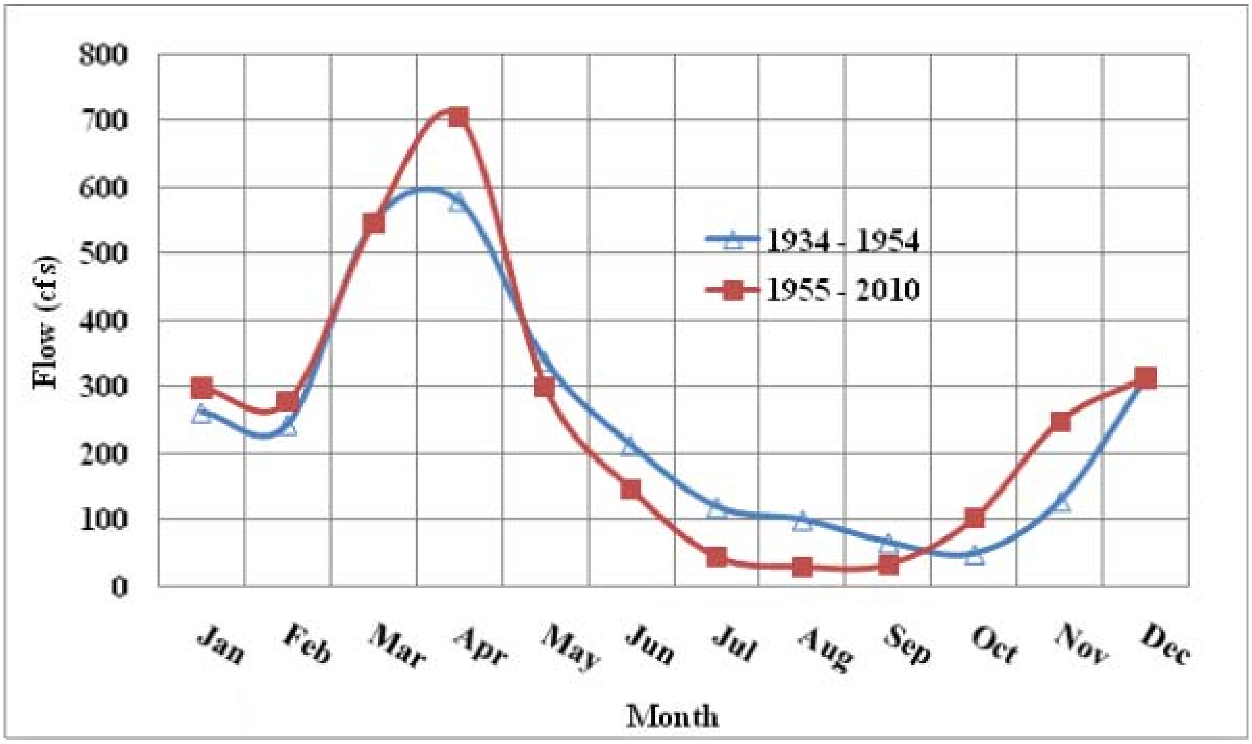


Figure I.1. Median monthly Lamprey River flows at the USGS gage near Newmarket, NH pre- and post-dam operation management change in 1955.

Figure I.2 displays the standard deviation for the same median monthly river flows. This figure demonstrates how operations at Pawtuckaway Lake and other impoundments help to reduce the summer variability of flows. Combined, Figures I.1 and I.2 show that with the current management of watershed impoundments for recreation, flows in the Lamprey River are lower in the summer and have less variability. While daily summer flows would naturally reach low values, these low flow periods would be broken up more frequently in the natural state (higher standard deviation) compared to the present state in which low flows persist for long durations. These conditions affect all instream uses and resources downstream.

The management of the Lamprey River in the past 50 years placed recreation and flood control as the highest objectives. Recreational use in particular has resulted in holding water in Pawtuckaway Lake to the detriment of the downstream river reaches. The Lamprey River Water Management Plan concludes that infrequently, when low flows persist excessively, a small amount of water stored in these same impoundments should be released in order to relieve the stress on the downstream aquatic flora and fauna.

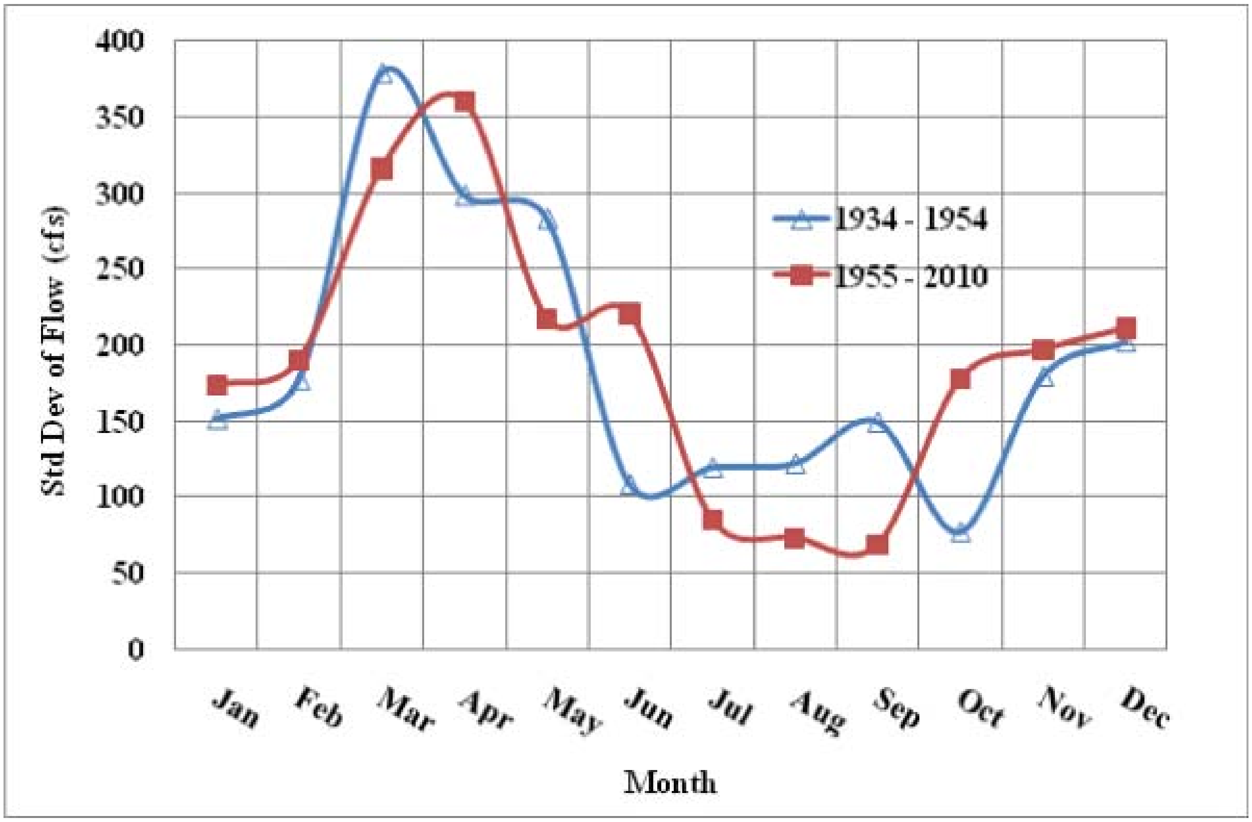


Figure I.2. Standard deviation (variability) of median monthly Lamprey River flows at the USGS gage near Newmarket, NH pre and post dam operation management change in 1955.

<u>Change in Fall Drawdown and Winter Water Levels</u>

Issue: Numerous comments were received regarding the proposed reduction in the fall drawdown and the resulting higher lake levels during the winter. The majority of the commenters did not support reducing the lake drawdown during the fall and maintaining higher lake levels during the winter. The primary concerns noted in the comments were: potential changes to docks resulting from higher winter lake levels; reduced opportunities for dock and shoreline maintenance during the winter months; less destruction of aquatic invasive weeds along the shoreline; and, reduced potential for flood storage.

Response: The Lamprey River Water Management Plan reduces the annual fall drawdown of the lake level from 7 feet to 4.8 feet to accommodate storage for the Overwintering bioperiod. The change in winter lake level also will improve water quality in Pawtuckaway Lake by providing more habitat for fish, better habitat for hibernating frogs and turtles, and greater removal of phosphorus.

DES has evaluated the fall drawdown relative to the lake's water quality and ecosystem health. The effects of changing the fall drawdown were the subject of a 2012-13 Lake Level

Investigation, which included the results of two winter release tests at different lake levels, a survey of dock conditions at the new winter lake level and an extension of the measurement of phosphorus levels from October through April. DES has concluded that the deeper (i.e., 7 foot) drawdown negatively impacts the lake and that the 4.8 foot drawdown will reduce these impacts.

In addition, if a relief flow release is needed to support Lamprey River winter flows, then one relief flow release event can be accommodated. Using part of the water retained, there is sufficient volume and water level to conduct a single release starting from the 4.8 food drawdown level, but not enough starting at a lower lake level because outflow rates drop as the lake level falls. DES determined from two release tests conducted in December 2012 and January 2013 that a deeper drawdown would not allow for sufficient release flow rates. At 4.8 feet, an effective release averaging 65 cfs can be maintained for 2 days, thereby meeting the winter relief flow goal. At a deeper drawdown of 5.5 feet, the effective release was less than 36 cfs.

DES determined from sampling and analysis of phosphorus samples and from lake outlet flow conditions, that the deeper drawdown is causing phosphorus to stay in the lake, and that a shallower drawdown is likely to reduce concentrations of phosphorus, especially in the northern section. Less water is released from the northern section when there is a deeper drawdown and, at the same time, most of the phosphorus load enters the northern section of the lake.

The DES Dam Bureau routinely manages impoundments based on its assessments of snowpack and ice conditions. In order to fill the lake by summer, the DES Dam Bureau must begin refilling Pawtuckaway Lake in late January to early February even though ice is still present on the lake. The DES Dam Bureau will continue to manage spring snowmelt to balance the desire for summer full pool Mendums Pond and Pawtuckaway Lake with the demand to avoid flooding. The DES Dam Bureau has assessed the flood hazard resulting from the changed winter water level. Because of the small volume difference between the old and new winter lake levels, there is very little change in storage conditions. The storage at the new winter lake level attains the safety requirements for passing storm flows. If ice is still present at the end of March, DES can delay filling the last three feet of the pond. The DES Dam Bureau will determine storage needs and manage the dams by storing and releasing water to fill or drain these waterbodies. If an Overwintering release is not needed for stream flow management, the DES Dam Bureau may delay refilling or may conduct a release to increase available lake volume for the storage of spring runoff. As seen with Hurricane Irene, the DES Dam Bureau can operate the storage to provide for flood storage. The DES will retain its prerogative to manage the lake for human health and safety.

With the reduction of the fall drawdown by about one and one-half feet, some shorefront owners' access to the lake bottom and to their docks may change. The fall drawdown will generally reach the new winter lake level at the end of November. Management of lake levels to accommodate shorefront owners' access to deeper waters for maintaining their docks and water fronts will be addressed on an individual basis.

A field survey of dock depths was performed relative to winter ice affecting docks. UNH measured water depth at 42 docks in the southern lake area on July 2, 2011.[1] Figure I.3 displays these data which show that 59% of docks are located in a water depth of 4.8 feet or shallower. These docks will not be affected by the suggested winter drawdown of 4.8 feet. A Pawtuckaway Lake resident toured parts of the lake over New Year's Day 2012 and measured the amount of exposed lake bottom at various locations and photographed these conditions at full drawdown. DES conducted a trial of the new winter lake level beginning November 26, 2012. During the week that the lake level was held at 4.8 feet of drawdown, DES and shorefront owners examined and photographed dock conditions around the whole lake area. An estimated 25% of the docks around Pawtuckaway were in the water at this drawdown, although many of these docks were in less than a few inches of water. The Lake Level Investigation proposed to mitigate potential impacts on these docks by phasing in the new drawdown depth over a period of 4 years. This will allow affected dock owners time to assess and make changes as necessary. All seasonal docks are required by rule to be removed for five months every year at the end of boating season.

A baseline aquatic plant survey has been proposed for October 2013 to evaluate long-term changes in the distribution and composition of lake plant life. Studies have shown that winter drawdowns have mixed results in reducing undesirable plant growth. DES has conducted a study at Ashuelot Pond that indicates that species tolerant of winter freezing may replace those native species killed by this management technique. Other studies have shown that the drawdown method of aquatic plant management leaves openings for exotic and invasive species to colonize. The presence of invasive species historically requiring removal at Pawtuckaway Lake indicates that the drawdowns are at most partially successful in controlling invasive vegetation.

Change made as a result of comments: The change in the winter drawdown is described in an August 2013 Notice of Decision on Determination of Lake Level for Pawtuckaway Lake. According to the decision, the change in winter drawdown will be phased in over a four year period. DES will make no winter relief pulses during that time. A new baseline plant survey will be conducted in the fall of 2013.

[1] Pawtuckaway Lake was at 250.5 feet (0.1 ft higher than normal full pool elevation)

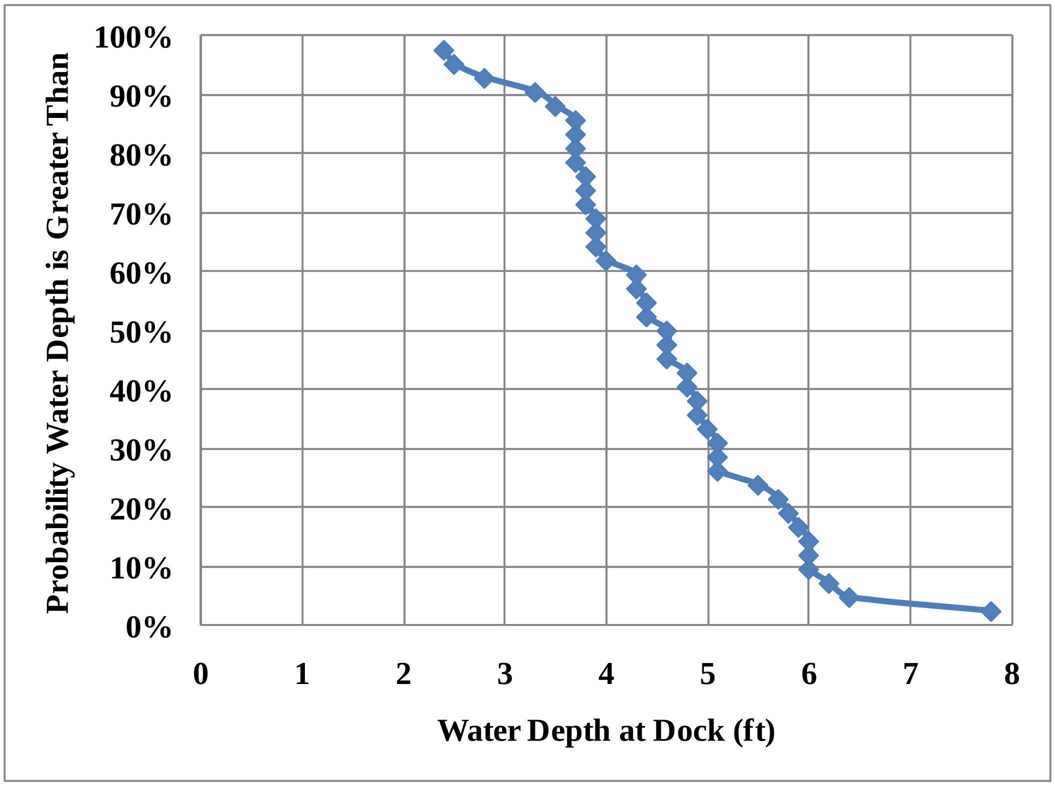


Figure I.3 Cumulative probability distribution of water depths at Pawtuckaway Lake docks on 2 July 2011.

Summer Relief Flow Releases and Lake Level Changes

Issue: Of significant concern to the commenters is the proposal to create relief flows for the Lamprey Designated River, which would result in lower water levels in Pawtuckaway Lake during the summer. The main concerns expressed in the comments are the potential effects of lower lake levels on fish, wildlife and recreation.

Response: A relief flow is additional water to raise the flow in the river for two days to a level above a particular bioperiod's instream flow target. The relief flows in the three bioperiods from May 5 to October 6 (see Table I.1) will be created by releasing stored water from both Mendums Pond and Pawtuckaway Lake. Table I.1 also shows the anticipated water level declines as a result of relief flows. The size of the relief flows were developed by comparing the targeted instream flows[2] to the Lamprey River flows over a 30-year period. The relief flow volume is calculated to make up for a deficit between stream flow and the targeted instream flow in 90% of the deficit events.[3]

[2] Refer to Table 1 in the Water Management Plan.
[3] A failure rate of one year in ten is considered acceptable and desirable to maintain the natural flow variability. A 20% buffer was added to offset losses from the relief pulse due to such factors as bank storage, wetlands, and attenuation by distance.

Many of the stated concerns appear to be a consequence of the perception that lake levels will change frequently or by large amounts as a result of relief flows. DES's assessment of historical stream flow conditions indicate that the occurrence of summer relief flows will be rare and will be less than 4 inches due to management.

The magnitude and frequency of changes to lake levels due to hypothetical relief flows have been estimated for a 56 year period from 1956 through 2011 (see Figure I.4.. In the 56 years, there were 33 years when no relief pulses would have occurred and thirteen more years when one relief pulse each year would have occurred. During two years, six relief flows would have been applied. The change in water level from management in these worst two years was four inches.[4] This review shows that even in the driest years, water level changes due to management would have been within the range of natural lake level fluctuations.

Natural lake levels in New Hampshire vary between one and two feet. During the summer, Pawtuckaway Lake, even without outflow, commonly falls 6 to 8 inches. Mendums Pond may commonly fall 3 inches during the summer, but during a dry summer may fall 7 inches. DES has determined that no relief flow releases will be initiated if the combined effect of management and natural decline have or will result in a water level 18 inches below the Dolloff Dam spillway (elevation 250.4 feet) or the Mendums Pond Dam spillway (elevation 224.5 feet.) These conditions are described in the Dam Management Plans for Mendums Pond, and the Drowns and Dolloff Dams developed for this Water Management Plan.

The effects of the relief flows on fish and wildlife in Pawtuckaway Lake were discussed with representatives of the New Hampshire Fish and Game Department (NHF&GD) and their concerns were summarized in their comment letter (dated June 16, 2011). The principal concern raised by NHF&GD was the potential effect of a flow release on diadromous fish and on loons. The NHF&GD noted that the release of water from the Pawtuckaway Lake dams during the summer to generate the relief flows may initiate the downstream migration of diadromous fish, specifically alewives. Stop logs would be removed from the dam outlet structures at times during the summer to produce the relief flows. This action has the potential to provide attraction flow to juvenile alewives at a time (summer) when inhospitable conditions would exist in the Lamprey River. NHF&GD notes in their comment letter (included in this appendix) that they would not want the alewives to swim downstream into the Lamprey River until they are either mature enough or flow conditions are optimal for them to migrate directly to the ocean. The management objective for the alewives is to keep them in Pawtuckaway Lake and have them continue to grow until October, at which time they normally migrate downstream into the Gulf of Maine. Based on discussions between NHF&GD and DES, a flow-through barrier will be placed on the upstream side of the dam outlets to prevent juvenile alewives from leaving Pawtuckaway Lake during a summertime flow release.

Regarding loons, NHF&GD has documented one loon nest in the northern part of Pawtuckaway Lake and one in the southern part of Pawtuckaway Lake. DES discussed protections for loon

[4] These water level decline estimates assume that the impoundments started at full normal pool. Should starting water levels be lower than this full pool, the water level decline would be less than 13 percent greater. Should wet weather follow a relief flow event, the water level in these lakes may be raised.

nesting with NHF&GD and The Loon Preservation Committee. The lowering of water levels more than six inches during the nesting period could prevent the loons from being able to return to their nests as they can only slide their bodies across the ground. Raising water levels during the nesting period may flood nests. As a result, NHF&GD requested that significant lowering of water levels should not occur between May 15 and July 15. This period coincides with the Clupeid and the GRAF Spawning and early Rearing and Growth bioperiods, during which time relief flow releases could potentially occur. DES has changed the Pawtuckaway Lake and Mendums Pond dam management plans to protect loon nesting during this period.

Prior to conducting any relief flows deemed necessary between May 15 and July 15, DES will request an evaluation of loon nesting conditions from NHF&GD, in coordination with The Loon Preservation Committee (http://www.loon.org/) and with Pawtuckaway Lake Improvement Association. Relief flow releases that would result in a cumulative reduction in water level greater than six inches will be avoided during this period if successful nesting is occurring. The Loon Preservation Committee has agreed to work on evaluations of loon nesting during the May 15-July 15 period for Mendums Pond and Pawtuckaway Lake.

NHF&GD stated that drawdowns to offset low water conditions before May 15 and after July 15 should have minimal or no effect on the loons. NHF&GD also requested that winter drawdowns not commence until after October 15 to allow loon chicks to fledge. Generally, the fall drawdown begins at about this time. Protected instream flows during this bioperiod will be maintained by the annual fall drawdown.

NHF&GD also noted that DES had not analyzed conditions of cumulative lowering of water levels from multiple relief flow releases and their effects on fish and wildlife. DES later evaluated the cumulative lake level decline during years when multiple relief flows would have been applied. From 1956 through 2011, 82% of the years had one or zero management events to which this concern would not apply. The remaining nineteen percent of the years had between two and six events. The two worst years that had six relief flows had cumulative lake level declines from management of four inches. Under those circumstances management would have been within the range of natural lake fluctuation; however, DES and NHF&GD will continue to work cooperatively to further address this concern.

The anticipated effects of the water level changes on summer recreation in Pawtuckaway Lake were considered not to be significant because the summer pool is generally managed within a one foot range around the full lake level mark. The lake generally is filled above the full pool level by Memorial Day and then may drop six to nine inches over the summer. The lake level typically declines from evaporative losses and from the small amount of leakage at the dams by as much as would occur as a result of the relief flows.

Table I.1 Relief flow releases by bioperiod from Mendums and Pawtuckaway to meet flow deficits and the calculated changes in water level from full pool.

Bioperiod	Period	Volume needed to meet 90% of historical deficits (ac-ft)	Volume needed to meet 90% of historical deficits with 20% buffer (ac-ft)	Equivalent two-day flow release (cfs)*	Change in water level from full pool using releases that meet 90% of historical deficits w/ 20% buffer (feet)	Water source
Overwintering	Dec 9 – Feb 28	216	259	65	0.65 feet – not from full pool	Mendums Pond not used. Pawtuckaway Lake release from the 4.8 foot level.
Spring Flood	Mar 1 – May 4	-	-	-	-	No active management planned
Clupeid Spawning	May 5 – Jun 19	118	142	36	0.14	from storage and drawdown
GRAF Spawning	Jun 20 – Jul 4	20	24	6	0.02	from storage and drawdown
Rearing & Growth	Jul 5 – Oct 6	47	56	14	0.05	from storage and drawdown
Salmon Spawning	Oct 7 – Dec 8	75	90	23	4.82 at Pawtuckaway and ~7 feet at Mendums	Annual fall drawdown

Mendums	265	Acres at full recreational pool
Pawtuckaway	783	Acres at full recreational pool

*Division of the releases between Mendums and Pawtuckaway at the ratio of 265:783 or about 1:3.

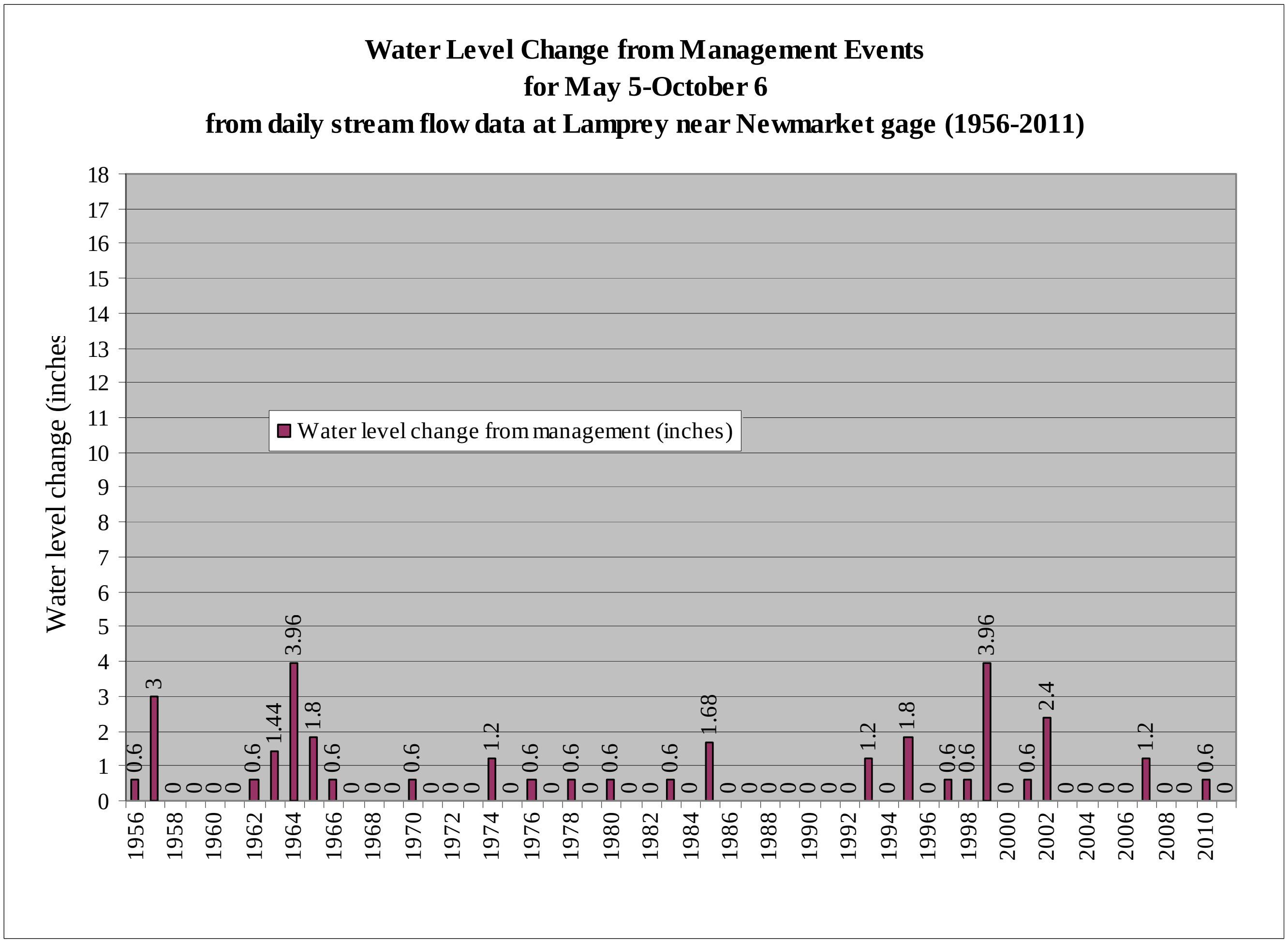
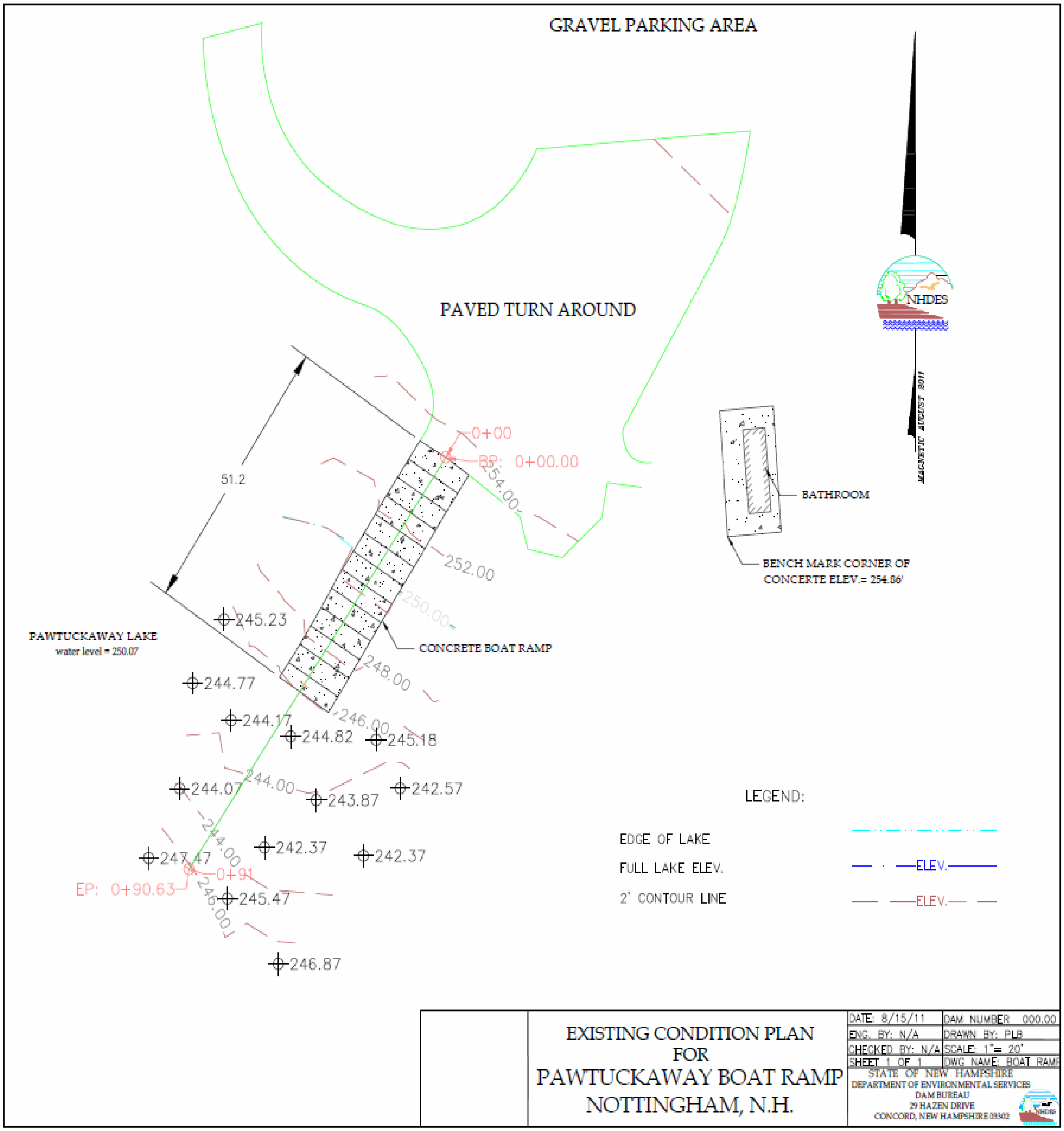


Figure I.4 Historical assessment of lake level change as a result of relief flows

Several commenters, including NHF&GD, noted that Fundy Cove is a shallow area where the lowering of water levels could be an issue to fish and wildlife residing there and could also limit the utilization of the NHF&GD's existing public boat ramp. As described in the previous paragraph, changes in water level from management are likely to be rare and of a sufficiently small amount as to be unlikely to affect fish or wildlife. At the best of times, Fundy boat ramp is a difficult access point. DES surveyed the boat ramp at Fundy Cove to evaluate its use from a waterbody management perspective and in terms of routine lake decline effects. Figure I.5 and Figure I.6 show the results of this survey in plan view and as a cross-section of the boat ramp. A reduction in the depth and length available for boat launching would occur if the water level is lowered 18 inches, but sufficient water depth remains for use of the boat launch—approximately 40 feet of the boat launch would be in depths of at least 2 ½ feet, and most of that distance would be over 3 ½ feet deep. This would be an extremely rare occurrence.

Figure I.5 2011 Survey data and plan view at the Fundy Cove Boat Ramp.



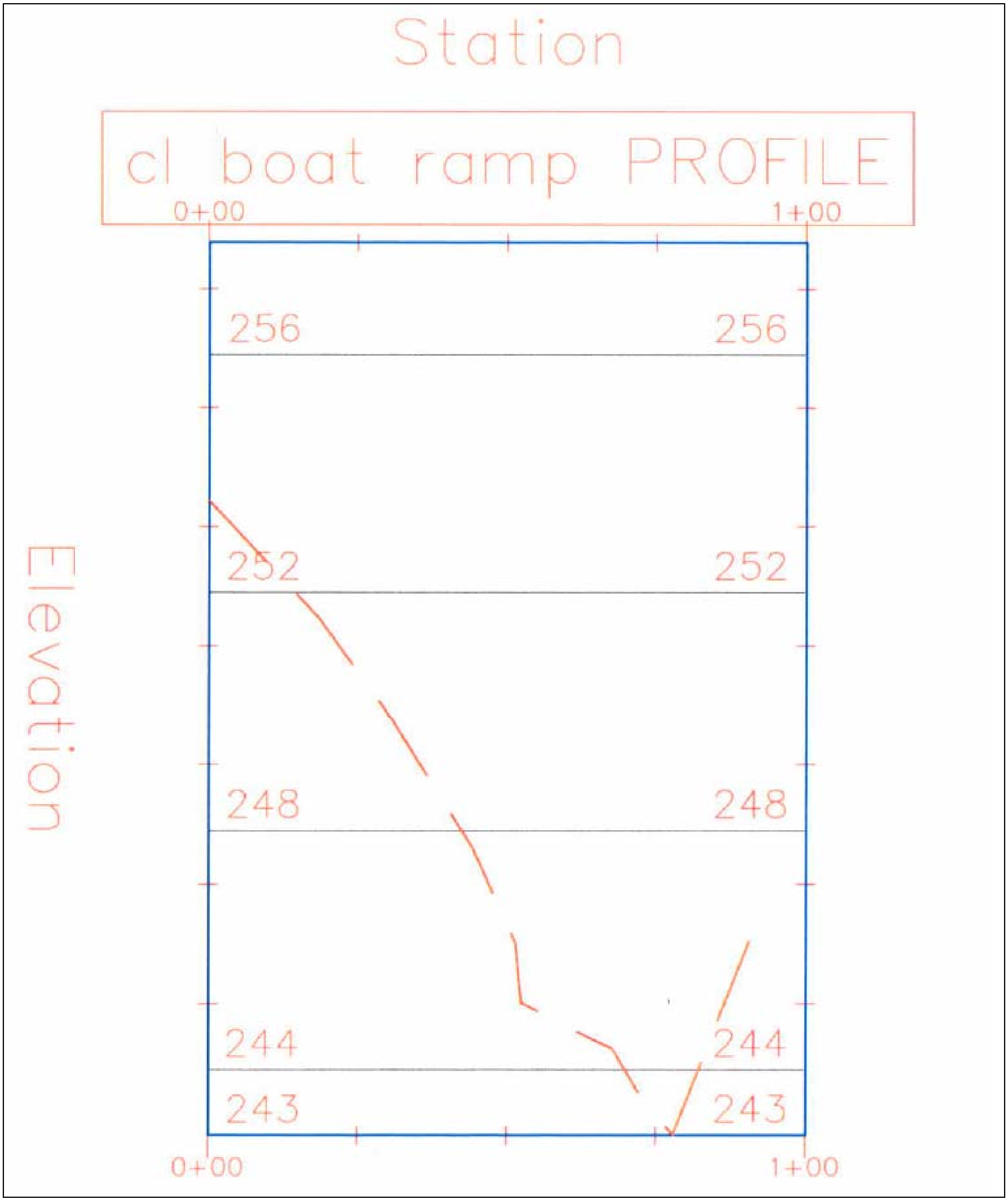


Figure I.6. Profile along the Fundy Cove Boat Ramp. Normal pool level is 250.4 feet.

In summary, the summertime relief flows that may result in up to a few inches of drawdown in Pawtuckaway Lake in addition to the routine lake level declines can be accommodated and still allow for recreational use and aquatic life support in Pawtuckaway Lake. The effects of the relief flows on loons are manageable. Barriers can be employed to address untimely downstream alewife migration. If necessary, NHF&GD will advise DES through the adaptive management process on revisions to the Lamprey River Water Management Plan to limit negative effects on fish and wildlife. Use of the Fundy boat ramp is not likely to be compromised. The Water Management Plan acknowledges that there may be times when the relief flows are not viable, and it is the intent of the Plan to achieve the best possible outcome for lake interests and instream flow protection.

Changes made as a result of comments: Limits have been added to the amount of change in water level in order to protect recreational uses and habitat needs. Summertime (May 5 through October 6) water level changes will be limited to less than 18 inches below the full lake level. Water levels between May 15 and July 15 during successful loon nesting will not, as a result of management, be lowered by greater than six inches. DES and NHF&GD will develop a process and implement barriers for preventing alewife from outmigration during relief flow releases.

Water Quality and Cyanobacteria

Issue: Numerous comments were received regarding the effect of the proposed water level changes on the water quality of the lake, particularly water temperature, dissolved oxygen and cyanobacteria. Concerns were that lowering water levels in the summer would make the lake shallower and increase water temperature, which would, in turn, lower dissolved oxygen levels and increase the frequency of cyanobacteria blooms. Commenters expressed concern over the potential effect of an increased frequency of such blooms on recreation in the lake and at beaches located on the lake.

Response: The plan's effects on water levels are within the natural variability of lake levels. Separating the effects of management from existing water quality issues within the slight variations of water level from management will require years of water quality data, and may never be possible. However, the relief flow strategy will be reviewed in light of water quality data to determine if the Pawtuckaway Lake water levels that result from relief flows are associated with water quality degradation.

While increased water temperature during the summer was not studied in detail, the increased lake level elevation in the winter in part offsets this concern: more water in the impoundment in the winter maintains more cold thermal mass to absorb summer temperature increases. The winter water level is recommended for every year, whereas the relief flows are not. In addition, since the relief flows result in water level declines within the normal range for the lake, summer water temperature should remain within its normal range. Relief flow releases will have little effect on temperature. Similarly, dissolved oxygen conditions are affected by other factors such as thermal stratification and photosynthesis to a larger degree than by temperature.

NHF&GD expressed concerns regarding the effect that the release of water from Pawtuckaway Lake would have on water temperatures downstream and on aquatic fauna there and requested in their comments that continuous (hourly) water temperature data be collected in summer 2011 in order to make informed decisions about the effect of the water level changes on water temperature and aquatic fauna. Temperature recorders were installed in 2010 through 2013.

Long term monitoring of water temperature may be implemented to address and evaluate this concern. Temperature measurements were collected during the release test conducted in September of 2012. These measurements showed that stream flow below Dolloff Dam increased as a result of adding flow from the lake since there was very little flow prior to the release. Temperature changes in the river were compared with a tributary flowing into the lake and were within the range of diurnal fluctuations found there. Temperature effects downstream of the release disappeared within a short distance below Dolloff Dam.

There is no evidence to suggest that the changes in water level from relief flow releases will aggravate algal blooms. DES advisories for cyanobacteria in Pawtuckaway Lake have been issued during two recent years, most recently on May 27, 2011. This advisory came during a cold, rainy period in the spring of that year. Since cyanobacteria blooms are occurring now, they are obviously not caused by the proposed management plan and the existing causes are in need of attention. Cyanobacteria blooms result from a complex set of conditions that include nutrient availability and depletion, light, temperature, percent oxygen saturation, wind patterns, internal lake mixing, growth stage, and zooplankton predation. However, the chief cause is continued inflow of phosphorus to the lake.

Change made as a result of comments: DES will continue to monitor temperature during the evaluation period.

Notification of Water Releases and Water Level Changes

Issue: Several commenters asked about plans to notify property owners before any water release and requested that abutters to the Lake be notified of any water releases or water level changes in writing.

Response: DES will post a notification 48 hours in advance of planned water releases on its web site. The DES tool that tracks Lamprey River flow conditions relative to the protected flow criteria is available on the DES Instream Flow Program website. This tool uses tables and graphic forms of data to show flow conditions relative to protected flows. The tool identifies when conditions that will require flow management are imminent. DES will email notification to the Towns of Nottingham and Barrington and to the leadership of the Pawtuckaway Lake Improvement Association of an impending relief flow release.

Change made as a result of comments: The notification process is described.

Use of Survey Results in Notice of Decision on Determination of Lake Level for Pawtuckaway Lake dated December 19, 2000 to Support Water Management Plan.

Issue: Some commenters noted that they had not participated in any survey performed as part of the study done for the 2000 Notice of Decision (NOD) or for the Draft Lamprey River Water Management Plan Report. Many felt the descriptions of the NOD survey results were misleading because they were outdated, they did not represent the conditions being proposed or were misinterpreted.

Response: The NOD described the survey results. At that time there was a distribution of interests ranging from zero feet through seven feet for the fall drawdown.[5] Most people surveyed at that time preferred a lesser drawdown. DES documented this information in the Draft Water Management Plan. A survey of current landowners was not performed as part of this project but based on the comments received on the Water Management Plan the majority of the commenters did not support the proposed water level changes.

Change made as a result of comments: Reference to the survey results from the 2000 NOD has been removed from the Water Management Plan.

Impact of Recent River Designations in the Lamprey River Water Management Planning Area on the Draft Water Management Plan and Pawtuckaway Lake

Issue: Several comments were received questioning the impact of the 2011 designation of the remaining portion of the Lamprey River and its major tributaries[6] on the Water Management Plan and its proposed actions on Pawtuckaway Lake.

Response: The Lamprey River Protected Instream Flows and the Lamprey River Water Management Plan apply only to the Lee-Durham segment of the Lamprey River. The Water Management Planning Area begins at the Durham/Newmarket Town line as established when it was designated in 1990. The enacting legislation (House Bill 1449-A) described only this river segment for a pilot program to study and establish protected instream flows and water management plans on the Lamprey River. As a result, the additional assessment of the effect of the recent river designations is beyond the scope of the current study.

The current instream flow program, which applies to the 1990 designated portion of the Lamprey River, is a pilot program that will be evaluated and perhaps revised by the legislature and DES. The effects on Pawtuckaway Lake of the future application of the instream flow program to the upper portions of the Lamprey River cannot be defined at this time.

Changes made as a result of comments: No change.

Public Comment Recommendations and Requests for Further Study

Issue: Many of the comments received included recommendations of actions that should be taken to improve the Lamprey River Water Management Plan and studies that should be performed to further evaluate potential effects on Pawtuckaway Lake. These included:

- Developing a monitoring plan to assess overall effects due to relief flow releases;
- Developing a mechanism for feedback from lake residents and users after programs are implemented to document any observed effects;
- Consider first 24 months after Plan implemented as a trial period or pilot project during which careful assessment of effects be conducted;

[5] Undocumented in the draft Water Management Plan was the 1992 request from Pawtuckaway residents and fishermen to reduce or do away with the seven foot drawdown as harmful to the fish.
[6] Little River, North Branch River, North River, Pawtuckaway River and Piscassic River

- Conduct studies of weed and algae growth and drift, loon habitat, water quality and fish populations;
- Information gathered from monitoring and studies be analyzed and used to weigh the cost to Pawtuckaway Lake of implementing the Plan, which should then be revised accordingly;
- Involve the UNH Lamprey River Hydrologic Observatory, the UNH Stormwater Center and the Piscataqua Estuaries Regional Partnership in additional studies;
- Keep the Pawtuckaway Lake Improvement Association informed of activities that affect Pawtuckaway Lake and seek feedback from its members;
- Conduct additional studies to assess effects that proposed drawdowns would have on the quality, enjoyment and economic value of Pawtuckaway Lake;
- Complete an environmental impact study of the Pawtuckaway River Watershed before any changes in the management of water levels in Pawtuckaway Lake are approved or reallocation of water resources occurs; and
- Conduct an environmental impact study that considers economic impacts of the Plan, including the potential effects on visitation to Pawtuckaway State Park and the likely effects to real estate from diminished property values.

Response: DES acknowledges that monitoring is warranted to address the issues raised concerning the Lamprey River Water Management Plan. DES notes that the two-year period through September 2015 will be an evaluation period of the Plan, at the end of which a legislative review of the pilot program will occur that will include the opportunity for additional public input. As discussed in the summary section of the Plan, monitoring is recommended to determine if the desired outcomes are being achieved and, if not, how the management actions can be revised to better meet the objectives of maintaining protected instream flows and minimizing impacts.

DES will work cooperatively with stakeholders to develop targeted studies and monitoring plans to identify any impacts or unintended consequences associated with the implementation of the Plan. DES and the Pawtuckaway Lake Improvement Association conducted a test relief flow release in September 2012 at the suggestion of the Pawtuckaway Lake Improvement Association. DES also conducted two winter time release tests suggested by the Pawtuckaway Lake Improvement Association, and conducted monitoring through the fall, winter and spring of 2012 and 2013, continuing the lake water quality measurements carried out during the summer by the Pawtuckaway Lake Volunteer Lake Assessment Program. DES has scheduled an update of previous aquatic plant surveys for October 2013. DES will continue to assist local property owners, lake associations, river and watershed associations as well as regional planning and scientific research groups to develop work plans and pursue grants to fund these studies and monitoring plans.

DES has met several times with the Pawtuckaway Lake Improvement Association leaders, Nottingham selectmen and the public to present information and continue the dialogue about stakeholders' interests in lake management.

Changes made as a result of comments: DES will continue to keep the public informed about the Lamprey River Water Management Plan activities and will maintain a website to distribute project information. DES intends to continue to discuss the implementation with the Lamprey Water Management Planning Area Advisory Committee and other interested parties during the evaluation period. Public response to conditions and effects may continue to reach DES.

In the short term, DES will develop a report on the 2013-2015 implementation period of the Water Management Plan to evaluate its effects. At the end of this period, there will be a public hearing and a legislative review of the results to date, including economic effects if any, that will be used by the legislature to determine the future application of instream flow protection measures.

Public Input and Outreach

Issue: Issues raised in the comments received on public input and outreach included various opinions: that the Plan was prepared with limited input from the affected community, other state agencies or other regional planning efforts; that the public hearing was not well advertised and many stakeholders were unaware of the management changes proposed for Pawtuckaway Lake; that the composition of the advisory committee leaned toward water suppliers and Durham town officials; and concerns that a survey of Pawtuckaway Lake residents on the lake was not conducted.

Response: Pursuant to the Instream Flow Rules (Env-Wq 1900), DES issued a public notice 30 days prior to the public hearing held in Durham on May 11, 2011. This notice was distributed to Affected Dam Owners, Affected Water Users, members of the Lamprey River Water Management Planning Area Advisory Committee and Lamprey River Technical Review Committee, Lakes Management Advisory Committee, Rivers Management Advisory Committee, the Towns of Lee and Durham and each of the other watershed towns, the Water Quality Standards Advisory Committee, chairs of the Local River Management Advisory Committees, the Senate Bill 330 Study Committee, persons who requested notification of Instream Flow Program activities along with the other parties identified in Env-Wq 1906.06 Hearing and Opportunity for Public Comment on Water Management Plans. As required under the Instream Flow Rules, DES issued a notice of the public hearing in Foster's Daily Democrat. Notice of the public hearing was posted on the DES website calendar and the Instream Flow Program's webpage.

DES and the project team met in public meetings with the Lamprey River Water Management Planning Area Advisory Committee five times during the development of the Lamprey River Water Management Plan, beginning in January 2009. The Lamprey River Water Management Planning Area Advisory Committee consists of members representing a broad range of stakeholders including: Local River Management Advisory Committee representatives; Affected business Water Users; a conservation commission member; local government officials; recreational interests; a community citizen representative; conservation interests; business interests; a state senator; a state representative; a lake association representative; public water supplier; Affected Dam Owner; and an Affected agricultural Water User. Meetings were held on July 9, 2010, February 11, 2011, May 6, 2011 and May 20, 2011 that specifically focused on the draft sub-plans and the Draft Lamprey River Water Management Plan.

DES met with members of other State of New Hampshire agencies (the DES Dam Bureau, the NHF&GD, the NH Department of Resources and Economic Development, and the Pawtuckaway State Park Manager) on March 18, 2011 to discuss the Draft Lamprey River Water Management Plan. DES met again with NHF&GD on June 1, 2011 and continued those discussions in response to the comments received on the Plan.

DES also met with the Pawtuckaway Lake Improvement Association (PLIA) after receiving comments from many of their members at the Water Management Plans public hearing. DES presented the plan at the PLIA annual meeting on June 11, 2011 and delayed the end of the comment period as requested by the PLIA. DES also suspended completion of the plan to continue dialogue with Nottingham and the Pawtuckaway Lake Improvement Association and to conduct various studies. DES conducted a public hearing as part of the Pawtuckaway Lake Level Investigation in May 2012, met with Pawtuckaway Lake Improvement Association leadership in August 2012 and in February and May of 2013, and also conducted many discussions and answered questions by email and phone. DES held a Science Round table on September 28, 2012. And DES provided an update and discussion followed by a public information meeting to answer questions on October 30, 2012.

DES also met with a subcommittee of the Lakes Management Advisory Committee and the Rivers Management Advisory Committee to address their concerns about conflicts between lakes and rivers resulting from the need to manage water resources. The Committees jointly developed and recommended a set of guiding principles for comprehensive management of lakes and rivers.[7]

Changes made as a result of comments: No changes.

2. **Mendums Pond: Specific Comments or Questions**

Issue: Comments specific to Mendums Pond in general mirrored those for Pawtuckaway Lake and, therefore, much of the Pawtuckaway Lake response (above) is relevant to Mendums Pond. UNH Campus Recreation commented that while their use is now from March through November, they are intending on expanding their use to up to 10 months per year. UNH commented that the effect of the current management (annual 7-foot fall drawdown) represents a safety issue in the fall and early spring. The commenter sees the management for protected flows as representing a reduction or elimination of recreational opportunities. Mendums Pond was identified as a loon nesting area.

Response: The Plan does not include any recommended changes to the fall drawdown and winter pond level for Mendums Pond, so management would not affect changes planned by UNH Campus Recreation from October 7 through May 4. DES has not yet addressed the large, 7 foot annual drawdown at Mendums Pond. Mendums Pond will be used to support relief flows only outside that period. The pond level decline due to relief flow releases is on the order of a

[7] The document containing the guiding principles for comprehensive water resource management is available on the Rivers Management Advisory Committee blog at http://xml2.des.state.nh.us/blogs/rmac/ and on the Lakes Management Advisory Committee blog at http://xml2.des.state.nh.us/blogs/lmac/.

few inches, which should not significantly impact recreation on Mendums Pond. DES has apportioned the release volumes to result in equal water level changes in each lake from a relief flow pulse. The frequencies and extent of relief flow releases are as rare and limited as described above for Pawtuckaway Lake. As described above with respect to Pawtuckaway Lake, should wet weather ultimately follow a relief flow, the Mendums Pond water level may be restored to the pre-relief flow level. Management for loons will be conducted in the same fashion as that being applied at Pawtuckaway Lake including limits on management between May 15 and July 15 during nesting, and coordinated evaluations of conditions and effects of management with NHF&GD. DES will notify the town of Barrington when a relief flow release is imminent.

Changes made as a result of comments: Limits have been added to the amount of change in water level in order to protect recreational uses and habitat needs. Summertime (May 5 through October 6) water level changes will be limited to less than 18 inches below the full lake level. Water levels between May 15 and July 15 during successful loon nesting will not, as a result of management, be lowered by greater than six inches.

3. Lamprey River Specific Comments or Questions

There were a number of comments specific to the Lamprey River focused on 1) why a minimum flow was not proposed, and 2) the basis for the proposed two-day relief flows. The comments are summarized below and responses are provided.

<u>Minimum Flow</u>

Issue: Several commenters noted that a minimum flow of 4 cfs was mentioned in the Draft Lamprey River Protected Instream Flow Report (dated 12/09/2008), but was not included in the final version of that report issued on July 13, 2009 or in the Draft Lamprey River Water Management Plan Report. Comments requested an explanation as to why a 4 cfs minimum flow was not included in the Draft Lamprey River Water Management Plan Report and for its reconsideration as part of the Lamprey River Water Management Plan.

Response: In the Draft Lamprey River Protected Instream Flow Report, a minimum flow value of 4 cfs was suggested, but this recommendation was not included in the final version of the report dated July 13, 2009 and was not included in the Draft Lamprey River Water Management Plan Report. The reason for dropping the consideration of a 4 cfs minimum flow was explained in the response to the comments received on the Final Lamprey River Protected Instream Flow Report:

> A flow of 4 cfs was proposed as a minimum flow because it was the lowest flow observed in the river. The description of the lowest flow was a new concept in the pilot program that had not been used in the Souhegan study. The naturalized flows for the period 1976 through 2005 were observed to contain no flows lower than 3.7 cfs. The 3.7 cfs value was the lowest measured flow after correction for human effects of water withdrawals and management of Lake Pawtuckaway. The conclusion was that stream flow in

the Lamprey should not be lower than these historical naturalized flows. The 3.7 cfs value was rounded up to 4 cfs.

Management issues were not investigated in the (Protected Instream Flow) study and would have been defined for this condition in the water management plan, but the decision was made that the 4 cfs criteria were redundant under the flow protections and that flow conditions below 4 cfs would likely result in emergency conditions being declared by the commissioner. The use of a 4 cfs minimum flow as a stream flow criterion has been dropped from the protected flow recommendations.

Relief Flow

Issue: Commenters noted that the concept of relief flows was not evaluated by the Technical Review Committee and was not included in the Lamprey River Protected Instream Flow study reports. The biological rationale and efficacy of this approach was questioned along with the possible effects on Pawtuckaway Lake and Mendums Pond. It was posited that the relief flows are conceptual and untested and may be counter to the Natural Flow Paradigm. An alternative approach was also proposed, whereby the human-caused impacts on extreme low flows are quantified so that dam releases offsetting these impacts be conducted as opposed to the two-day relief flows.

Response: The relief flow concept was not presented to the Technical Review Committee as part of the Lamprey River Protected Instream Flow study because it was not part of the technical content developed during that phase of the project. The role of the Technical Review Committee was to evaluate the results of the Protected Instream Flow study and did not continue into the development of the Water Management Plan. The concepts presented in the Draft Lamprey River Water Management Plan Report were presented to and discussed with the Lamprey River Water Management Planning Area Advisory Committee (WMPAAC), which provided critical comment and recommendations.

Recreating the patterns of stream flow conditions is a major focus of protecting rivers worldwide. The duration of the relief flow was developed by studying the characteristics of the monitored river hydrograph. Figure I.7 displays the cumulative probability distribution of the duration of natural relief periods from June 20 to October 6 each year. In this figure, it can be seen that one third of the natural relief flow events last one or two days. Two days is the duration of summertime stream flow responses to small rainfall events that result in flows above the protected flow magnitudes. Longer relief flow periods might be better at supporting flow-dependent fish and other aquatic species, but doing so may unnecessarily remove water from storage.

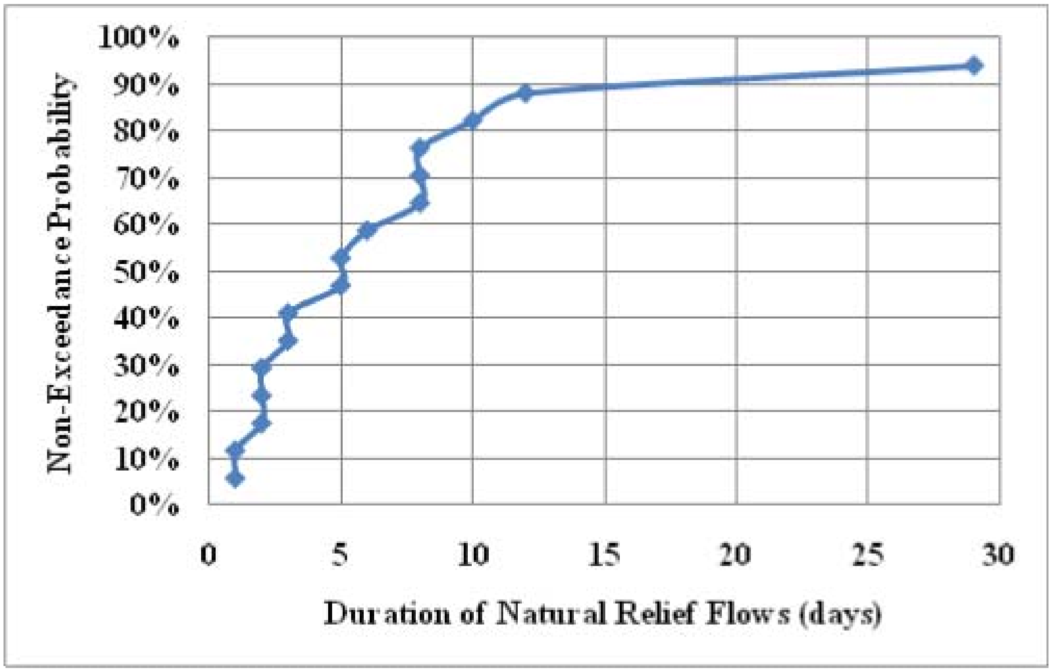


Figure I.7. Lamprey River Natural Relief Flow Durations 2000 – 2010.

Table I.2 displays other rivers where re-creating hydrologic variability is presently occurring across the United States. As the Water Management Plan is implemented, metrics such as fish numbers may support the two day relief flow, or indicate that it should last longer.

The proposed alternative of quantifying the human-caused impacts on extreme low flows and then off-setting only these impacts with dam releases is interesting, but could be more complicated and problematic. A major issue would arise in the determination of the magnitude of human impacts that are not related to direct and indirect water groundwater or surface water withdrawals. Examples of these impacts are impervious surfaces, land use changes, displacement of water by sewer systems and other actions which change stream hydrology but are difficult to quantify.

Changes made as a result of comments: No change required.

Table I.2: Summary of recent projects where flow regimes have been "naturalized"
(from Poff et al.: *The natural flow regime: a paradigm for river conservation and restoration;* BioScience 1998)

Location	**Flow Components Mimicked**	**Ecological Purpose**	**Reference**
Trinity River, CA	timing and magnitude of peak flow	rejuvenate gravel habitats, provide flows for out-migrating salmonid smolts	Barinaga 1996, Trinity River Report 1997
Truckee River, CA	timing, magnitude, duration of peak flow, rate of change during recession	restore riparian trees	Christensen 1996
Owens River, CA	increase base flows, partially restore overbank flows	restore riparian vegetation and habitat for brown trout and native fish	Hill and Platts 1997
Rush Creek, CA and other tributaries to Mono Lake	increase minimum flows	restore riparian vegetation and habitat for waterfowl and non-native fish	Los Angeles DWP
Oldman River and tributaries, southern Alberta	increase summer flows, reduce rates of post-flood stage decline	restore riparian vegetation (cottonwoods) and cold water fisheries (trout)	Rood et al. 1995
Green River, CO	timing and duration of peak flow; duration and timing of non-peak flows; reduce rapid baseflow fluctuations from hydropower generation	recovery of endangered fish species; enhance other native fishes	Stanford 1994
Gunnison River, CO	timing and duration of peak flow; duration and timing of non-peak flows; reduce rapid baseflow fluctuations from hydropower generation	recovery of endangered fish species	Pfeiffer et al. 1996
Rio Grande, NM	timing, duration of floodplain inundation	ecosystem processes (e.g., nitrogen flux, microbial activity, litter decomposition)	Molles et al. 1995
Pecos River, NM	magnitude, frequency, timing	spawning signal for endangered fish	Hoagstrom et al. 1994

Colorado River, AZ	magnitude, timing	restore habitat for endangered fish	Collier et al. 1997
Bill Williams River, AZ (proposed)	mimic natural flood peak timing and duration	promote establishment of native trees	US Army Corps of Engineers 1996
Pemigewasset River, NH	do not exceed natural frequency of high flows during summer low flow season; reduced rate of change during hydropower generation	enhance native Atlantic Salmon recovery	Federal Energy Regulatory Commission 1995
Roanoke River, VA	restore more natural patterning of monthly flows in spring; reduce rate of hydrograph rise/fall	increased reproduction of striped bass	Rulifson and Manooch 1993
Kissimmee River, FL	magnitude, duration, rate of change	restore floodplain inundation to recover wetland functions and native species	Toth 1995

4. University of New Hampshire/Town of Durham Water System and Wiswall Dam

Issue: Several comments were received regarding the University of New Hampshire/Town of Durham Water System (UDWS) and Wiswall Dam. The comments focused on UDWS's Water Use Plan, its use of the Lamprey Designated River as a water supply source, its increasing dependence on the river as its water supply, the lack of discussion in the Water Management Plan of its development of an alternative water supply source and management of Wiswall Dam. One commenter questioned why UDWS was given an additional 10 days (15 day catastrophic duration plus 10 days) before having to implement a Stage 4 Alert when compared with other Affected Water Users and noted that there didn't appear to be any difference in the water conservation actions taken in the Stage 3 and Stage 4 Alerts.

Response: DES recognizes that UDWS does not fit into the standard water use patterns and conditions of many other public water suppliers. This stems from both the sources of supply outside the Lamprey River watershed and the characteristics of the water demand. Water use varies dramatically because of the student population, and UDWS has sources of water that do not impact the Lamprey River flow. UDWS has a unique water use pattern that includes peak use during September and October as opposed to the common pattern of peak use during July and August. The UDWS water use plan and conservation plan include actions affecting their water sources outside of the Lamprey River watershed. Use of these sources does not affect Lamprey River stream flow. These considerations were taken into account while developing UDWS's Conservation sub-plan and Water Use sub-plan.

UDWS changed its reliance on the Lamprey Designated River from its past use as an emergency source to use as the system's primary source beginning in late 2008. As a result, UDWS has increased its total withdrawals from the Lamprey River over the last several years. This change in use has the advantage of protecting water quality and quantity in the Oyster River. Under the Water Management Plan, UDWS will be managing its withdrawals from the Lamprey during periods of low flow.

During the development of the draft Water Use Plan, UDWS specifically requested that system capacity be considered in addition to flow in the Lamprey Designated River for triggering water use management actions. The reasoning was that the other sources (Lee Well and the Oyster River Reservoir) outside of the Lamprey River watershed are available.

Because of the availability of other sources outside the Lamprey watershed, UDWS also requested that the catastrophic duration for the Stage 4 Alert for implementing outside water use reductions be increased by 10 days. UDWS has demonstrated during the period from 2009 through to the present that they use other sources more heavily during Lamprey River low flow periods.

Stages 3 and 4 of the UDWS conservation plan are different. The major difference in the water conservation actions to be taken between the Stage 3 and 4 is that all outdoor watering is banned in Stage 4, while some limited outdoor use is allowed in Stage 3. It is worth mentioning that UDWS has never reached Stage 3 or 4 conditions.

The UDWS Conservation sub-plan notes that UDWS has developed a new water supply in the Spruce Hole Aquifer. This supply is expected to reduce its dependence on the Lamprey River, particularly during periods of low stream flow. The project has none of the supporting infrastructure in place and the well is not operational. As a result, the operation of this well was not discussed or incorporated into the UDWS Water Use Plan. UDWS's Water Use Plan may need to be revised and the Lamprey River Water Management Plan amended to reflect this new water source in the future.

UDWS, as with all the other Affected Water Users in the Lamprey River Water Management Planning Area, will be required to maintain the protected instream flows. The Town of Durham will be required to pass any relief flows released from Pawtuckaway Lake or Mendums Pond through Wiswall Dam.

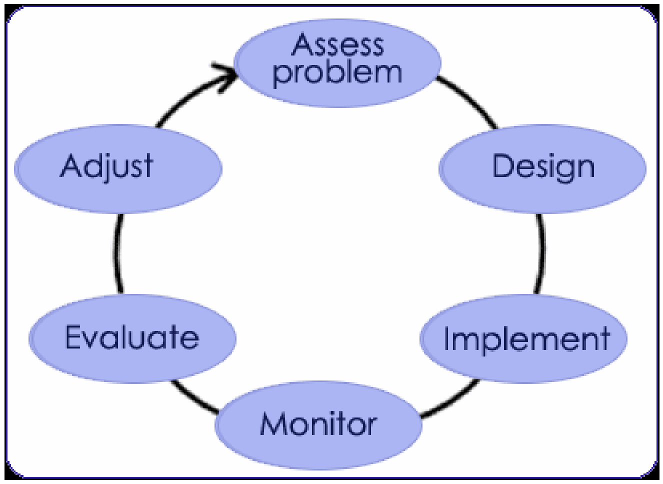
5. Public Policy Comments or Questions

Issue: Several comments were received regarding public policy issues and the Water Management Plan. Comments mentioned: a lack in confidence in the DES to manage the controlled water releases based on past experience; concern that triggers for management and decisions to pursue management actions would be automatic, with little human involvement; the desire for more local contact and input on management actions, dependence on adaptive management instead of defining solutions ahead of time; and; that the Water Management Plan is not consistent with the DES Commissioner’s 2010-2015 Strategic Plan.

Response: The DES Dam Bureau has significant experience in dam and impoundment management operations and is confident that the dams on Pawtuckaway Lake and Mendums Pond can be managed to meet the requirements of the Lamprey River Water Management Plan. The DES Dam Bureau demonstrated a successful relief flow release from Dolloff Dam in September 2012 and later held the lake at the new winter lake level from November 26 through December 2 prior to another successful release test in December 2012.

Relief flow releases will be evaluated by DES prior to initiation and will not be applied without review. The public and the downstream Affected Water Users and Affected Dam Owners will have advance warnings leading up to relief flow releases. DES’s decision to release water will be based on the flows recorded by the USGS gage at Packers Falls compared with the protected instream flow levels. The lake level conditions and biological concerns at the time in Mendums Pond and Pawtuckaway Lake will be factored into any decision to initiate a relief flow. A decision to create a relief flow pulse will be reviewed by the DES River Management Protected Program and the DES Dam Bureau staff prior to a management action. DES will notify the Towns of Nottingham and Barrington and the Pawtuckaway Lake Improvement Association leadership when a relief flow release is imminent. DES will be in consultation with others such as NHF&GD and The Loon Preservation Committee prior to making a release decision.

Since the Protected Instream Flows and the Water Management Plan are part of a pilot program and represent a new approach to water resource management in New Hampshire, adaptive management is an integral component. The adaptive management process, illustrated in Figure I.8, will help DES maintain flexibility in its decision making, improve its understanding of the Lamprey Designated River and guide the actions to be taken to meet the goals of the Instream Flow Program. Because of the large variability in the hydrology and site conditions, it is impossible to predict every aspect of instream flow in the watershed, no matter how long studies might last. DES is confident that the issues have been vetted enough to begin management activities. Learning from applying the management is the only way that deficiencies can be identified and corrected.



Source: U.S. Department of Interior

Figure I.8. The Adaptive Management Process.

Furthermore, the Protected Instream Flow Rules (Env-Wq 1900) provide Affected Dam Owners or Affected Water Users a petition process to make changes in the Water Management Plan (Env-Wq 1906.08) and the opportunity to request a waiver (Env-Wq 1908.01) of specific rules. DES expects to continue working with the stakeholders in the Lamprey River Water Management Planning Area during the two-year implementation period to further refine the Water Management Plan using the experience gained during implementation. In addition, the legislature will conduct a program review in 2015.

DES notes that the Lamprey River Water Management Plan is consistent with the vision of the DES 2010-2015 Strategic Plan (November 2010). The development of the Lamprey River Protected Instream Flows and the Water Management Plan are part of the overall efforts being taken by DES, as noted in Commissioner Burack's introduction, "ensuring high levels of water quality for water supplies, ecological balance, and swimming, fishing, and boating….and managing water resources for future generations." The development of these protections and management plans are part of the broader range of initiatives being pursued by DES to meet the challenge of Goal 2 of the 2010-2015 Strategic Plan to "effectively protect New Hampshire's natural resources and high quality of life as the state grows." Both the protected instream flows and the management plans provide meaningful measures to protect the natural resources of the Lamprey Designated River today and into the future.

Changes made as a result of comments: No changes required.

6. Overall Plan Comments or Questions

A broad range of comments were received on the Plan including those focused on: editorial changes or errors; support or opposition to the Plan as proposed; the deadline in the instream flow legislative statute; the extent of the study within the watershed and its level of detail; the plan's overall credibility; the structure of individual plans; the lack of evaluation of watershed scale measures; the reallocation of water resources from the lakes to the Lamprey River; and, the plans inability to protect resources of the Lamprey Designated River.

Comments regarding specific editorial changes were reviewed and, where appropriate, were incorporated into the Final Lamprey River Water Management Plan. The Executive Summary was replaced and several other sections were revised and re-organized to improve the readability of the Plan.

Many comments were from individuals, groups or local governments associated with Pawtuckaway Lake who opposed the plan. Their opposition to the Plan was focused on the potential impact of water level changes on: docks; property values; recreation (boating and fishing); water quality; and, wildlife (fish and loons) in the Lake. Opponents of the Plan also stated it is "full of inaccuracies, undocumented and unstudied assumptions and dangerous conclusions," is limited in scope, and will not protect the Lamprey Designated River. Most of these comments have been addressed in the 2013 Pawtuckaway Lake Level investigation and in other sections of this appendix. Comments and responses thereto, on the Lamprey River Water Management Plan not previously addressed are presented in the following paragraphs.

Several comments stated that the Water Management Plan should be scrapped or considered null and void since it had not been approved or adopted by its legislated deadline of September 30, 2010. The basis for this comment is incorrect. House Bill 588, passed by the House and the Senate and signed by the Governor in 2013, extended the instream pilot program deadlines. With this extension, the Lamprey River Water Management Plan must be adopted and implemented by September 1, 2013 and a final report documenting the results of the pilot program be submitted to the legislature by December 1, 2015. The program was extended to allow for the completion of the Plan and provide sufficient time for public review and comment, with the goal of establishing an acceptable Plan for the protection of instream flows on the Lamprey Designated River. DES notes that no one has been harmed by any delay in implementing the Plan and, therefore, the plan will be implemented when prepared. Likewise, no documentation of harm has been brought forth by the public.

Commenters noted that the scope of the Plan was limited, did not address watershed scale issues (impervious cover, future development, etc.), did not include an assessment of all water use in the Water Management Planning Area or did not consider the recent expansion of the designated reach. DES recognizes that many of these issues are important, but their consideration and analysis are beyond the scope of the Instream Flow Program statute and the required components of a Water Management Plan as defined by the Instream Flow Rules.

Several comments expressed the opinion that the Report was unrealistic, that the effects on other resources in the watershed were not fully considered, that it promotes the reallocation of resources, relies too much on adaptive management and may lead to additional management requirements in the future. DES notes that the Lamprey River Water Management Plan and its sub-plans (Conservation, Dam Management and Water Use Plans) incorporate the information as required by statute and by the Instream Flow Rules and that additional assessments were conducted that were not prescribed in order to evaluate effects of management. The Plan establishes a management plan to protect the flow-dependent entities on the Lamprey Designated River as required by statute. The Plan also has evaluated conditions on the lakes that are affected by the management plan to ensure persistence of valued characteristics and continued enjoyment of these lakes. The Plan incorporates adaptive management as a means of providing flexibility in the application of the Plan and to reflect the dynamic nature of water resource management.

One of the comments acknowledged that "a lot of work and data collection went into this analysis and it would be useful to have this raw data publicly available on the internet and presented in tables or spreadsheets (instead of PDFs) so that it can be easily used in other capacities." DES will attempt to make this information available via the OneStop Program on DES's website: http://des.nh.gov/onestop/index.htm.

Lastly, along with providing comments and recommendations on the Lamprey River Water Management Plan, several agencies and groups noted their support of the Instream Flow Program and its goal of establishing and maintaining protective instream flows for the Lamprey Designated River. These included:

- Lamprey River Advisory Committee
- Lamprey River Watershed Association
- National Park Service
- New Hampshire Fish and Game Department
- New Hampshire Lakes
- The Nature Conservancy

Changes made as a result of comments: No changes required.

7.0 Comments from UDWS and Responses

Comments

The University of New Hampshire and the Town of Durham sent a lengthy set of comments which is repeated here in its entirety (italics).

The following are general comments:

1. Originally, drafts of the proposed UDWS Water Use Plan, the Wiswall Dam Management Plan and the UDWS Water Conservation Plan were provided in MS Word format for UNH's and the Town of Durham's comments and as mentioned above we have been in discussion with NHDES for some time now regarding specific language. In April 2011, the bulk of the three draft plans were then incorporated into the body of the Draft Lamprey River Water Management Plan, which was provided in PDF format only, and the individual draft Plans were included in separate appendices in the PDF. This has unnecessarily complicated the comment process since now the same information exists in essentially three places with potentially three different versions making proofing of the final information very difficult. Hence, the reason most of the below comments contain three references. Does NHDES plan to maintain the format of having the bulk of the information from the three plans in the body of the Water Management Plan and entirety of the individual plans included in separate appendices? The UDWS does not feel this makes practical sense since it will make revising the information moving forward even more complicated than it already is. It is our recommendation that the body of the Water Management Plan not contain so much redundant information and instead refers to the individual plans which would be contained entirely in their own appendices.

2. The title of Table 3 on page 19 is "Affected Dam Owners", however it is a list dams not the actual owners. A column should be added that list the owner of the respective dams."

3. The discussion about manageability of instream flows and the need for it is based on a comparison of statistical analyses that were used developed the flow duration curve of the Lamprey River, projections of population increase and assumptions about water demand. It is important to bear in mind that neither regional population projections nor per capita water use can be expected to follow current trends with a *great deal of confidence. Per capita water use has been in decline since the 1970s, which is why the UDWS's water demand is only at 25% of what was projected in 1970.*

4. Page 25, first paragraph in the PDF. This paragraph exaggerates the per capita use of users in the watershed (150 gallons per person per day is about 50-100% greater than the per capita use in most area Towns) and therefore exaggerates its impact on the Lamprey River. There is lack of source references to support this discussion. In addition, the last sentence states: "So on average, there is plenty of water, however often demand exceeds supply". The use of the word "often" in this statement is contrary to the lengthy preceding discussion which makes the case that demand exceeds supply infrequently.

5. Page 26, 2nd paragraph in the PDF incorrectly refers to a Newmarket gage. There is no stream gage in Newmarket. The Packers Falls gage is located in the Town of Durham, however for some reason the USGS refers to it as "near" Newmarket.

6. Page 39, 3rd paragraph in the PDF states "prior to obtaining approval for the proposed new source, but no later than June 1, 2012, UDWS will finalize it proposed Water Conservation Plan in accordance with Env-Wq 2101". A deadline of June 1, 2012 may be unrealistic; however, UDWS will commit to making a reasonable effort to finalize the proposed Water Conservation Plan prior to this deadline.

The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS, and to ensure that basic operational constraints do not result in an accidental violation of the ***UDWS Water Use Plan****. The first page reference refers to the MS Word document of UDWS Water Use Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.*

7. Page 6, paragraph following bullet list (pages 54 and 224 in the PDF): The ability to base the 1 inch per day drawdown on a weekly average is needed in order to manage the reservoir outflow by removing 1 stop log at a time which would result in a release of "slugs" of water much like a relief pulse. This is also essential if for some reason outflow is managed with a low level gate in which case it is extremely tricky to maintain a steady drop in pool elevations.

8. Page 6, last paragraph (Page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): The notification requiring the UDWS to acknowledge within 24 hours is workable, unless the notification is received on a Friday or a weekend in which case acknowledgment will be provide on the following Monday.

9. Page 7, 1st paragraph (page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): All the language regarding DES plan to create relief flows, the estimated timing of the pulse arrive, and the estimated volume of the flow expected to arrive at the Wiswall Dam are only estimates since the operation of creating a relief flow on the Lamprey River is completely untested the UDWS is extremely uncomfortable with the prescriptive requirements prior to actual trials being conducted. The language suggests that the owner of the Wiswall Dam could create a relief flow "equal to the current bioperiod's 90%ile event volume, but without the volume of the 20% buffer released to compensate for losses" has great potential failing and cause the UDWS to violate the conditions if the volume that arrives at the Wiswall Reservoir is inadequate. Because the concept of creating a relief flow is untested, the UDWS has little confidence that the 20% buffer released from the upstream sources will provide enough of a buffer to allow the UDWS to maintain compliance without losing a significant amount of stored water that would otherwise be available to meet public drinking water requirements. It may also require the

Wiswall Reservoir be drawn down more than 18 inches total. The following language should be inserted: "Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod's 90%ile event volume, but without the volume of the 20 percent buffer released to compensate for losses".

10. Page 7, 2nd paragraph (page 55, 3rd paragraph and page 225, 4th paragraph in the PDF): The text currently states: "When stream flows in the Lamprey are below 18 cfs, the system's water sources will comprise the Lee Well, the Oyster River surface water withdrawal and the remaining storage within the drawdown limits of Wiswall Reservoir". This apparently implies UDWS will be required to maintain inflow equal to outflow at Wiswall, however the designated critical flow of 18 cfs has an associated allowable duration of 15 day. UDWS proposes to use this 15 day allowable duration to begin scaling down the operations at the UNH Water Treatment Plant, and requests the ability to withdraw 0.8 cfs from the Lamprey River instream flow when flows fall below 18 cfs for a period of plus 7 days, and the ability to withdraw 0.4 cfs from 7 days to 15 days. This is necessary for the UNH Water Treatment Plant to more reasonably transition from a high to lower operational level, and to preserve the capacity in the Lee Well until absolutely necessary as prescribed on page 9, 4th paragraph (page 57, 5th paragraph and 227, 6th paragraph of the PDF).

11. Page 9, 1st paragraph (page 57, 2nd paragraph and 227, 3rd paragraph in the PDF): In order for the UDWS to impose mandatory water use restrictions, the Durham Town Council would need to adopt an ordinance to require such actions and impose penalties. UDWS shall work with the Town and UNH to establish procedures to implement mandatory water use restrictions and water conservation measures consistent with this water use plan. Discuss procedure and schedule for adopting water use restrictions as part of a new or updated Town Water Ordinance.

12. Page 9: Cost considerations (page 57 and 228 of the PDF): The following language more accurately reflect the UDWS's true costs and should be inserted: "The management activities would be performed by UNH and Town staff and/or a consultant and the annual costs to implement and maintain the water use plan is expected to range from $10,000 to $30,000. The reduced water withdrawal capacity imposed by the protected instream flow program may trigger the permitting, engineering, and installation of associated infrastructure for a new water source and ranges from $4 million to $6 million".

The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS and the Town of Durham, and to ensure that basic operational constraints do not result in an accidental violation of the ***Wiswall Dam Management Plan.*** *The first page reference refers to the MS Word document of Wiswall Dam Management Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.*

13. Page 2, 3rd paragraph (page 46, introductory paragraph and page 191 of the PDF): Chapter 332 from 1965 referenced both the Town of Durham and UNH.

14. Page 3, 3rd paragraph (page 192 in the PDF) – The estimated volume of the impoundment of the top 12"is 12,142,211 gal or 1,623,290 CF or, 37.3 ac-ft per 8-25-10 email correspondence with Wayne Ives.

15. Page 3, 5th paragraph (page 193 in the PDF) – The primary purpose for reservoir is clearly for water supply storage and recreation is secondary. This was the conclusion of the 2003 Dufresne-Henry *study. The NH Dams Data Sheet 071.04 referenced in the paragraph needs to indicate "water supply storage" as the primary purpose. The UDWS requests that NHDES revise NH Dams Data Sheet 071.04 accordingly.*

16. Page 3, 3rd to last paragraph (page 193 in the PDF) – The last sentence of this paragraph is confusing.

17. Page 3, 2nd to last paragraph (page 193 in the PDF) – There may be approximately 3 miles of river downstream of Wiswall Dam, but the vast majority of this stretch of river is impounded. This should be acknowledged here.

18. Page 3, last Paragraph – (page 46 last paragraph and page 194, 1st paragraph in the PDF): As evident in Table 6, the volume of the Wiswall Reservoir is not "large" as stated in this paragraph, and for this reason it does not provide a significant potential to attenuate the relief flow. The soon to be installed outflow notch/weir will be self regulating which will help to reduce the potential for attenuation. In addition, for the reason stated in the previous paragraph it does not provide a great potential to provide significant relief flow for the mostly impounded downstream reach. DES is imposing requirements based on assumed behavior the system. They also have practical problems in that no one knows or can measure how much attenuation occurs between the Pawtuckaway dams and our reservoir since the upstream gage is on a side branch of the Lamprey. It is reasonable to assume that some degree of attenuation will occur upstream of the Wiswall Reservoir, but how much? The statewide drawdown in 2009, which was used to assess the relief flow volume needed, was conducted in mid October. The antecedent moisture conditions during this time would typically have been very different from what would be expected during a drought when an actual relief flow would be considered.

19. Page 4, starting with the 3rd Paragraph (pages 47 and 194 in the PDF) – Regarding relief flows: Without conducting some actual relief flow tests that would provide NHDES and the UDWS with some real data of what flows to expect and when, and to what degree the new notch/weir of the dam might actually have on flow attenuation, it is unreasonable to insist that the UDWS come up with a plan to "ensure the relief flows are conveyed" without some amount of attenuation. Pulling stop logs in anticipation of an untested relief flow increases the UDWS's liability of loosing drinking water storage during a potentially critical period of demand. Depending on when it happens, it could result in prematurely declaring Stage 4 (Water Emergency). What is a "controlled release"? The UDWS has proposed the accuracy as being what can be obtained by pulling a 4" stop log. What degree of control is expected? This is a natural system with natural variability. The degree of precision implied is inconsistent with the system being controlled, and this is all based on untested hypothetical information. The high degree precision of dam outflow controls will not exist to manage small changes in pool elevation. There needs to be a reasonable range of pool elevation variability by which the UDWS will be required to operate the dam.

20. Page 4 (Page 194 in the PDF): Delete the first bullet list. It is redundant with the following bullet list.

21. Page 4, bullet Item #1 (page 47 and 194, 1st bullet item in the PDF): This paragraph is confusing and it is not clear what the final phrase "whichever is less" is referring to.

22. Page 4, bullet Item #2 (page 47 and 194, 2nd bullet item in the PDF): The requirement to confirm receipt of DES's notification within 24 hours is unrealistic for a municipality where the responsible staff may not be available, particularly if the notification arrives on a Friday or weekend . The planning *involved in a relief flow release would happen at least a week before the actual release, and as such it seems reasonable that an "Affected" dam owner could be given more than 48 to 72 hrs notice.*

23. Page 4, bullet Item #3 (pages 47 and 194, 3rd bullet item in the PDF): Maintaining inflow equal to inflow on an "instantaneous" basis would require a staff person to continually reside at the dam and is simply unrealistic. The alternative approach proposed in the Water Use plan, and as suggested above, the following language should be considered here: "Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod's 90%ile event volume, but without the volume of the 20 percent buffer released to compensate for losses." However, UDWS would prefer to simply agree to cooperate with NHDES to develop reasonable relief flow protocols based on experience from actual relief flow trials.

24. Page 5, bullet Item #4 (pages 47 and 195, 4th bullet item in the PDF): The outflow weir will be self-regulating, and if the UDWS is not withdrawing then we do not plan to pull additional stop logs.

25. Page 5, bullet Item #5 (pages 47 and 195, 4th bullet item in the PDF): The water level drop is proposed to be based on a 7 day average of 1 inch per day.

26. Page 6, bullet Item #6 (pages 47 and 195, 5th bullet item in the PDF): Again, this level of monitoring will require a staff person to reside continuously at the dam. Automated measurements will consist of pool elevation at the Pump Station and flow at the Packers Fall USGS gage.

27. Page 6, 2nd paragraph (page 48 and 196 in the PDF): The paragraph regarding cost needs to be revised to more accurately reflect the Town of Durham's true cost with the following language "The estimated annual costs associated with this work will be dependent upon the number of personnel involved, and either the degree of automation of the system or the number of site visits required to perform the necessary flow management actions and the travel time and mileage, and is expected to range from $200,000 to $400,000 in infrastructure improvements (dam outflow controls) and $10,000 to $100,000 for operation and maintenance". NHDES recently informed the UDWS that they have changed its plan to nullify or supersede Durham's §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan, and instead has suggested that they would prefer to modify to the Certificate's language to simply refer to the Lamprey River Water Management Plan. As recently as October 2010, the Administrator of the Watershed Bureau, Paul Currier, informed the Durham Town Council that the §401 Water Quality Certificate would become null and void upon adoption of the Lamprey River Water Management Plan. The basis of nullifying the Certificate is because ALL the conditions included in the current Certificate will be updated and incorporated into the Water Management Plan. Once the Water Management Plan is adopted, the Certificate will serve no practical purpose and would only perpetuate unnecessary bureaucracy and redundancy regulatory oversight if maintained in some modified form. The UDWS insists that NHDES proceed with nullifying Durham's §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan as was promised to the Durham Town Council.

Responses

The UDWS comments were categorized into groups referring to the Water Management Plan in general, and to the UDWS Water Use Plan and the Wiswall Dam Management Plan. DES replied separately to some of UDWS's comments in a letter on August 26, 2011. The discussion below and the DES letter summarize DES's responses to these comments.

Water Management Plan Comments with responses

DES and UDWS have had continued dialogue which has resolved the comments received concerning their Water Use Plan. DES has made substantial changes to the form and content of the Water Management Plan in response to UDWS's comments.

1. UDWS suggests that the report should not summarize the plan information in the body of the text.
   DES response: This approach allows a comprehensive overview of the parts and will be retained.

2. UDWS suggests the addition of owners names to a list of dams.
   DES response: Owner's names will be added.

3. UDWS states that water use projections suggesting the need for management are not certain.
   DES response: Regardless of the figures used, management is needed to meet the protected flows under existing use and watershed conditions.

4. UDWS objects to certain details of per capita water use in the discussion of water demand impacts on the Lamprey and to the characterization as "often" of the occurrences of water demand exceeding flow based on the earlier discussion. (1st P. on p. 25)
   DES response: The per capita values are conservative estimates of water use and do not affect the implementation of the Water Management Plan. The value of 150 gallons is frequently used to estimate required flows for new developments.
   The point is being made that low flows that exceed water demand are common enough to be of concern. This text has been revised.

5. UDWS objects to referring to the Lamprey River near Newmarket gage as the Newmarket gage
   DES response: Text has been changed to say "near" Newmarket.

6. UDWS characterizes the deadline for the Conservation Plan by June 1, 2012, as possibly unrealistic, but will make a reasonable effort to complete it by that date.
   DES response: DES appreciates the continued effort to develop a UDWS Conservation Plan and will continue to provide whatever support is appropriate.

UDWS Water Use Plan

7. UDWS states they need the impoundment drawdown rate extended from a daily to a weekly average because management by gates and stoplogs is too coarse. (p.6, draft WUP).
   DES response: When management is needed there are three mechanisms at Wiswall Dam that may be used singly or in combination to manage outlet flows: an outlet notch, the Denil fish ladder gate, and two low-level outlet gates.
   DES recognizes that UDWS has had little experience with management of these dam outlet controls constructed in July 2011 and that a test period is warranted to try various configurations to meet outflow requirements. DES expects that management actions will not meet the management goals continuously. However, relaxing management actions will not result in meeting management goals.

The ideal management would maintain only as much outflow as is needed to match inflow. Using stoplogs in the outflow weir may make it difficult to maintain a steady drop in pool elevations. Releases by stoplog removal are likely to be represented as a increase in flow followed by a gradual decline as water level behind the dam drops.

DES agreed to a drawdown rate of 1 inch per day after discussions with UDWS. Several years ago during a rapid drawdown for repairs, Normandeau Associates noted that rapid drawdown between 12 inches and 18 inches had stranded aquatic species above the water line and flushed other aquatic species out of their wetlands habitat. UDWS has proposed a 1 inch per day drawdown averaged over a week, recognizing potential difficulties in creating the ideal management conditions. The worst case scenario under this proposal would be a large release and withdrawal resulting in up to a 7 inch drawdown in less than a day. This would be followed by a week of flow equal to inflow less UDWS's withdrawal, and the cycle would be repeated the following week. DES's goal is to match outflow with inflow more closely than a seven day average would allow.

The goal of one inch per day will be retained while allowing for a period of testing various configurations of the outlet structures to meet outflow goals. UDWS will operate the withdrawal and Durham will operate the dam to maintain outflow such that Wiswall Reservoir levels are commensurate with inflow. Adaptive management will be applied using experience gained through testing the operations of the outlet structures. DES and UDWS will arrive at a final rate of change goal for managing Wiswall Reservoir based on testing existing and alternative outflow configurations and their effects on aquatic life and habitat.

8. UDWS staffing hours during the work week means that acknowledgement of DES release plan notifications within 24 hours only works Monday through Thursday.

DES response: DES will issue a preliminary notification 72 hours in advance of an anticipated relief flow pulse, which will allow UDWS to schedule appropriate personnel.

9. UDWS states a lack of confidence in the arrival of sufficient relief flow volume and is concerned that they will be responsible for providing the difference. UDWS suggests the option of making a "reasonable effort" to pass the relief flows below Wiswall provided that an adequate volume is released.

DES response: UDWS need only pass the relief flow that arrives at the Wiswall Dam. UDWS is not responsible for making up any deficit in relief flow volume. Language to this effect will be added to the Water Use Plan.

DES's goal is to release from upstream and then pass through Wiswall Dam a pulse of water that exceeds the protected flow magnitude for two days following a catastrophic condition. These pulses are called relief flows.

DES determined the relief flow volumes that will be released so as to meet or exceed the requirements of the protected flows at the USGS gage downstream of Wiswall Reservoir. It will be up to DES to release sufficient flow such that an adequate volume arrives at Wiswall Reservoir.

UDWS must pass only inflow as it arrives from relief pulses until it exceeds the protected flow. If insufficient flow arrives at Wiswall, no water from storage must be passed to make up for any deficits in relief flows.

UDWS's Lamprey Flow Monitoring Plan states that they can calculate inflow based on change in impoundment level, the USGS gage flow rate and the UDWS withdrawal pumping rate. UDWS may withdraw water from Wiswall storage at any time. UDWS may take water from Wiswall storage during a relief pulse provided it can quantify and release the relief pulse inflow that arrives at Wiswall Reservoir.

UDWS does not need to operate Wiswall Dam to release the relief pulse if outflow is maintained to equal the inflow (i.e., the water level does not increase.) A relief pulse that is attenuated by the outlet structures at Wiswall Dam will require UDWS to operate those structures to pass the pulse within the two day period. If water is already passing over the spillway, this requires no further action. However, if UDWS is withdrawing water or water is not above the spillway, the relief flow would be partially or completely captured and the gates or stoplogs should be operated to release the relief flow.

Tests under actual low flow conditions were conducted by DES. Testing was necessary to confirm the time lag between release and arrival at Wiswall Dam. The time between the release and arrival at the USGS gage three miles downstream was measured at 23 hours in 2009. During tests in 2012 and 2013, pulses arrived 17 to 18.5 hours after the release. UDWS participated by evaluating Wiswall Reservoir water levels during these tests.

10. UDWS requests a 0.8 cfs allocation for 7 days after other water users are out of the river at 18 cfs and 0.4 cfs allocation for the next 8 days instead of using Oyster River Reservoir or Wiswall Reservoir storage.

DES response: Based upon further discussion with UDWS this will not be part of the UDWS WUP.

11. UDWS agrees to work with the Town Council and UNH to put summer time water use reduction into their ordinances.

DES response: Thank you. DES appreciates the work of UDWS to achieve these reductions and will be glad to provide assistance to UDWS and the Durham Town Council.

12. UDWS describes the costs of this part of the Water Management Plan to reflect permitting, infrastructure, and engineering costs for a new water source valued at $4 million to $6 million.

DES response: UDWS explained that this is the cost of developing and permitting the Spruce Hole well. Applying these costs to the Water Management Plan assumes that the additional water source is needed only because of the ISF program. DES believes instead that UDWS is anticipating increased water demands and acknowledging the desire for diversification of sources to reduce risk.

Currently, the Lamprey River Water Quality Certification #2001-001 regulates withdrawals from the Lamprey River when stream flows are below 45 cfs. The adopted Water Management Plan will expand the availability of water by increasing the volume of water available at lower flows, and by increasing the useable storage in Wiswall Reservoir. Management activities by UDWS during water withdrawals under the Water Management Plan will be less frequent than those required under the Water Quality Certification because they apply only under more rarely occurring conditions.

Wiswall Dam Management Plan

13. UDWS wants to include UNH into the list of entities granted water in the 1965 legislation.

DES response: The statute (Laws of 1965, Chapter 65) includes only the towns as authorized to use water from the Lamprey River, not the University. UNH's status under this legislation does not affect the Water Management Plan components for UDWS or Wiswall Dam.

14. UDWS revises the estimated Wiswall storage between 6 inches and 12 inches upward by 6% from initial estimates, citing documentation in a subsequent email of August 25, 2010.

DES response: The revised value has been used in the Water Management Plan.

15. UDWS requests that the primary purpose of Wiswall impoundment be changed from recreation to water supply.

DES response: DES described the procedure for changing the primary purpose to UDWS at the April 6, 2011 meeting. This request must be sent to the DES Dam Bureau. The Dam Bureau has stated that they would approve such a request. The Water Management Plan will retain the current information until an official change is made.

16. Confusing last sentence on p. 193, third to last paragraph. "Alternatively, water withdrawal may lower water levels in the impoundment below the spillway, thereby requiring operation of the dam to maintain downstream flows."

DES response: This section has been revised.

17. UDWS wants the report to note that the larger part of the three river miles below Wiswall is impounded.

DES response: Implied in this request is that flow downstream of Wiswall Dam is not very important. Water quality standards apply to all surface waters. This comment has no bearing on the Dam Management Plan.

18. UDWS disputes that Wiswall impoundment is large enough to attenuate the relief flows. UDWS then points out that DES assumes that the water released from upstream dams will be passed downstream to Wiswall.

DES response: Attenuation of the relief flows into longer and lower volume pulses will occur when a relief flow does not have access to the spillway or another outlet capable of passing these flows due to low water levels in Wiswall Reservoir. The volumes of two bioperiods' relief flow pulses could be stored in Wiswall Reservoir if the starting Wiswall water level is at 18 inches below the dam crest. These relief flows would be essentially captured under these conditions if an appropriate outflow is not maintained.

Larger relief flow pulses will occur during the Clupeid Spawning, the Overwintering and the Salmon Spawning bioperiods. Passage of these larger pulses will also be significantly attenuated if required to pass through the outlet notch without adjusting the stoplog level to maintain Wiswall Reservoir outflow equal to inflow.

Attenuation of the relief flow before it arrives at Wiswall Reservoir is possible and DES has accounted for some attenuation between the points of release and Wiswall Dam. The volume released reflects a buffer estimated to offset this attenuation. Testing of the relief flow effectiveness was conducted in September and December 2012 and January 2013. Testing was not under low flow conditions. Under these conditions, DES observed the flow releases passed through Wiswall Reservoir with minimal attenuation. Further testing under low flow conditions will be needed and will be conducted on those occasions. Adaptive management will be applied if release volumes or timing need to be adjusted based on the results of these tests.

DES does not expect UDWS to use any stored water to create the relief pulse, only to pass the pulse that arrives at the Wiswall Reservoir.

19. UDWS states that DES is unreasonable to expect UDWS to pass the relief flows since UDWS cannot manage outflows accurately.

DES response: DES believes that UDWS, with the additional structures related to the fish ladder construction, has the ability to pass the relief flow pulses and manage flows to offset the effects of pumping withdrawals when expected. The July 2011 construction of an outlet notch with stoplogs, a Denil fish ladder with a gate, and the replacement of the two existing lower level gates create mechanisms for managing outflow that were not available in the September 2010 trials using only the older lower level gates, which were then in disrepair.

20. UDWS suggests deletion of a list as redundant to another list on Page 4 (Page 194 in the PDF).

DES response: The first list is a summary. The following text expands on that outline. No change will be made.

21. UDWS does not understand the text saying, "whichever is less" in the first management condition applying to passing flow on Page 4, bullet Item #1 (page 47 and 194, 1st bullet item in the PDF.)

DES response: The text has been revised.

22. UDWS staff is not available to confirm receipt of notification within 24 hours on Fridays or weekends. UDWS wants 48 to 72 hours advanced notice.

DES response: DES will issue a preliminary notification 72 hours in advance of an anticipated relief flow pulse.

23. UDWS does not want to commit to passing the relief flows. UDWS would prefer to agree to cooperate with NHDES to develop reasonable relief flow protocols based on experience from actual relief flow trials.

DES response: UDWS will attempt to pass the increase in flows arriving at Wiswall impoundment. Adaptive management will be applied if initial attempts fail. Adaptive management is part of the Water Management Plan provisions as are trials of the volumes and the timing of relief pulse flows arriving at Wiswall Reservoir.

UDWS will base trial releases on measurements of inflow based on the process described in the Lamprey Flow Monitoring Plan developed to meet conditions of the Lamprey Water Quality Certification. DES will work with UDWS to evaluate and adjust release conditions based on trial runs.

24. UDWS does not plan to manage the stoplogs if they are not pumping because the outflow weir will be self-regulating.

DES response: It is not clear how UDWS will cause the outflow weir to be self-regulating. If the outflow weir constricts inflow from passing downstream, management will be needed. If not, then no management will be required.

When the water level is over the spillway, additional flow resulting from a relief flow pulse would not be delayed and no management would be required. Whether currently pumping or not, water levels below the spillway will require flow to pass through the outflow weir that was constructed in July 2011. As long as outflow equals inflow, no stoplog management will be needed. Larger volumes of flow change attempting to pass through the outflow weir may be constricted. To pass some of the relief flow pulses, management of the stoplogs to meet the relief flow conditions may be necessary.

25. UDWS proposes the rate of water level decline of 1 inch per day be averaged over 7 days.

DES response: The rate of decline will be 1 inch per day during a period of adaptive management to test the effectiveness of the management processes. See response to Comment 7 also for more discussion.

26. UDWS states that limiting the drawdown to 18 inches overall and 1 inch per day would require extensive staff time. UDWS states that automated measurements will consist of pool elevation at the Pump Station and flow at the USGS gage.

DES response: UDWS later notified DES that a water level recorder has been installed at the UDWS withdrawal point on the river. This is a component of UDWS's Lamprey Flow Management Plan to measure inflow under their Water Quality Certification # 2001-001.

UDWS has not yet provided DES with results from calculating inflow under UDWS's Lamprey Flow Management Plan and reserves the need to make changes based on demonstrated results. DES has calculated withdrawal rates equivalent to 1 inch of drawdown per day and these calculations can be used by UDWS. By managing pumping and dam operations to match these rates, staff time will be minimized. UDWS will be developing an Standard Operating Procedures (SOP) document for determining inflow to Wiswall Reservoir and for determining the necessary outflow configurations of the dam to match inflow.

27. UDWS attributes the costs of the Water Management Plan to include the cost of infrastructure improvements for the dam outflow controls at costs from $200,000 to $400,000 and $10,000 to $100,000 for O&M.

DES response: UDWS indicated at subsequent meetings that these changes are the costs for installation of the Wiswall Dam fish ladder, outlet notch and low flow gates. These values of $200,000 to $400,000 should not be attributed solely to the Instream Flow program. The fish passage construction was necessitated by other state and federal requirements and was largely paid for with federal funding (including a significant local match).

The management plan will require additional time for UDWS employees to operate the dam outlet structures during a flow relief pulse since these pulses are new conditions, so there is an increased cost. However, these conditions requiring management are rarely encountered. In addition, the fish passage system will also require management.

Without further input from UDWS, DES's original estimates will continue to be used in the plan.

28. Lamprey 401 Water Quality Certification #2001-001 – UDWS insisted on not having a 401 Water Quality Certificate.

DES response: Text referring to the status and application of the 401 Water Quality Certification (WQC) relative to the Water Management Plan has been struck from the WMP; statements that the 401 WQC applies still remain in the historical documentation.

Issuance of the WMP does not relieve UDWS from its federal 401 WQC requirements. However, the 401 WQC will be revised to say that, after its adoption, the Water Management Plan will become the effective description of water use management applicable under the 401 WQC.

DES additional comments:

29. DES is concerned with the use of demand/capacity ratios that UDWS has added to the plan to determine outside water use stages

DES developed plans for outside water use reductions tied to Lamprey River stream flow stages to reduced demand. Outside water use reductions are in effect from May 5 through October 6 when limited source water availability corresponds with low river flow periods according to criteria described in the Durham UNH Conservation Plan.

Earlier in the development of the Water Use Plan, UDWS suggested adding demand/capacity ratios as additional criteria for determining the stage conditions when the outside water use conservation would begin. DES believed the additional criteria were justified because UDWS has water sources outside of the Lamprey watershed not affecting flow in the Lamprey and because UDWS has a unique seasonal water use pattern whereby the highest demand occurs in September and October.

However, these additional criteria add unneeded complexity to evaluating conditions for reducing outside water use reductions. DES suggests the removal of these criteria.

If retained, the application of demand/capacity criteria to this plan needs to be further evaluated as to the values used and how the ratios are to be assessed. DES reserves the right to re-evaluate these criteria with UDWS as UDWS continues to develop this process. Development, with DES involvement, of the demand/capacity ratio algorithm is a requirement under UDWS's Water Use Plan.

8.0 Received Written Comments

All received written comments may be found Appendix J.

Appendix J

Written Comments

Lamprey River Water Management Plan

August 2013

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MA 02109-3912

Mr. Ted Diers, Administrator,
Watershed Management Bureau
New Hampshire Department of Environmental Services
P.O.Box 95
29 Hazen Drive
Concord, New Hampshire 03302

June 20, 2011

Re. Proposed Lamprey Designated River Watershed Management Plan

Dear Mr. Diers:

Thank you for the opportunity to comment on the Proposed Lamprey Designated River Water Management Plan (WMP). EPA is providing these comments in its role as a member of the Instream Flow Technical Review Committee (TRC) for the Lamprey River. It is our understanding that Lamprey River River Instream Flow Report's (DES, 2009) Protected Instream Flows (PISFs) will be maintained through implementation of the Proposed Lamprey River WMP. Although we have not actively participated the development of the WMP, to the extent that it relies on the findings of the PISF, we are providing comments. Our comments focus on two topics: elimination of the 4 cubic feet per second (cfs) cut off flow and the proposed relief flows.

Cut off flow of 4 cfs

The Draft PISF included a recommendation that a 4 cfs minimum be maintained at the USGS gauge at Packers Falls.

> "The lowest naturalized flow recorded in last 30 years was 3.7 cfs at the Packers Falls gage. Hence, allowing flows to fall under this level creates unpredictable, catastrophic conditions that are not protective to the aquatic community. Therefore we recommend that the flows should never be allowed to fall below 4 cfs.

That recommendation was not included in the Final PISF or in the Proposed Lamprey River WMP. In a response to a comment on this by the National Park Service on the Draft PISF, DES stated,

> "It should also be noted that the recommendation that "flows never be allowed to fall below 4 cfs" has been withdrawn from the report. It is believed that the remaining flow protections, when implemented under the Water Management Plans, will prevent abnormally low flow

> conditions. If flows were to reach these levels because of natural conditions, it is likely that emergency status would be declared by the Commissioner under RSA 483:9-c.IV.

While we recognize if natural flows that drop to this level it may constitute an emergency situation, it seems that having no floor in the PISF is not protective of aquatic life. We believe that you can have both, a floor to withdrawals and a provision for emergency use (Chapter 483:9-c s)

Proposed Relief Flows

The WMP contains provisions for relief flows. (Table 7 and Appendix F) According to the WMP, aquatic experts on the project team suggested that

> … the stress on the aquatic ecosystems due to flows being below the protected instream flow could be reset by the occurrence of least one day where the river flow exceeded the protected instream flow magnitude.

To the best of our knowledge the concept of relief flows was not examined by the Technical Review Committee nor is included in either the Draft or Final Lamprey River Instream Flow Report. The relief flow volume, according to the Proposed WMP, was computed as the amount of water deficit for the two day period immediately after each persistent and each catastrophic duration was reached in the historic record. Not surprisingly, an examination of Table 7 shows that it is roughly the same percentage of the volume needed to meet historical deficits for each bioperiod. While two days of relief flows would give some aquatic species some relief from lows flows, the biological rationale for a two day relief period for each bioperiod should be re-examined by either the Technical Review Committee or other appropriate scientists. The relief flows would require releases from two upstream impoundments. We understand that the WMP looks at balancing water uses with PISF recommendations; however, a better scientific rationale for the length of the pulse releases would make that process more transparent.

Thank you for the opportunity to provide comments. Please contact me at (617) 918-1629 if you have any questions about our letter.

Sincerely,

Ralph W. Abele

Ralph W. Abele
Instream Flow Coordinator
EPA Region 1

-----Original Message-----
From: Lee Bartlett [mailto:leebartlett@juno.com]
Sent: Monday, June 20, 2011 3:24 PM
To: Ives, Wayne
Subject: Lamprey River Water Management

Mr. Ives,

Thank you for extending the comment period regarding the Lamprey River plan.

I have concerns regarding instream flow management and its reliance on Pawtuckaway Lake as a reservoir. The study seems to have been limited to management of a small section of the Lamprey without any study of the impact that might result to the Pawtuckaway and to the wildlife in and around the streams that feed into the lake. There also seems to be no limit to the number of discharges and the total volume per year that could be released.

As a lakefront property owner, a change in the level of the fall drawdown increases the probability of damage to docks. I am unsure what that level means to my property and others have voiced the same concern. As the usual drawdown will occur this fall, would it be possible to stop the drawdown at the proposed level for a period of two weeks before resuming to completion? This would give property owners, as well as DES time to assess the conditions at that level.

Thank you for your consideration.

Lee Bartlett
36 Barderry Lane
Nottingham, NH

The Nature Conservancy
Protecting nature. Preserving life.™

The Nature Conservancy in New Hampshire
22 Bridge Street, 4th Floor
Concord, New Hampshire 03301-4987
Tel: [603] 224.5853
Fax: [603] 228.2459
www.nature.org/newhampshire

CELEBRATING 50 Years OF CONSERVATION IN NEW HAMPSHIRE

Wayne Ives, Instream Flow Specialist
Watershed Managemen Bureau
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

RE: Comments on Lamprey River Water Management Plan; Public Comment Period

20 June 2011

Dear Wayne,

Please accept these comments on the Lamprey River Water Management Plan (WMP). The mission of The Nature Conservancy is to preserve the plants, animals, and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. The Conservancy's freshwater conservation includes decades of working to balance human and ecosystem needs in rivers.

We applaud the use of similar methods employed by DES and its partners, particularly basing flows on magnitude, duration, and timing necessary to sustain river life, as defined by the Natural Flow Paradigm. We also applaud DES and its partners for defining human needs, such as recreation and water supply, as part of the list of Instream Public Uses, Outstanding Characteristics, and Resouces (IPUOCRs). We support balancing water for nature and people, particularly where management actions resulting in minor adjustments provide relatively high benefit for the majority of uses and resources.

In general, we support the method, science, and approach used by DES throughout the Instream Flow Program's pilot study. While there are multiple ways to define and protect instream flows, the methods used by DES are science-based, detailed, and can serve as base line against which to compare future conditions. The staff at DES has been responsive to input and comment from multiple parties. We urge DES to employ an adaptive management approach in the future, which will allow for flexibility, and requires employing new information and tools as they become available.

While we do not offer comments on specific recommendations for each dam owner and water user, we do support DES's proposal that during emergency drought periods (catastrophic low flows), water from impoundments be released to protect downstream resources. Based on the available data, such draw-downs would be rare, and would have minor impacts to human and ecosystem needs relative to the benefits downstream. Similarly, we support retaining more water in impoundments during winter months to ensure there is enough water storage for potential use in summer months. Retaining higher winter pools would also support lake ecosystem processes and can help maintain long-term water quality and wildlife habitat. We believe reducing the winter drawdown can be done in a way that achieves both human and ecosystem objectives.

We recommend that DES identify a catastrophic flow level, regardless of duration, that will require management if, or when, it is reached. For example, if during severe drought, the cubic feet per second (cfs) flow falls below XX cfs, water releases would be utilized to maintain a minimum flow level. DES should define that minimum flow based on the combination of historic hydrograph data and the IPUOCR analysis already performed. While conservation measures may already be in place during such a rare event, it seems important for an Instream Flow Program to define the absolute minimum allowable flow, no matter its duration, timing, or seasonality.

We also recommend that DES define a monitoring and adaptive management approach that will inform future Instream Flow management and program decisions. The online tools that compare current flow data against Protected Flow thresholds are a good start – they allow for comparison between defined thresholds and actual flow conditions. How will DES provide for changes in thresholds and/or management decisions, particularly as patterns of climate and extreme precipitation events change over time? River flows fluctuate over time, and patterns are not necessarily detectable over a few years or even decades. DES should address how to they will adapt given new information. Because fisheries are one of the primary IPUOCRs defining flows, monitoring their response to flow management would be an essential part of any long-term adaptive management approach.

In closing, we would like to re-iterate our support of DES and its partners for developing a systematic, detailed, and science-based Water Management Plan. River ecosystems and the human and natural resources they support, are inherently complex and notoriously difficult to manage. DES has, for years, utilized the best tools and data to develop comprehensive decision-support protocols for Instream Flow, and we support and applaud their efforts. We hope they continue to act in a way that is responsive to human needs, and protects the resources under their charge.

Sincerely,

Doug Bechtel

Doug Bechtel
Director of Freshwater Conservation

From:	Collins, Luke
To:	cboudreau@verizon.net
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Pawtuckaway Lake involvement with Lamprey River Water management plan
Date:	Thursday, May 19, 2011 8:08:10 AM

Dear Ms. Boudreau,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau
Phone: 603-271-2963
Fax: 603-271-2867

-----Original Message-----
From: cboudreau@verizon.net [mailto:cboudreau@verizon.net]
Sent: Wednesday, May 18, 2011 1:54 PM
To: Ives, Wayne
Subject: Pawtuckaway Lake involvement with Lamprey River Water management plan

May 18, 2011
To: wayne.ives@des.nh.gov
Regard: Lamprey River Water Management

My family has been part of Pawtuckaway Lake since 1948. I remember when the lake was drawn down each summer for "water rights" even though the mills in Portsmouth no longer used water to make their energy. We were unable to use the lake at all in the summer time—it was a mud puddle. When the water drawn-down stopped, the properties on the lake were developed and the state park came in, which as everyone knows, is a hugh asset for southern NH.

A few years ago the town of Nottingham assessed each owner of lake front property a minimum of $250,000 plus the regular assessment for land. That computes to $1,000,000/acre since my family has but 1/3rd acre of land on Pawtuckaway Lake. How much do you think the lake front properties are going to be worth if the water is reduced in the summer time to take care of the lower Lamprey? The answer will be zero and the town of Nottingham will be bankrupt.

Pawtuckaway Lake has many wonderful attributes, both for the property owners and the thousands of visitors that come there year round. Destroying this beautiful lake by drawing down the water in the summer to support the lower Lamprey is a crime.

We have already had to deal with a foreign company trying to tap into the water table above the lake to sell commercially bottled water. We have been fighting evasive weeds, farm fertilizer and animal waste contamination, etc. for years to protect this resource.

One responder wrote “let nature take care of its own”. Unfortunately, that true to only a certain extent. Pawtuckaway is a man-made lake. Its’ resources are used (and abused) by many. We need to be good stewards of this asset. Reversing 50 years of policy (no draw-down) for whatever reason, is a very bad idea.

Sincerely,

Claire Boudreau
55 Mooers Road
Nottingham, NH

Original Message-----
From: Jim Breen [mailto:jimbosr@comcast.net]
Sent: Monday, June 13, 2011 9:06 AM
To: Ives, Wayne
Subject: Re: Lamprey River Water Management Plan Report

Mr. Ives,

I am a resident of the Pawtuckaway lake area and listened to your comments this past weekend. I have some questions for you.

1. Was a legislative study, showing negative impact to the designated river area, done prior to enacting this legislation funding you and your study? It appears the whole focus of this report is to sell the river flow whether or not it makes scientific sense.

2. You studied the river flow for many years and used this to justify your report, but couldn't be bothered to study the history of the Pawtuckaway Lake pool levels during this time frame. Instead you use "Change in water level is based on a starting point of full pool. Lower starting points will result in larger changes in water level." This is where your report is totally unrealistic. If you are using drought figures for your river flow rates, justifying water draws, why wouldn't you use drought conditions for the level of your water source to draw from. No science here. Just political salesmanship. Much easier to justify just 3 inches from full pond level than 8 inches from a pond already down a foot!

3. You stated the draw down will only affect 75 acres 10% of Pawtuckaway's 750 acres. Since you didn't do any study of Pawtuckaway, is this using the volume of the lake as if it were a flat bottom with square sides? So if 50% of Pawtuckaway's acreage is located in the first 3 inches, at full pond level , your draw down could affect 375 acres. But that would require a proper study, which is not the case here.

4. Your 2 day draw is to restore a minimal flow to the designated area of study for 1 day. I have to ask if you looked at how many acres are we affecting with this restored flow? If the river area we are looking at is 12.05 miles long and the restored river is 25 feet wide (Optimistic), we have restored 36 acres of the river for ONE day. Yet you claim to be disturbing 75 acres of Pawtuckaway for the remainder of the drought period(Many Days). This doesn't make sense to me! Then you talked about the reclaiming properties of the lake. That requires rain. But if it rains you don't need the draw down?

I will admit I am not an engineer, however my common sense would tell me, running a couple of days of water across a dry river bed is not much help to the environment, when all areas of the environment are being stressed. Ask your "Grass engineers", who tell us not to water a lawn with a minimal amount of water, because the grass will be better able to take care of itself through a dry period without it.

Your comments Saturday, seem to indicate, all the water held in Pawtuckaway lake is un-natural and the reason for the river flow being low. Seems to me, if all the damns were removed and all the water were allowed to flow into Great Bay all year long, a drought would have the same effect on your designated area as it does now. Plus, all the wetlands, marshes etc. now created from the damns would be gone also.

In conclusion, your study and report is far short of a truly impartial look at the benefits versus the side effects of this river flow plan. We need a third party impartial review of the whole thing prior to pulling or leaving boards in the damns of these lakes.

James Breen
14 Brustle Rd.
Nottingham, NH.

6/17/11 UNH Campus Recreation Comments (Sailing, Crew, General Outdoor Recreation)

Lamphrey River Emergency Drawdown Notes:

Sailing:

The University of New Hampshire Sailing Program uses Mendums Lake, in Barrington eight months out the year for its various programs, March (pending ice out) – Early November.

During the academic year the UNH Sailing Team provides sailing lessons and racing programs for over 50 collegiate students. The collegiate team also hosts several regattas at Mendums. At each of these events there are between 90-130 participants. During the spring of the year in addition to the collegiate team we also serve a large number of junior and senior high school students from the neighboring towns/schools. We host the NH State Championships and several other regattas, including the Mark Trophy the New England Team Racing Championship which saw over 100 competitors for the weekend. In addition we run an instructional program for the UNH Family Boatbuilding Program and their docents. During the summer the Summer Community Program serves over hundreds of different family members, including children ages 6-18 **and** adults.

After our devastating fire last year (March '10) the local sailing community, families, various regional and national yacht clubs and team parents helped raise over $85,000 in order to purchase new sailboats. In addition seacoast community members also loaned and donated various boats for the Sailing Programs' use.

In the fall and early spring the effects of the current lowered/normal water levels has presented significant safety issues as well as damage concerns for all of our sailors and boats. When sailboats come close to the shore damage can be significant. Rescue becomes more difficult, often damaging safety boat propellers in addition to the damaging sailboats. Often rocks are closer to the surface in areas not expected. All costs money, time and decreases the availability of use. These costs are borne by the sailing team members.

The availability of boats negatively impacts the Sailing Program both for practice and hosting events. In addition the lowered water level makes it extremely difficult to both launch and remove safety boats as well as our docks from the water. In years past when the water level was low in the spring the Sailing Program was unable to have our docks and boats accessible to the shoreline, instead we had to anchor docks 100 feet away from shore creating access difficulties for all concerned and putting our sailboats and sailors at greater risk. Additionally participation decreased as a result. A side consequence was access by homeowners as they too have less area in which to recreate.

The thought of lowered water for more than a week or so puts the entire University of New Hampshire Sailing Program in serious jeopardy, impacting hundreds of kids and adults. It spells potential disaster for the only community sailing program in the state of New Hampshire.

All kids on the seacoast should know how to sail.

Crew/Rowing:

- Extremely difficulty in launching the safety/chase/coaching launches in the cove that houses the team docks and boat ramp.

- As depth decreases, the danger of hitting rocks increases around the sailing cove and the sailing practice area.

- The navigation/hazard markers, throughout the pond, will need to be updated in a very timely manner, to help prevent damage to persons and property.

General Outdoor Recreation:

There are a few concerns we would like to share regarding the emergency drawdown recommendations by DES. The first and foremost comment offered is 1. safety of our participants, 2) reduction/elimination of recreational opportunities for the UNH and Barrington communities. Assuming normal depth reduction due to weather and supply issues, we would see a significant safety risk to those using Mendums for recreation, swimming, boating, canoeing, kayaking and fishing. The pond itself is, at point of high water, always a safety concern. The area around the key swimming and boating areas are shallow, with intermittent rocks throughout. Some of the rocks are easily seen, many are at water level or just slightly below water level, regardless of water depth. Assuming a drought condition and normal evaporation/weather related conditions, a 4" lowering of this body of water will make the recreational area a greater risk for those utilizing the area. Swimming may need to be eliminated or restricted to a level that children are not allowed to participate. Boating will likewise be affected as the 'informal beach like' areas, the islands, the sailing bay (also a loon nesting area) and surrounding areas are rife with both hidden rocks, those rocks in plain sight and those just under the surface. Marking the rocks or problems areas will be problematic/difficult. We are not sure of the effect of a drawdown on the portable docks and safety launches as we have not mapped the bottom when the pond is drawn down in the late fall…we will be doing this, this next fall drawdown period. The last major concern I would like to mention is one which was highlighted during the Pawtuckaway Lake Improvement Assn. meeting on Sat June 11 in Nottingham. That fact is: that the studies done have been done with Pawtuckaway Lake and the river in mind, but the detailed studies have not been completed to the same level at/for Mendums Pond. I would think this would be a major concern in implementation at this point-from the perspective of Mendums.

Please let me thank you for your consideration of these concerns and we all here at UNH would be happy to discuss this further at any point in this process!

Respectfully,

Denny Byrne, Director
UNH Campus Recreation
128 Main St.
Durham, NH 03824
603-8622-2073

LAMPREY RIVER
Wild & Scenic

LAMPREY RIVER ADVISORY COMMITTEE
NEWMARKET - DURHAM - LEE - EPPING
NEW HAMPSHIRE
www.lampreyriver.org

June 16, 2011

C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
Watershed Management Bureau
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

RE: Lamprey River Water Management Plan Report NHDES-R-WD-11-9

Dear Mr. Ives,

The Lamprey River Advisory Committee (LRAC) appreciates the opportunity to comment on the Lamprey River Water Management Plan Report NHDES-R-WD-11-9, hereinafter referred to as the "Plan."

As with its previous comments on instream flow, the LRAC's principal concerns regarding this subject are ensuring that there is adequate flow in the Lamprey River for ecological needs and recreational use. The LRAC continues to believe that if adequate flows are protected to support and maintain these uses there will be ample flow for other protected uses.

The LRAC generally supports the protected instream flows and the triggers for the seasonal bio-periods. The LRAC also supports in general the three-pronged strategy for managing instream flows—Conservation Plans, Dam Management Plans, and Water Use Plans. However, the LRAC also offers the following comments and concerns regarding the Plan.

1. There is some confusion among the stakeholders as to the pilot nature of the two-year program. The introduction to the Plan should make that clear. The LRAC suggests that an evaluation be made **one year** after implementation to inform stakeholders and the public as to how the Plan is working and to make any adjustments for the next year. In 2013, we understand that the pilot program in its entirety will be evaluated, but feel that an interim evaluation is necessary as well.

2. The Plan should articulate <u>how</u> the pilot program would be extended to the rest of the Lamprey and several of its tributaries which have just been designated into the program

as well as how other rivers designated under the NH River Management and Protection will be included in the Plan.

3. The water conservation plans should be mandatory for drinking water suppliers that withdraw water from the Lamprey River. We believe that these water conservation plans should be made enforceable through a town ordinance with penalties for non-compliance.

4. According to the Instream Flow report and subsequent advisory management meetings, the River should never fall below 4 cfs and the protected flow is established at 16 cfs. However, the Plan is structured in such a way that the potential exists for the flow at the USGS gage 01073500 Lamprey River (Packer's Falls location) to drop to zero for as many as 25 days during the rare flow, catastrophic duration during the July 5—October 6 bio-period before Stage 4 conservation actions are taken. Such a situation would clearly result in negative effects to ecological resources, including but not limited to the rearing and growth of the shiner. This is contrary to RSA 483:9-c, IV which states: "The protected instream flow levels established under this section shall be maintained at all times…" The LRAC urges that some provision tied to flow magnitude, not duration, be added to the Plan to address this possible scenario. Further, it is unclear to us why the 4 cfs protected flow value was removed from the Plan. Please explain.

5. We are uncertain that the proposed relief pulses are of adequate duration to address the negative ecological effects that occur during low flow periods. Natural relief in the form of precipitation tends to be widely dispersed throughout a watershed. Consequently, runoff and infiltrated precipitation are gradually delivered to the stream network in a dispersed and staggered manner. By contrast, the relief pulses presented in the Plan are delivered in short bursts to the largest components of the network. While they may buy some time, it is uncertain if they will be effective at offsetting the ecological effects of low flow. Please explain how the Department of Environmental Services intends on evaluating whether or not the relief pulses are having the desired effect.

6. The LRAC is mindful that the relief pulses during the summer and winter seasons may result in drawdowns which could negatively affect upstream lakefront property owners. While unwanted, the summer drawdowns are likely to be infrequent with little change to lake level. However, winter drawdowns are more ecologically problematic and less manipulation of the impoundment levels would be preferred. The LRAC encourages further examination of this management strategy.

Thank you for this opportunity to comment. The LRAC looks forward to the implementation of instream flow protections for the Lamprey River and its tributaries.

Sincerely,

Sara Callaghan,
LRAC Chair

From:	Collins, Luke
To:	casescove@comcast.net
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Lamprey Designated River Water Management Plan
Date:	Monday, May 16, 2011 2:53:19 PM

Dear Mr. Case,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

-----Original Message-----
From: casescove@comcast.net [mailto:casescove@comcast.net]
Sent: Sunday, May 15, 2011 12:23 PM
To: Ives, Wayne
Cc: Tom Duffy
Subject: Lamprey Designated River Water Management Plan

Good Morning Mr.Ives,
I have supported the Nomination of the Lamprey River Water management effort from almost the start. I have voted for this designation on two occasions in the "House". I hope that I will not be sorry that I have taken these actions.

We have been land holders on the shore of Pawtuckaway Lake since 1963. We have had our primary residence here since 1984. As home owners here, we are concerned about the recent discussion of action to be taken to protect the "watershed areas of the Lamprey River" This action is the draw-down of both Pawtuckaway Lake and Mendums Pond.

I can only express my concerns in regards to Pawtuckaway Lake, as we are owners of shore line property and if the 5 1/2 foot instead of the usual 7 foot draw-down does not drain the water from our docks, there is the possibility of damage to docks, by out going ice. Many of us on the shore line also pull our pontoon boats up on shore in the fall and then when the lake is dropped the 7 feet, our boats are on dry land for the winter.
I am also concerned about the effect that this could have on our wild life, such as beavers, game fish,the loons and other wild birds who nest here at Pawtuckaway Lake.

Lastly, there is a possibility of "infrequent" 2.5 inch drawn-downs during the late summer months, which concerns every one on the lake who travel around the lake by boat. With there "infrequent" and probably
unannounced withdrawals which would cause rocks not usually exposed or just under the surface, which if struck by a boat motor would do damage to the propeller and possibly the transmission shaft and pontoons or boat

hulls. Pawtuckway Lake is known for the many rocks now in existence, thus the use the term 'A Pawtuckaway Propeller", we do not need to have more rocks exposed during the summer months.

Frank.........................

Frank G.Case,RPh.
NH State Representative
Candia
Deerfield
Northwood
Nottingham

UNIVERSITY of NEW HAMPSHIRE

UNH/DURHAM WATER SYSTEM
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Tel: (603) 868-5578
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June 24, 2011

Mr. Wayne Ives, P.G.
NHDES – Watershed Management Bureau
P.O. Box 95
Concord, NH 03302-0095

RE: Comments from UNH/Durham Water System on the Draft Lamprey River Water Management Plan

Dear Mr. Ives:

The University of New Hampshire/Durham Water System (UDWS) is pleased to provide the below comments relative to the Draft Lamprey River Water Management Plan provided by NHDES in PDF form and dated April 11, 2011, and earlier versions in MS Word format of specific sections pertaining to the UDWS which are attached. The UDWS has been in discussion with NHDES regarding specific language in the proposed UDWS Water Use Plan, the Wiswall Dam Management Plan, and the UDWS Water Conservation Plan. A public meeting between representatives of the UDWS, NHDES, and NHDES's contractors was held on April 6, 2011 to discuss this specific language and the operational realities of complying with the draft plans. It is understood that at least one more meeting will be held to revise and finalize the language.

The following are general comments:

1. Originally, drafts of the proposed UDWS Water Use Plan, the Wiswall Dam Management Plan, and the UDWS Water Conservation Plan were provided in MS Word format for UNH's and the Town of Durham's comments and as mentioned above we have been in discussion with NHDES for some time now regarding specific language. In April 2011, the bulk of the three draft plans were then incorporated into the body of the Draft Lamprey River Water Management Plan, which was provided in PDF format only, and the individual draft Plans were included in separate appendices in the PDF. This has unnecessarily complicated the comment process since now the same information exists in essentially three places with potentially three different versions making proofing of the final information very difficult. Hence, the reason most of the below comments contain three references. Does NHDES plan to maintain the format of having the bulk of the information from the three plans in the body of the Water Management Plan and entirety of the individual plans included in separate appendices? The UDWS does not feel this makes practical sense since

it will make revising the information moving forward even more complicated than it already is. It is our recommendation that the body of the Water Management Plan not contain so much redundant information and instead refer to the individual plans which would be contained entirely in their own appendices.

2. The title of Table 3 on page 19 is "Affected Dam Owners", however it is a list dams not the actual owners. A column should be added that list the owner of the respective dams.
3. The discussion about manageability of instream flows and the need for it is based on a comparison of statistical analyses that were used developed the flow duration curve of the Lamprey River, projections of population increase, and assumptions about water demand. It is important to bear in mind that neither regional population projections nor per capita water use can be expected to follow current trends with a great deal of confidence. Per capita water use has been in decline since the 1970s, which is why the UDWS's water demand is only at 25% of what was projected in 1970.
4. Page 25, first paragraph in the PDF. This paragraph exaggerates the per capita use of users in the watershed (150 gallons per person per day is about 50-100% greater than the per capita use in most area Towns) and therefore exaggerates its impact on the Lamprey River. There is lack of source references to support this discussion. In addition, the last sentence states: "So on average, there is plenty of water, however often demand exceeds supply". The use of the word "often" in this statement is contrary to the lengthy preceding discussion which makes the case that demand exceeds supply infrequently.
5. Page 26, 2nd paragraph in the PDF incorrectly refers to a Newmarket gage. There is no stream gage in Newmarket. The Packers Falls gage is located in the Town of Durham, however for some reason the USGS refers to it as "near" Newmarket.
6. Page 39, 3rd paragraph in the PDF states "prior to obtaining approval for the proposed new source, but no later than June 1, 2012, UDWS will finalize it proposed Water Conservation Plan in accordance with Env-Wq 2101". A deadline of June 1, 2012 may be unrealistic; however, UDWS will commit to making a reasonable effort to finalize the proposed Water Conservation Plan prior to this deadline.

The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS, and to ensure that basic operational constraints do not result in an accidental violation of the **UDWS Water Use Plan**. The first page reference refers to the MS Word document of UDWS Water Use Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.

7. Page 6, paragraph following bullet list (pages 54 and 224 in the PDF): The ability to base the 1 inch per day drawdown on a weekly average is needed in order to manage the reservoir outflow by removing 1 stop log at a time which would result in a release of "slugs" of water much like a relief pulse. This is also essential if for some reason outflow is managed with a

low level gate in which case it is extremely tricky to maintain a steady drop in pool elevations.

8. Page 6, last paragraph (Page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): The notification requiring the UDWS to acknowledge within 24 hours is workable, unless the notification is received on a Friday or a weekend in which case acknowledgment will be provide on the following Monday.
9. Page 7, 1st paragraph (page 55, 2nd paragraph and page 225, 3rd paragraph in the PDF): All the language regarding DES plan to create relief flows, the estimated timing of the pulse arrive, and the estimated volume of the flow expected to arrive at the Wiswall Dam are only estimates since the operation of creating a relief flow on the Lamprey River is completely untested the UDWS is extremely uncomfortable with the prescriptive requirements prior to actual trials being conducted. The language suggests that the owner of the Wiswall Dam could create a relief flow "equal to the current bioperiod's 90%ile event volume, but without the volume of the 20% buffer released to compensate for losses" has great potential failing and cause the UDWS to violate the conditions if the volume that arrives at the Wiswall Reservoir is inadequate. Because the concept of creating a relief flow is untested, the UDWS has little confidence that the 20% buffer released from the upstream sources will provide enough of a buffer to allow the UDWS to maintain compliance without losing a significant amount of stored water that would otherwise be available to meet public drinking water requirements. It may also require the Wiswall Reservoir be drawn down more than 18 inches total. The following language should be inserted: "Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod's 90%ile event volume, but without the volume of the 20 percent buffer released to compensate for losses".
10. Page 7, 2nd paragraph (page 55, 3rd paragraph and page 225, 4th paragraph in the PDF): The text currently states: "When stream flows in the Lamprey are below 18 cfs, the system's water sources will comprise the Lee Well, the Oyster River surface water withdrawal and the remaining storage within the drawdown limits of Wiswall Reservoir". This apparently implies UDWS will be required to maintain inflow equal to outflow at Wiswall, however the designated critical flow of 18 cfs has an associated allowable duration of 15 day. UDWS proposes to use this 15 day allowable duration to begin scaling down the operations at the UNH Water Treatment Plant, and requests the ability to withdraw 0.8 cfs from the Lamprey River instream flow when flows fall below 18 cfs for a period of plus 7 days, and the ability to withdraw 0.4 cfs from 7 days to 15 days. This is necessary for the UNH Water Treatment Plant to more reasonably transition from a high to lower operational level, and to preserve the capacity in the Lee Well until absolutely necessary as prescribed on page 9, 4th paragraph (page 57, 5th paragraph and 227, 6th paragraph of the PDF).

11. Page 9, 1st paragraph (page 57, 2nd paragraph and 227, 3rd paragraph in the PDF): In order for the UDWS to impose mandatory water use restrictions, the Durham Town Council would need to adopt an ordinance to require such actions and impose penalties. UDWS shall work with the Town and UNH to establish procedures to implement mandatory water use restrictions and water conservation measures consistent with this water use plan. Discuss procedure and schedule for adopting water use restrictions as part of a new or updated Town Water Ordinance.
12. Page 9: Cost considerations (page 57 and 228 of the PDF): The following language more accurately reflect the UDWS's true costs and should be inserted: "The management activities would be performed by UNH and Town staff and/or a consultant and the annual costs to implement and maintain the water use plan is expected to range from $10,000 to $30,000. The reduced water withdrawal capacity imposed by the protected instream flow program may trigger the permitting, engineering, and installation of associated infrastructure for a new water source and ranges from $4 million to $6 million".

The following comments are provided primarily to prevent an unreasonable burden from being placed on the operations of the UDWS and the Town of Durham, and to ensure that basic operational constraints do not result in an accidental violation of the **Wiswall Dam Management Plan.** The first page reference refers to the MS Word document of Wiswall Dam Management Plan (see attachment) followed by the page reference(s) in the complete PDF Water Management Plan document.

13. Page 2, 3rd paragraph (page 46, introductory paragraph and page 191 of the PDF): Chapter 332 from 1965 referenced both the Town of Durham and UNH.
14. Page 3, 3rd paragraph (page 192 in the PDF) – The estimated volume of the impoundment of the top 12"is 12,142,211 gal or 1,623,290 CF or, 37.3 ac-ft per 8-25-10 email correspondence with Wayne Ives.
15. Page 3, 5th paragraph (page 193 in the PDF) – The primary purpose for reservoir is clearly for water supply storage and recreation is secondary. This was the conclusion of the 2003 Dufresne-Henry study. The NH Dams Data Sheet 071.04 referenced in the paragraph needs to indicate "water supply storage" as the primary purpose. The UDWS requests that NHDES revise NH Dams Data Sheet 071.04 accordingly.
16. Page 3, 3rd to last paragraph (page 193 in the PDF) – The last sentence of this paragraph is confusing.
17. Page 3, 2nd to last paragraph (page 193 in the PDF) – There may be approximately 3 miles of river downstream of Wiswall Dam, but the vast majority of this stretch of river is impounded. This should be acknowledged here.
18. Page 3, last Paragraph – (page 46 last paragraph and page 194, 1st paragraph in the PDF): As evident in Table 6, the volume of the Wiswall Reservoir is not "large" as stated in this paragraph, and for this reason it does not provide a significant potential to attenuate the

relief flow. The soon to be installed outflow notch/weir will be self regulating which will help to reduce the potential for attenuation. In addition, for the reason stated in the previous paragraph it does not provide a great potential to provide significant relief flow for the mostly impounded downstream reach. DES is imposing requirements based on assumed behavior the system. They also have practical problems in that no one knows or can measure how much attenuation occurs between the Pawtuckaway dams and our reservoir since the upstream gage is on a side branch of the Lamprey. It is reasonable to assume that some degree of attenuation will occur upstream of the Wiswall Reservoir, but how much? The statewide drawdown in 2009, which was used to assess the relief flow volume needed, was conducted in mid October. The antecedent moisture conditions during this time would typically have been very different from what would be expected during a drought when an actual relief flow would be considered.

19. Page 4, starting with the 3rd Paragraph (pages 47 and 194 in the PDF) – Regarding relief flows: Without conducting some actual relief flow tests that would provide NHDES and the UDWS with some real data of what flows to expect and when, and to what degree the new notch/weir of the dam might actually have on flow attenuation, it is unreasonable to insist that the UDWS come up with a plan to “ensure the relief flows are conveyed” without some amount of attenuation. Pulling stop logs in anticipation of an untested relief flow increases the UDWS’s liability of loosing drinking water storage during a potentially critical period of demand. Depending on when it happens, it could result in prematurely declaring Stage 4 (Water Emergency). What is a “controlled release”? The UDWS has proposed the accuracy as being what can be obtained by pulling a 4” stop log. What degree of control is expected? This is a natural system with natural variability. The degree of precision implied is inconsistent with the system being controlled, and this is all based on untested hypothetical information. The high degree precision of dam outflow controls will not exist to manage small changes in pool elevation. There needs to be a reasonable range of pool elevation variability by which the UDWs will be required to operate the dam.
20. Page 4 (Page 194 in the PDF): Delete the first bullet list. It is redundant with the following bullet list.
21. Page 4, bullet Item #1 (page 47 and 194, 1st bullet item in the PDF): This paragraph is confusing and it is not clear what the final phrase “whichever is less” is referring to.
22. Page 4, bullet Item #2 (page 47 and 194, 2nd bullet item in the PDF): The requirement to confirm receipt of DES’s notification within 24 hours is unrealistic for a municipality where the responsible staff may not be available, particularly if the notification arrives on a Friday or weekend . The planning involved in a relief flow release would happen at least a week before the actual release, and as such it seems reasonable that an “Affected” dam owner could be given more than 48 to 72 hrs notice.

23. Page 4, bullet Item #3 (pages 47 and 194, 3rd bullet item in the PDF): Maintaining inflow equal to inflow on an "instantaneous" basis would require a staff person to continually reside at the dam and is simply unrealistic. The alternative approach proposed in the Water Use plan, and as suggested above, the following language should be considered here: "Provided that an adequate volume of water is released from upstream sources arrives at the Wiswall Dam, UDWS will make a reasonable effort to create a relief flow that is equal to the current bioperiod's 90%ile event volume, but without the volume of the 20 percent buffer released to compensate for losses". However, UDWS would prefer to simply agree to cooperate with NHDES to develop reasonable relief flow protocols based on experience from actual relief flow trials.
24. Page 5, bullet Item #4 (pages 47 and 195, 4th bullet item in the PDF): The outflow weir will be self-regulating, and if the UDWS is not withdrawing then we do not plan to pull additional stop logs.
25. Page 5, bullet Item #5 (pages 47 and 195, 4th bullet item in the PDF): The water level drop is proposed to be based on a 7 day average of 1 inch per day.
26. Page 6, bullet Item #6 (pages 47 and 195, 5th bullet item in the PDF): Again, this level of monitoring will require a staff person to reside continuously at the dam. Automated measurements will consist of pool elevation at the Pump Station and flow at the Packers Fall USGS gage.
27. Page 6, 2nd paragraph (page 48 and 196 in the PDF): The paragraph regarding cost needs to be revised to more accurately reflect the Town of Durham's true cost with the following language "The estimated annual costs associated with this work will be dependent upon the number of personnel involved, and either the degree of automation of the system or the number of site visits required to perform the necessary flow management actions and the travel time and mileage, and is expected to range from $200,000 to $400,000 in infrastructure improvements (dam outflow controls) and $10,000 to $100,000 for operation and maintenance".

NHDES recently informed the UDWS that they have changed its plan to nullify or supersede Durham's §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan, and instead has suggested that they would prefer to modify to the Certificate's language to simply refer to the Lamprey River Water Management Plan. As recently as October 2010, the Administrator of the Watershed Bureau, Paul Currier, informed the Durham Town Council that the §401 Water Quality Certificate would become null and void upon adoption of the Lamprey River Water Management Plan. The basis of nullifying the Certificate is because ALL the conditions included in the current Certificate will be updated and incorporated into the Water Management Plan. Once the Water Management Plan is adopted, the Certificate will serve no practical purpose and would only perpetuate unnecessary bureaucracy and redundancy regulatory oversight if maintained in some modified form. The UDWS insists that NHDES proceed with nullifying

Durham's §401 Water Quality Certificate upon adoption of the Lamprey River Water Management Plan as was promised to the Durham Town Council.

We look forward to receiving NHDES's responses to the above comments, and working through the final language of the Lamprey River Water Management Plan in the near future. Please contact us with question and/or to schedule a follow-up meeting.

Sincerely,

David Cedarholm, P.E.
Durham Town Engineer

Paul Chamberlin, P.E.
UNH Assistant Vice President of Energy and Campus Development

cc: Todd Selig, Town Administrator
Michael Lynch, Director of Public Works
James Dombrosk, UNH Director of Energy & Utilities
Michael Metcalf, P.E., Underwood Engineers
Dana Bisbee, Esq., Devine, Millimet & Branch

From: Collins, Luke
To: tucklake@comcast.net
Cc: alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject: RE: Concerns regarding Pawtuckaway Lake drawn down proposal
Date: Wednesday, May 18, 2011 10:04:22 AM

Dear Ms. Chaurette,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau
Phone: 603-271-2963
Fax: 603-271-2867

-----Original Message-----
From: Lauren E. Chaurette [mailto:tucklake@comcast.net]
Sent: Wednesday, May 18, 2011 9:18 AM
To: Ives, Wayne
Subject: Concerns regarding Pawtuckaway Lake drawn down proposal

Wayne,

Please see my attached letter outlining my concerns over the proposed drawn down of Pawtuckaway Lake. I am a 20+ year resident in the Tuckaway Shores neighborhood and together with my immediate and extended family we have worked hard to maintian the integrity of this lake through the weed watcher program, boat inspections and participation and organization of educational programs through the Pawtuckaway Lake Improvement Association. In addition both my son and husband are avid fishers of the Pawtuckaway waters. This proposed random drawdown is of great concern and needs more time and attention put into it before any such procedure would be put into effect.
Thank you,

Lauren E. Chaurette
21 Brustle Road
Nottingham, NH 03290
tucklake@comcast.net

May 18, 2011

Mr. Wayne Ives, DES

I would like to express my concerns regarding the proposed potential drawn down of Pawtuckaway Lake:

1. Although I applaud the intent of creating a plan that takes into account water management, conservation, and damn management, I find the plan lacking in the very essence of its stated purpose, which is to protect the integrity of surface waters and in-stream flows in the Lamprey watershed area. No study or impact of the entire watershed area, more specifically with Pawtuckaway Lake, has been done. The focus on the lower Lamprey area in my estimation makes this entire report invalid as a guideline for all three stated goals.
2. It appears that that the study did not involve any knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further impact the lake. There is no inflow to replenish the water levels for Pawtuckaway and through natural evaporation the lake loses up to 1/4 of an inch of water daily. By releasing more water, this would impact the shallows and make it virtually impassable for boating, an activity that creates revenue for the state and the local economy through usage of the state park campgrounds.
3. I own Property on Pawtuckaway, Lake and have never been notified of any surveys in the year 2000 or even notified that this committee was being formed to address any proposals related to the lake level -- summer or winter.
4. I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on lake. That would be in direct contradiction to previously stated policy.
5. The evidence in this report does not support keeping additional water in this lake during the winter.
6. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would have a greater requirement for water than the lower Lamprey area.
7. Why is the health of the lower Lamprey River more important that that of the Pawtuckaway Lake area?
8. If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.
9. Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another.

10. You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.
11. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.
12. It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the September 30th, 2010 required date. I think this entire plan needs to go back to the drawing board or be scrapped.
13. There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments. All this to protect the bio-areas which is the plans stated goals.
14. My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. I have been living on this lake for over 20 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

Thank you for your time and attention to my concerns.

Lauren E. Chaurette
21 Brustle Road (Tuckaway Shores Neighborhood)
Nottingham, NH 03290
603-895-4854
tucklake@comcast.net

Loon Preservation Committee
Box 604, Lee's Mills Road, Moultonborough, NH03254
476 -LOON (5666) / Fax 603-476-5497 / www.loon.org

20 June 2011

Wayne Ives
Watershed Management Bureau
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

Greetings Wayne and all concerned,

Thank you for the opportunity to comment on the Lamprey River Water Management Plan and for your email response to my earlier comments in May, which I mention below. The Loon Preservation Committee has monitored loon presence and nesting success on Mendums, Pawtuckaway, and Onway Lakes since the mid-1970s. In the last decade, loons have consistently nested on all three lakes, with two territories on Pawtuckaway. Loon nests are always at the waterline because loons can't move easily over dry land. Changes in lake level during the four-week nest incubation period can flood the nest or strand it too far from water.

Our main concern with the proposed management plan is that drawdowns of Mendums or Pawtuckaway Lake during active loon nesting periods could strand a nest, causing the loons to abandon it. Your email in May addressed those concerns, and you pointed out that the proposed summer drawdowns are relatively small (approximately 2 inches or less). I agree that in most cases, a drawdown on that scale would be unlikely to impact nesting loons on either Mendums or Pawtuckaway. However, I encourage planners to offer a clear summary of the proposed drawdown regime in further drafts of the Management Plan, specifically:

- whether multiple drawdowns could occur in a single season
- the likely timing of the drawdowns (nesting peaks in June, may occur from early May until early August)
- how often drawdowns may be required (the report seems to indicate about four in ten years).

I recognize that some of this information is contained in the existing report, but the report is lengthy and it may reassure stakeholders concerned with potential loon impacts to clarify this information in the summarizing material . LPC comments provided here are intended to summarize our concerns about loon nesting based on a preliminary review of the Management Plan Report; we welcome discussion about potential loon impacts with all stakeholders, including NH Fish and Game, NH DES, and interested lake residents.

Thank you in advance for your consideration,

John Cooley, Jr.

Senior Biologist, Loon Preservation Committee
jcooley@loon.org

CC: Harry Vogel, LPC
Emily Brunkhurst, NHFG
Elizabeth Kotowski, Pawtuckaway Lake resident

May 17, 2011

Gary and Lynn Cox

I have the following concerns regarding the public hearing session held in Durham on May 11:

1. We own property on Pawtuckaway Lake and have never been notified of any surveys in 2000 OR notified that there was a committee being formed to address any proposals related to the lake level at any time.
2. In regards to the history of Pawtuckaway Lake, during a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.
3. I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on Lake. That would be in direct contradiction to previously stated policy.
4. There is no evidence stated in this report that water levels would be kept (additional water) in the lake during the winter months.
5. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would have a greater requirement for water than the lower Lamprey area.
6. Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?
7. If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.
8. Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another. Leave Mother Nature to resolve these issues by herself!
9. You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.
10. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.

11. It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date. I think this entire plan needs to go back to the drawing board or be scrapped.
12. There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments.
13. My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. We have lived on Pawtuckaway Lake for 13 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

Respectfully submitted,

Gary and Lynn Cox
52 Lakeview Drive
Nottingham, NH 03290

-----Original Message-----
From: Dwight & Ellie [mailto:decrow1@juno.com]
Sent: Friday, June 17, 2011 12:03 PM
To: Ives, Wayne
Subject: Instream Flow & Pawtuckaway Lake

Att: C Wayne Ives, P.G., Hydrogeologist

Re: Instream Flow & Lamprey River Watershed Management
As pertaining to Pawtuckaway Lake Area

I wish to express my displeasure to think the DES could and would regulate the flow and drawdown at Pawtuckaway Lake based on the assumption that maybe water will be needed down stream at some unpredictable time..

I would like the drawdown to remain at 7 feet, the boards to be maintained and regulated as they are now. We have had very high water level seasons and very low ones and it seems to depend on the weather not man.

The weed watchers here are doing a super job of keeping the exotic weeds eliminated and they need the water level drawn down to continue keeping "your and our" lake healthy.

Please consider this a request to leave the drawdown at 7 feet with no changes. I would appreciate being on your email list. DECROW1@juno.com.

Sincerely,

Eleanor Crow,
34 Barderry Lane
Nottingham, NH 03290

-----Original Message-----
From: Daley, Michelle [mailto:michelle.daley@unh.edu]
Sent: Monday, June 20, 2011 4:34 PM
To: Ives, Wayne
Subject: RE: Lamprey WMP comments - deadline extension to June 20

Hi Wayne,

Unfortunately I have not been able to thoroughly review the proposed instream flow rules, but I hope that the extension for public comment has allowed a more comprehensive review from groups like the Pawtuckaway Lakes association etc. My main comment is that a lot of work and data collection when into this analysis and it would be useful to have this raw data publically available on the internet and presented in tables or spreadsheets (instead of PDFs) so that I can easily be used in other capacities.

Thanks for your efforts on this,
Michelle

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Michelle L. Daley
Research Scientist
Associate Director NH Water Resources Research Center (http://www.wrrc.unh.edu/)
Manager Northeastern States Research Cooperative Theme 2 (http://www.uvm.edu/envnr/nsrc/)
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Phone: 603-862-1794
Fax: 603-862-4976
Email: michelle.daley@unh.edu

From:	Collins, Luke
To:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Against implementation of the Lamprey River Water Management Plan
Date:	Wednesday, May 18, 2011 8:47:48 AM

Dear Ms. Danis,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau
Phone: 603-271-2963
Fax: 603-271-2867

-----Original Message-----
From: Ives, Wayne
Sent: Wednesday, May 18, 2011 8:39 AM
To: Collins, Luke
Subject: FW: Against implementation of the Lamprey River Water Management Plan

C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/index.htm

-----Original Message-----
From: Donna Danis [mailto:ddanis@comcast.net]
Sent: Tuesday, May 17, 2011 4:22 PM
To: Ives, Wayne
Subject: Against implementation of the Lamprey River Water Management Plan

I have the following comments/concerns re: Lamprey River Water Management Plan:

1. It seems remarkably clear that those involved in the study have little or no local knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.

2. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would

have a greater requirement for water than the lower Lamprey area. Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?

3. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.

4. The study does not seem to consider a maximum lake and win-win proposals, such as a maximum limit on the amount that the lake can be drawn down. Wouldn't it make more sense to suggest something like 8" from full pond, rather than an open-ended, unlimited drawdown?

This effort requires a full study of the entire watershed area before an aspect of implementation is considered.

Donna Danis

24 Brustle Road

Nottingham, NH.

Version: 5/16/2011

Comments Received From:

Eric Danis
24 Brustle Road
Nottingham, NH.
erdanis@comcast.net

Source: email dated May 15, 2011

I attended the public hearing session held in Durham on May 11 and have the following comments/concerns:

Comment DAN-1:

Although I applaud the intent of creating a plan that takes into account water management, conservation, and damn management, I find the plan lacking in the very essence of its stated purpose, which is to protect the integrity of surface waters and in-stream flows in the Lamprey watershed area. No study or impact of the entire watershed area, more specifically Pawtuckaway Lake, has been done. The single minded focus on the lower lamprey area in my estimation makes this entire report invalid as a guideline for all three stated goals.

Response:

Comment DAN-2:

It seems remarkably evident that the study and those involved have little or no local knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.

Response:

Comment DAN-3:

I own Property on Pawtuckaway, Lake and have never been notified of any surveys in the year 2000 or even notified that this committee was being formed to address any proposals related to the lake level -- summer or winter.

Response:

Comment DAN-4:

I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on Lake. That would be in direct contradiction to previously stated policy.

Response:

Comment DAN-5:

The evidence in this report does not support keeping additional water in this lake during the winter.

Response:

Comment DAN-6:

The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It’s quite possible that these areas would have a greater requirement for water than the lower Lamprey area.

Response

Comment DAN-7:

Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?

Response:

Comment DAN-8:

If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.

Response:

Comment DAN-9:

Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another. Leave Mother Nature to resolve these issues by herself. She usually does a great job.

Response:

Comment DAN-10:

You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.

Response:

Comment DAN-11:

The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.

Response:

Comment DAN-12:

It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date. I think this entire plan needs to go back to the drawing board or be scrapped.

Response:

House Bill 63, an act extending the instream pilot program for one year (from September 1, 2010 to September 1, 2011) was passed by the House and Senate and then signed by the Governor (Chapter 0034) on May 9, 2011. The Final Lamprey River Water Management Plan will be submitted to the DES Commissioner prior to September 1, 2011 for his consideration and adoption.

Comment DAN-13:

There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments. All this to protect the bio-areas which is the plans stated goals.

Response:

Comment DAN-14:

My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. I have been living on this lake for over 20 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

Response:

-----Original Message-----
From: deckerjc@comcast.net [mailto:deckerjc@comcast.net]
Sent: Friday, May 27, 2011 7:47 AM
To: Ives, Wayne
Cc: Groen, Fenton; Case, Frank; Duarte, Joe; Reagan, John; Tasker, Kyle; Sullivan, James; Lynch, John; news@forumhome.org
Subject: Draft Lamprey River Water Management Plan Report (NHDES-R-WD-11-9)

Dear Mr. Ives:

I am a long-time resident of Pawtuckaway Lake, and I am writing to express my concern about the Draft Lamprey River Water Management Plan Report (NHDES-R-WD-11-9). I understand that this plan is being considered to maintain adequate flows within the portion of the Lamprey River designated under The Rivers Management & Protective Act.

I unfortunately did not attend the public session or read the entire 327 pages of this plan and do not claim to fully understand the impacts of low flows within the Designated River. I do however understand some of the impacts that low water within Pawtuckaway Lake would have on the residents and other users of the lake. The impacts on Pawtuckaway Lake and/or Mendums Pond do not appear to be a concern within this report.

As you probably know, Pawtuckaway Lake is a relatively shallow lake with many boulders below the lake surface and a large shallow area know as Fundy Cove. The lake is marked quite well for boaters when the lake is at full pond but still can be tough to navigate for people unfamiliar with the lake. When levels are low, this could be disastrous. I recall a few years back when for some reason the dam was not closed in a timely fashion and lake levels remained low all season long. I witnessed several people hit boulders and break props if not do more damage than that. If the lake is just a few inches below full pond which it is many summers, the risk increases for hitting an underwater obstacle. The public boat launch is deep within Fundy Cove and boaters need to navigate through a narrow channel to get to the main body of water. With low lake levels, I foresee boaters getting stuck and/or further stirring up the bottom of this already shallow area. There are several loon families that return each year to nest and they are subject to changes in lake level as well.

In the hot summer months the lake temperature can get quite warm and the lake has been known to produce blooms of cyanobacteria. I believe that lower lake levels will further contribute to more frequent blooms of this potentially deadly poison which may have impacts further downstream.

The basic problem is that when water levels are low downstream the probability is that water levels are low upstream. Unfortunately we have no control of the weather and a drought is a drought. Without considering the entire impact on all water levels, I find this plan flawed.

I am also concerned with the means of controlling any outflows from the dams. The seasonal draw down is controlled by removing boards from the spill way. Each board is approximately six inches or so therefore removing a single board could result in lowering the lake by this amount. This does not seem to be a smooth control of downstream water flow. There is a lower gate at Dolloff Dam but I have not seen that operated since the large drawn down in the ’80s for dam repairs. I am not sure if that is the intended control but am concerned that if this is the cooler water from below would be the water taken from the lake further increasing lake temperature.

I believe there are additional risks with changing the winter water level of the lake as well. This becomes especially concerning if the lake level varies during the period in which it is frozen. This could cause the ice to become unstable or inaccessible and people or pets may be more subject to falling through the ice and into the water. Keeping the winter level higher may additional cause undue hardship on some property owners as they will now need to modify preexisting docks and/or add bubblers to keep ice from damaging these docks. This would also lead to additional energy consumption that has been unnecessary in the past.

Furthermore, with the proposal to designate the remaining portion of the Lamprey along with the North Branch, North, little Pawtuckaway and Piscassic Rivers into the Rivers Management and Protection Program as described in The Lamprey, North Branch, North, Little, Pawtuckaway and Piscassic Rivers, A Report to the General Court (R-WD-11-2) adds additional concern as these additional 87.7 miles of proposed protected rivers are not addressed within the plan and may provide further stress to Pawtuckaway Lake and/or Mendums Pond in later versions of this plan.

It would seem that a full Pawtuckaway lake increases surrounding property values. A low Pawtuckaway Lake, on the other hand, will increase potential risk for further unknown concerns and will decrease property values. I am completely opposed to changing the seasonal drawdown.

In the end I find this plan to be immature and incomprehensive and relate it analogous to “robbing Peter to pay Paul”. Are these the tradeoffs that we really want to make? I am looking forward to your response.

Sincerely,

John Decker

June 19, 2011

C. Wayne Ives
NH DES
29 Hazen Drive
Concord, NH 03302

Subject: comments on the Draft -Lamprey River Water Management Plan
(hereinafter, "THE PLAN")

Dear Mr. Ives,

As you can see from the many comments that you have received from Pawtuckaway Lake residents, "THE PLAN" has raised many serious concerns and appears flawed in many respects.

Some of the concerns that residence have expressed to me:

1. The drawdown numbers presented are theoretical. They have not been actually tested or measured by experiment. There is no evidence that the plan would even work, ESPECIALLY in time of DROUGHT. Simply stated, there is hypothetical statistical projection, but there is NO SCIENCE.

2. There should be a downside limit to the removal of waters in the Spring, Summer, Fall. For example, if the lake measure is full to minus 12 inches, perhaps 5 inches (as projected in the report) could be supplied downstream. However, if the lake level is already decreased by more than a certain measure – as in -12 inches in the above example, the drawdown will cease.

3. Water impoundment in the winter? It appears that the report has changed it mind on this, even in the last 90 days. In "THE PLAN", the lake drawdown in Winter has decreased from a 5 foot drawdown to a 4.7 foot drawdown, as presented on June 11, 2011, This has happened during the public comment period. How can "THE PLAN" keep changing

4. One main feature of the Plan centers on Winter impoundment of water for emergency purposes. Meanwhile, there are DES and Coastal Management plans to remove dams on the Lamprey! How does this fit the impoundment strategy? Recently, the dam on the Lamprey at Rt. 27 in Epping (Bunker Dam) has been released. Page 1 of a DES archaeological report says, "Removal of the dam will eliminate the pond upstream and may lower water levels in the area by as much as nine feet (Finemore 2009:2)." WHERE IS THIS STRATEGY IN THE INFLOW PLAN? So how does removing it affect all the flow calculations in the DES plan? There are inherent conflicts in planning even at the NH DES.

5. **"THE PLAN"** looks like a cover to supply Durham and the State University with water. The University has grown to over 15,000 who use facilities. YET, THEY DON'T HAVE A PRIVATE WATER SUPPY! They have an aquifer that is recharged from the LAMPREY RIVER !

At a recent meeting , I was told "oh, they are planning on drilling a well." When? How much water is projected from it? Why not drill the wells, supply the water needed via the wells, and shelve this plan until there is truly an emergency.

The fact is, in the event of a true emergency, the NH DES can lower all the lakes that feed the lamprey and take as much water as they deem necessary. The State controls the flowage rights.

Therefore, if we are going to make a plan such as, "THE PLAN", let's think it through, test it for soundness, and then proceed.

I recommend that you do not implement the Lamprey River Water Management Plan as written.

Sincerely,

Tom Duffy

Tom Duffy, President ,
Pawtuckaway Lake Improvement Association
PO BOX 30
Raymond, NH 03077

Lake Residence: 23 Jampsa Trail, Nottingham, NH 03290

-----Original Message-----
From: John Edwards [mailto:john-edwards@comcast.net]
Sent: Wednesday, June 15, 2011 2:02 PM
To: Ives, Wayne
Subject: Lamprey WMP Comments

Dear Mr. Ives,
My name is John K. Edwards. My wife and I built a new waterfront home on Pawtuckaway Lake and have resided here for 15 years.

Prior to moving to Pawtuckaway Lake we enjoyed camping at the State Park nearly every year since the park opened.

I attended the June 11th 2011 PLIA meeting where you presented the DES Lamprey River watershed plan.

I do not recall receiving any notice in 2000 nor in 2010 from DES concerning this plan.

Concerning the "7 foot Winter Drawdown'" of Pawtuckaway Lake:

You stated that the reason for the proposed change to a much smaller drawdown was to insure that there would be sufficient Pawtuckaway water and head pressure to re-flood the Lamprey watershed in a 2-day cycle in mid winter if the river level became so low that the ice might settle on the riverbed, thereby threatening the fish and other aquatic life.

Further, you stated that **this threatening riverbed condition has never occured in the past history**. So the change to the annual Pawtuckaway Lake fall drawdown from 7 feet to a lesser amount is just a "precaution" the DES has decided should be implemented, regardless of its significant impact upon Pawtuckaway waterfront properties.

That history does not justify such significant change action to the annual 7 foot Fall drawdown.

I understand the DES plan has a 2-day flow-rate based on head pressure from Pawtuckaway Lake to refill the Lamprey watershed.

I propose that there is no legitimate reason for a 2-day period. I observed one of your "remote flow-rate reporting units" on the Lamprey on Route 27 in Raymond, NH which transmits flow rate data automatically via its antennae to your management system 24 hous a day. I must assume you have installed these units along areas in the lower reaches of the Lamprey watershed as well. **Therefore you have up-to-the-minute river flow data year round**. Should DES detect an imminent winter flow problem, dam operators could open the last gate at Dolloff Dam. It may require more than 2 days flow to restore the Lamprey watershed to satisfactory levels due to low head at Pawtuckaway. However, your "early warning system" and 5-Day weatherforcasts should easily enable DES to manage flow levels. This suggested change to your Plan would prevent the disasterous damage to waterfront owners docks expressed in many of the comments from Pawtuckaway Lake waterfront owners. And in all likelyhood may never have to be employed!

Thank you for the opportunity to comment,

John K. Edwards
53 Mooers Road
Nottingham, NH 03290

United States Department of the Interior

NATIONAL PARK SERVICE
Northeast Region Office
15 State Street
Boston, Massachusetts 02109-3572

IN REPLY REFER TO:

June 17, 2011

C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
Watershed Management Bureau
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

RE: Lamprey River Water Management Plan Report NHDES-R-WD-11-9

The National Park Service is pleased to offer the following comments regarding the proposed Lamprey River Water Management Plan. We have reviewed the Plan in the context of the state and federal protection of the Lamprey, and as a partner of the Lamprey River Advisory Committee on whose behalf I have participated as a member of the Lamprey WMPAAC.

Before commenting on the Plan, the NPS would like to express its overall support for the process employed by NH DES for conducting the Lamprey Protected Instream Flow pilot study. Specifically, we commend the DES for taking a science based, seasonally sensitive approach to determining the instream flow needs for identified ecological and recreational attributes of the protected Lamprey River. This process included technical review by a well qualified and diverse Technical Review Committee and an open bid process to evaluate and select the most appropriate and qualified scientific consultants to undertake the required evaluations and analysis. This establishes an important precedent critical to the value of this pilot effort.

Comments on Proposed Water Management Plan

1. The National Park Service supports the results of the Protected Instream Flow Study as it has established flow requirements and various seasonal "trigger" flows that would serve as indicators of ecological stress and triggers for contemplated corrective actions.

2. The National Park Service asks that the removal of the 4cfs minimum flow from the final PISF and from the Water Management Plan be reconsidered. As presented to the WMPAAC and the public as a key recommendation of the PISF in public meetings held in late 2008 and early 2009 (see attachments), the NPS, other WMPAAC and TRC members, and other interested parties were under the impression that this would be carried forward into the WMP. To date, no substantive rationale for not doing so has been provided. It clearly would do dramatic ecological harm to allow the Lamprey to drop to zero flow between relief pulses (as the current WMP would allow). It is very difficult to maintain or establish credibility of a pilot instream flow protection process that ignores the very real danger that the Lamprey could realistically (based on the evidence within the period of record and the documented human development related flow trends in the watershed) cease to flow.

3. The National Park Service supports the three tiered concept for managing flows presented in the Plan: 1) Conservation Plans for water users; 2) Water Use Plans to shift, spread and reduce water use; 3) Dam Management Plans for relief of catastrophic events.

4. The National Park Service asks for further consideration of a 4th element to long-term maintenance of Protected Stream Flows: long-term watershed strategies to maintain a healthy, natural ecosystem. Such strategies as long-term planning re impervious surfaces, aggressive BMP's for watershed-wide stormwater management; comprehensive basin-wide planning for water resources; etc. Over the long haul, these sorts of proactive investments will help reduce the need for "catastrophic Interventions" etc.

5. We support the statement in the Plan that communities with affected municipal water supplies need to adopt ordinances that allow for mandatory water conservation.

6. We support the notion that the Plan should clearly establish a maximum lake drawdown (Mendums & Pawtuckaway) for the June 20 through Oct 6 (GRAF Spawning; and Rearing & Growth) summer period. Data on this is confusing and poorly presented in the current Plan, and many have misconstrued and over-estimated the potential cumulative drawdown that might reasonably occur. A stated maximum (human induced) drawdown supported by a clearer analysis of the actual likely cumulative effects based on the period of record would be beneficial.

7. The NPS supports the immediate implementation of the first two phases of the Plan: Conservation Plans and Water Use Plans. This is the "bread and butter" of the Plan - - reduce as much as reasonable man's direct water use impact upon stream flow during times of extreme ecological stress (i.e. when the trigger thresholds are reached).

8. The NPS believes that there should be a scientific re-evaluation of the two day "relief pulse" concept. Two aspects of this seem particularly troublesome:

A. Overwintering Period. During this time of year, flows are relatively high, and man's combined influence on winter flows are extremely small (relative to the overall flow). The value of relief pulses during this time period seems particulary suspect. In addition, the 1.5 ft of less winter drawdown in Pawtuckaway is very controversial and particularly destructive to docks, etc. This deserves to be re-evaluated.

B. During a persistent summer drought (as in 2002, for example) two day relief pulses will become very controversial as Mendums and Pawtuckaway levels fall. At some point, it would be counterproductive to pulse high water flows through the Lamprey, when between pulses the River could approach zero flow. The wisdom of the relief pulse concept in the face of a long, persistent summer drought needs to be re-evaluated. No scientific references are provided in the Plan for the ecological benefit of the "relief pulse" concept. One completely different approach to potential dam releases would be to quantify the degree to which human-causes in the watershed are contributing to extreme low-flow scenarios (even after the conservation plans are in effect). Cumulative watershed development (impervious surfaces, lawns, individual wells, unregistered users, etc.) is having a quantifiable impact on summer stream flow. Dam releases could be made to offset this impact based on the PISF-established triggers. Such an approach should be evaluated as an alternative to the "relief pulse" concept.

9. The Management Plan appears to require the Town of Durham to manipulate Wiswall gates and install a new guage to ensure that relief pulses pass through Wiswall without delay or attenuation. NPS comments on Durham's draft Water Use Plan supported Durham's position that the Town should be allowed to simply take no action, i.e. not retain the pulse. The effect would be that the pulse would be slowed and peak pulse flow (cfs) would be reduced (attenuated) in the reservoir - - but ultimately (over an additional day or so) the whole pulse would pass. We continue to believe that the requirement of active gate manipulation and gauge installation and monitoring is overly complicated and onerous.

Thank you for this opportunity to comment. Please feel free to contact me or Jim MacCartney (603 226-3436) with questions on these comments or to discuss any related matters.

Sincerely,

Jamie Fosburgh
Northeast Region Rivers Program
New England Team Leader
(617) 223-5191

Copy:

Sarah Callaghan, Chair LRAC
Richard Kelley, Chair Lamprey WMPAAC

From: Collins, Luke
To: Ives, Wayne; ggalp@extremeadhesives.com
Cc: alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject: RE: Pawtuckaway Lake
Date: Friday, May 20, 2011 2:45:58 PM

Dear Ms. Galpin,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

Phone: 603-271-2963

Fax: 603-271-2867

-----Original Message-----
From: Ives, Wayne
Sent: Friday, May 20, 2011 2:37 PM
To: Collins, Luke
Subject: FW: Pawtuckaway Lake

Appears to be a duplicate.

C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/index.htm

-----Original Message-----
From: Gwen Galpin [mailto:ggalp@extremeadhesives.com]
Sent: Friday, May 20, 2011 11:45 AM
To: Ives, Wayne
Subject: Pawtuckaway Lake

May 15, 2011
Wayne Ives,

I share the same concerns and comments to the following issues submitted by Eric Danis, who attended the public hearing session held in Durham on May 11.

1. Although I applaud the intent of creating a plan that takes into account water management, conservation, and damn management, I find the plan lacking in the very essence of its stated purpose, which is to protect the integrity of surface waters and in-stream flows in the Lamprey watershed area. No study or impact of the entire watershed area, more specifically Pawtuckaway Lake, has been done. The single minded focus on the lower lamprey area in my estimation makes this entire report invalid as a guideline for all three stated goals.
2. It seems remarkably evident that the study and those involved have little or no local

knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.

3. I own Property on Pawtuckaway, Lake and have never been notified of any surveys in the year 2000 or even notified that this committee was being formed to address any proposals related to the lake level -- summer or winter.
4. I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on Lake. That would be in direct contradiction to previously stated policy.
5. The evidence in this report does not support keeping additional water in this lake during the winter.
6. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would have a greater requirement for water than the lower Lamprey area.
7. Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?
8. If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.
9. Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another. Leave Mother Nature to resolve these issues by herself. She usually does a great job.
10. You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.
11. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.
12. It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date. I think this entire plan needs to go back to the drawing board or be scrapped.
13. There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments. All this to protect the bio-areas which is the plans stated goals.
14. My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. I have been living on this lake for over 20 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and

miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

Respectfully submitted,

David Galpin

Nottingham, NH.

gdgalp@comcast.net

Neighborhood Guardians
PO Box 104, West Nottingham, NH 03291

June 18, 2011

Mr. C. Wayne Ives
NH Department of Environmental Services
PO Box 95, 29 Hazen Drive
Concord, NH 03302-0095

RE: Comments Pertaining to the Draft Lamprey Designated River Water Management Plan Report

Dear Wayne:

I am submitting these comments as the volunteer chair of the Neighborhood Guardians (NG) for the past 5 years. For background purposes the NG are a Nottingham-based local citizen action group which is **dedicated to protecting and guarding groundwater, property values**, the health and safety of the residents of Nottingham and the surrounding communities in this special region of New Hampshire.

I first want to thank you for your presentation at the Pawtuckaway Lake Improvement Association's (PLIA) annual meeting. As you know you have received many substantive comments and concerns from various stakeholders, including PLIA members. The most recent comments that I have read were from the Nottingham Board of Selectmen which details apparent deficiencies in the above-referenced 'Plan'.

Rather than to repeat the concerns outlined in the Selectmen's comments and on behalf of the NG, **I would like to also recommend that a complete and adequate environmental impact study of the Lamprey River Watershed must be completed before any changes in the management of water levels in Pawtuckaway Lake be approved and that no reallocation of water resources be done.**

As a former selectman who completed the Selectperson's Institute I can certainly empathize with the PLIA and the Nottingham Selectmen on the potential adverse impacts to property values that this 'Plan' may cause to almost 400 taxable waterfront and water access parcels around Pawtuckaway Lake. Under state statute (RSA 41.8) Selectmen 'shall manage the 'prudential affairs' of the town'.

As stated in Chapter 278, HB 1449-A, the final version passed in the 2002 legislative, 'DES shall consider the public comments received in any revisions to the protected instream flow levels and water management plans for the Lamprey River'. The PLIA has a large investment in their lake-side properties for recreational purposes. Although there is an avenue available (RSA 483:9-c,VI) for 'any party who is aggrieved by a determination establishing such protected instream flows to petition the commissioner for a hearing to review such determination', it would be worthwhile if DES found a remedy beforehand.

If you have any questions, please contact me by email at jhadley@metrocast.net.

Sincerely,

Jim Hadley

Jim Hadley, Chair ~ Neighborhood Guardians

Cc: Nottingham Board of Selectmen (via email)
Representative Frank Case (via email)
PLIA (via email to Therese Thompson and Liz Kotowski)
Ted Diers and Steve Couture, DES (via email)

From:	Collins, Luke
To:	bearpaw8ph@comcast.net
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Lamprey River management project
Date:	Monday, May 16, 2011 3:25:36 PM

Dear Mr. Herald,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

-----Original Message-----
From: bearpaw8ph@comcast.net [mailto:bearpaw8ph@comcast.net]
Sent: Monday, May 16, 2011 2:35 PM
To: Ives, Wayne
Subject: Lamprey River management project

Dear Wayne;

Having been on lake Pawtuckaway for the past sixty years, I find it alarming to think that the State would be thinking of

having draw offs to support the lamprey river. The water flow hasn't changed much in the last forty years, we have spill ways

on both dams, plus the openig of the dams themselves done with the removal of boards. The lake is brought up in the early

spring, which shuts the water down for about a month, when high water is reached the water flows over the spill ways, or the

boards themselves which is the actual water accumulated in the lake, and continues until the fall when the lake is lowered, plenty

of water flowing then and continues flowing in its natural state until the following spring. What you plan on doing is to supplement

a natural flow of water entering the lamprey, with an unnatural flow from Pawtuckaway lake, disrupting our water level ,

I would like to think you would leave our water level alone, the Lamprey has servived the past sixty years and will probably servive sixty more, why change something that seems to work, and flow water out of Pawyuckaway, which wasn't established to increase,

or decrease the supply of water to the Lamprey. Have you had a survey on what the effects will be on Pawtuckway Lake?

Thank You:

Paul Herald

From:	Collins, Luke
To:	Ives, Wayne; kjordan882000@yahoo.com
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: I do not support changing the drawdown to Lake Pawtuckaway
Date:	Wednesday, May 18, 2011 9:26:36 AM

Dear Mr. Jordan,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau
Phone: 603-271-2963
Fax: 603-271-2867

-----Original Message-----
From: Kevin Jordan [mailto:kjordan882000@yahoo.com]
Sent: Tuesday, May 17, 2011 5:39 PM
To: Ives, Wayne
Subject: I do not support changing the drawdown to Lake Pawtuckaway

Dear Wayne Ives,

There are a great many wildlife issues beyond the lower Lamprey River area. Following are a few that I recently came across that come to mind. There are issues with invasive weeds in Lake Pawtuckaway that the winter draw down helps to regulate. And a further drawdown in the summer would be contradictory to improving wildlife on the lake.

Though I do see why people along the lower Lamprey would want more water in the river, in many summers, we who live on the lake would like more water in Lake Pawtuckaway. Robbing Peter to pay Paul leaves Peter's well empty. So, I know I speak for many on the lake who would vehemently oppose an increased drawdown in the summer, and higher water levels in the winter.

I think the discussion needs to be opened up to all the communities that will be effected, not just the lower Lamprey. And, I for one, have not heard of this issue until today, which means we were not properly notified.

Thank you,
Kevin Jordan

1. Although I applaud the intent of creating a plan that takes into account water management, conservation, and damn management, I find the plan lacking in the very essence of its stated purpose, which is to protect the integrity of surface waters and in-stream flows in the Lamprey watershed area. No study or impact of the entire watershed area, more specifically Pawtuckaway Lake, has been done. The single minded focus on the lower lamprey area in my estimation makes this entire report invalid as a guideline for all three stated goals.
2. It seems remarkably evident that the study and those involved have little or no local knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond.

If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.

3. I own Property on Pawtuckaway, Lake and have never been notified of any surveys in the year 2000 or even notified that this committee was being formed to address any proposals related to the lake level -- summer or winter.

4. I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on Lake. That would be in direct contradiction to previously stated policy.

5. The evidence in this report does not support keeping additional water in this lake during the winter.

6. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would have a greater requirement for water than the lower Lamprey area.

7. Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?

8. If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.

9. Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another. Leave Mother Nature to resolve these issues by herself. She usually does a great job.

10. You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.

11. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.

12. It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date. I think this entire plan needs to go back to the drawing board or be scrapped.

13. There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments. All this to protect the bio-areas which

is the plans stated goals.
14. My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. I have been living on this lake for over 20 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

From:	Collins, Luke
To:	jim@jimkelly.net
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: comments on proposed Lamprey River Water Management Plan
Date:	Friday, May 27, 2011 10:25:27 AM

Dear Mr. Kelly,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau
luke.collins@des.nh.gov
Phone: 603-271-2963
Fax: 603-271-2867

-----Original Message-----
From: Ives, Wayne
Sent: Friday, May 27, 2011 10:07 AM
To: Collins, Luke
Subject: FW: comments on proposed Lamprey River Water Management Plan

C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/index.htm

-----Original Message-----
From: Jim Kelly [mailto:jim@jimkelly.net]
Sent: Friday, May 27, 2011 9:57 AM
To: Ives, Wayne
Subject: comments on proposed Lamprey River Water Management Plan

Dear Mr. Ives,

I am a resident of Pawtuckaway Lake and I take issue with the Lamprey River Water Management Plan's conclusion that "55 percent of those polled in 2000...were in favor or accepting of conditions that changed the fall drawdown to a lesser amount." The actual results of that poll show that 45% were opposed and 32% were in favor. The rest was a mixed bag, many expressing no preference. To add all the mixed answers to the 32% favorable and come up with 55% is both preposterous and deceptive. For example, those expressing no preference may have been uninformed and unable to provide a meaningful answer. To suggest that these answers fall in the "I don't care" category is just plain wrong.

Further, the reason for the investigation resulting in the 2000 decision was a concern about low water levels in summer months. That problem has been successfully addressed through better management of Pawtuckaway's dams. Some people hoped a lesser drawdown would solve the low summer water levels experienced in 1999, and so their answers reflected that concern. Using that old polling data to support this recent decision for a lesser drawdown is thoroughly disingenuous. The issues are completely different in the two scenarios.

Moreover, since 2000 many changes have taken place on Pawtuckaway that would affect the answers to this poll were it taken today. Large numbers of summer camps have been converted to year round residences, and the population of lake dwellers has increased accordingly. Through its Pawtuckaway Lake Improvement Association, lake property owners have become educated about water quality monitoring, invasive weed and algae growths, shoreline conservation, lake stewardship, phosphate loading, septic issues, and the impact of the Shoreline Protection Act, enforcement of which has only been a recent phenomenon.

The DES is now announcing "a revision to the December 19, 2000 Notice of Decision on Determination of Lake Level Regarding Pawtuckaway Lake (DES, 2000)." In that decision, the DES concluded that the drawdown of Pawtuckaway Lake in the fall should remain at 7 feet. Now, without any updating of its data, the DES has unilaterally decided that the fall drawdown will be 5 1/2 feet. Eleven years have passed, conditions have changed, and a public hearing and further polling must be conducted before this reversal of a decision may be decreed.

One of the Plan's premises is that "(m)anaging water levels on Pawtuckaway Lake for the purpose of flow management on the Lamprey Designated River should not have a significant effect on shoreline properties or on recreational opportunities on the Lake." It should be clear from the substance of the comments already received that this premise is false. A lesser drawdown threatens docks with damage from ice in the winter. Shoreline property owners constructed docks designed for the 7 foot drawdown, especially since the DES announced its decision on December 19, 2000. The DES cannot deny that property owners were entitled to rely on the December 19 decision, just as it cannot now abruptly reverse that decision without giving affected parties the right to be heard on the issue. I believe that lawyers call this principle promissory estoppal. If the public had a right to be heard in 2000, why do they not have a similar right when a new decision is being contemplated?

Perhaps it is time for a new petition to be filed similar to the one that resulted in the 2000 investigation. At least we could then expect a new survey and public hearing before a decision is rendered.

Sincerely,
James Patrick Kelly
35 Sachs Road
Nottingham, NH 03290

TO: THE NH DEPARTMENT OF ENVIRONMENTAL SERVICES
RE: PUBLIC COMMENT ON LAMPREY DESIGNATED RIVER WATER MANAGEMENT PLAN

I have been a year-round resident of Pawtuckaway Lake for eleven years. I read the Study and the Report of the Lamprey Designated River Water Management Plan and I attended the public hearing in Durham on May 11, 2011. The following are the comments that were solicited from interested persons in accordance with the law mandating the Study and Plan:

It is clear that much time and effort have been devoted to studying Lamprey River instream flows and devising a plan to manage them, but it strikes me that the attitude of the Plan toward its impact on Pawtuckaway Lake is cavalier at best, ignorant at worst. I understand that the mandate, and thus the scope, of the Study and resulting Plan was to develop a strategy for protection of instream flows. Targeting Pawtuckaway as a water "impoundment" was an easy choice and concluding that releasing its water would be effective to manage instream flows is probably valid. But in using the word "ignorant" I mean "without knowledge or information," in the sense that the Plan *assumes* that the only impact of water releases on Pawtuckaway will be a "minimal" drop in lake water level. The Report states that this "should not have a significant effect on shoreline properties or on recreational opportunities on the Lake." Based on what evidence? And what about other considerations like the overall ecosystem of the lake? There is no reference to studies or facts on which *these* conclusions are based, because in point of fact, *there are none.*

I accept that this study was not supposed to focus on these areas but DES cannot simply ignore them when rolling out this "comprehensive" Plan. Government action must take into consideration the relative costs and benefits to *all* interested stakeholders, and in this case lake dwellers and users have had little voice in the process. Moreover, they have absolutely *no* means of providing feedback by way of actual data about the impact the Plan will have on the lake when it is implemented. If there are any adverse effects, it will be too late to do anything about it. Most of us understand the benefit of being proactive rather than reactive. It's a more cost effective and intelligent way to proceed. Hence we have seatbelts, smoke detectors, and other protective measures we all recognize as preferable to injuries, fire damage, and other preventable harms. Some things are irreparable, and maybe damage to Pawtuckaway will be one of them.

Further, the decision to lessen the fall drawdown of the lake appears to have somewhat arbitrary or at least ambiguous origins. Is it really necessary to the Plan or does it just seem like a good idea? The Report itself concedes that "(i)t is not clear what will be the effects of reducing the fall drawdown", but concludes that people who were polled didn't object. Really? No lake residents of my acquaintance were polled. And without knowing what the effects would be, how can *anyone* validly or responsibly make a judgment like that? Do we administer medication to patients without knowing what side effects or long-term damage might result merely because they consent to take it? Obviously not! I submit that in this case, deciding *on the basis of no evidence* *whatsoever* that a lesser fall drawdown will be acceptable is extremely irresponsible and downright dangerous. As a small example, there are docks and other shoreline improvements (for which property owners pay handsomely through enhanced real estate tax assessments, by the way) that will be jeopardized by a smaller fall drawdown resulting in lake ice at higher levels, hence closer to shore where it can damage structures that project into the lake. The State Park does not have such concerns, so its opinion on this issue is immaterial.

What disappoints me most is that when it comes to evaluating the health of instream flows and figuring out what solutions will work, this Study and Plan leave no stone unturned and rely on exhaustive data and scientific evidence in reaching conclusions, yet when possible effects on Pawtuckaway and its residents and ecosystem are mentioned in passing, *opinions, guesswork, and assumptions* are relied upon, with a figurative shrug and little apparent concern for whether there are any underlying facts to support them.

Accordingly, in order to remedy this glaring defect in the Plan and its implementation, I propose the following:

- **That advance notice be provided to Pawtuckaway Lake residents or their representative organization before any drawdown or water release is performed.**

- **That the first 24 months be considered a trial period (or pilot project) during which careful assessment of the impact of all aspects of the Plan affecting Pawtuckaway be conducted.**

- **That a strategy be devised to monitor the ecosystems of Pawtuckaway Lake to determine whether changes or damage have been caused by reason of any part of the Plan's implementation.**

- **That this strategy include studies of weed and algae growth and drift, loon habitat, water quality, and fish populations.**

- **That anecdotal feedback from lake dwellers or users be solicited and collected to establish a pool of data or measurements from which conclusions may be drawn about the impact of implementation of any part of the Plan on property use, recreation, and safety.**

- **That the above information be analyzed and used to weigh the cost to Pawtuckaway Lake of implementing the Plan and that revisions to the Plan be considered accordingly.**

Respectfully submitted, ______________________________ __________

Pamela D. Kelly Date
35 Sachs Road, Nottingham, NH 03290
603-895-6125 pdkelly@comcast.net

-----Original Message-----
From: Donna King [mailto:kingernh@comcast.net]
Sent: Tuesday, May 17, 2011 3:15 PM
To: Ives, Wayne
Subject: Pawtuckaway Lake draw

Dear Sir:
I am a homeowner located on Pawtuckaway Lake. I have received a notice about the intentions of releasing water for the wildlife (fish) downstream from the lake.
Have you ever been on Pawtuckaway Lake? Have you been to Pawtuckaway Lake during the middle of August or early September? The water is usually very low at this time of the year, especially if we are experiencing a dry period. These are important questions as the summer goes by the quality of the lake changes due to all the use and abuse on the lake. Pawtuckaway Lake is a shallow lake, especially over near Fernald's property and the public boat ramp, draining the lake will really affect this area and make it a danger as there will be no water for the boaters and Pawtuckaway has lots of rocks along with it being very shallow. Not a good thing for the property owners and visitors to the lake.
If we experience a drought draining the lake will have severe consequences with the wildlife in and on our lake the draw down will also be a danger to the loon's habitat and nesting areas and please also consider the herons, cormorants, moose and turtles that live in and on our lake.
I don't think this was thought out correctly as to whom and what it would affect but would be correcting another problem farther downstream which is only affecting wildlife (fish). I think you should come up with another solution and leave Pawtuckaway alone, we have enough problems on our lake and I love our lake.

Thank you.

Donna King
20 Brustle Road
Nottingham, NH 03290

May 26, 2011

Comments on the April 11, 2011 Draft Lamprey River Water Management Plan Report (NHDES-R-WD-11-9)

Dear Mr. Ives: As someone who has read DES's near-final Water Management Plan Report for the Lamprey River and attended the public hearing on May 11, 2011 in Durham, I've had a chance to consider and discuss the 327-page proposed plan, as well as hear from you directly. In addition, I participated in the Lamprey River Watershed Association's meeting in West Epping on May 24, 2011 to ask further questions of you and Mr. Couture on the specifics (or in many cases, the lack of specifics) in this plan as they relate to watershed impacts.

My opinion is that the Draft Lamprey River Water Management Plan Report (LRWMPR) is full of inaccuracies, undocumented and unstudied assumptions, and dangerous conclusions.

Comment 1

Table 1 indicates that an overwinter flow rate (12/8 to 2/28) should be 265% of the previous period's flow rate. This undocumented assumption forces inaccurate calculations for the overwinter period. During the public hearing on May 11, you indicated that there was difficulty measuring winter flows because the gages used frequently froze and access to them was limited as well. Due to this difficulty, the information for the overwinter period has not been adequately studied and the assumptions and calculations are in error.

Comment 2

The higher water level proposed for the overwinter period is also in error. The report states that the amount of additional water needed for this period is 1.53 feet. However, the amount of water actually necessary, using the report's own data, is only 0.66 feet. I have attached a spreadsheet to these comments that calculates the additional impoundment necessary to achieve the reported flows.

In a discussion after the meeting, you indicated that there were no boards remaining in the Dolloff Dam in the overwinter period, so extraordinary measures would be needed to ensure adequate impoundment, necessitating the increased impoundment (more than double the necessary amount?). The information about all boards being removed during the winter may not be correct because I've heard otherwise from someone who lives on the lake near the dam. If that's the case, no extraordinary measures would be needed.

At the Lamprey River Watershed Association's meeting in West Epping on 5/24, you indicated the lake level change due to overwinter releases of 0.33 may be in error. What else is wrong in the report?

Comment 3
In the public hearing and subsequent meeting I attended you indicated that the lake level would only decrease by about 2 inches in the summer months. This is incorrect. The potential decrease due to releases is about 11 inches. I have attached the calculations in the same spreadsheet as in comment 2. During the meeting in West Epping you said DES would adjust the report to show the maximum allowable lake reduction and that this number would be less than 11 inches. Even at this late stage of the planning process, you did not know what number this would be. The report is incomplete if this number is not disclosed. There would also be no public comment on this change in the report as required by law.

Due to the inaccuracies and incorrect calculations in this one part of the report I doubt the accuracy of the complete report. Furthermore, why should average citizens need to do calculations in order to find what the effect would be on all watershed resources? This was the job of the experts DES hired for the task.

Comment 4
The report assumes there will be negligible effects on Pawtuckaway Lake, despite the fact that the dam has been managed solely for recreation for more than 50 years. Although the plan states that summer releases and overwinter increases will not significantly alter recreation or water quality in the lake, there is no evidence provided to back that up. DES, the Fish and Game Department, and the Department of Resources and Economic Development have invested a great deal of money and staff effort on the protection of Pawtuckaway Lake and Pawtuckaway State Park. The risks of making a hasty decision are serious because the lake would lose much of its current value if water quality and recreation were impaired.

Part of the mandate for this report was to study the effect on water users, not just the river. I understand that in water management studies the term "water users" refers just to water supplies and companies that withdraw water from the watershed, but a meaningful report would have included the detailed impacts on other "users" of the water that's released from the lakes for downstream purposes. The fact that no study or recent survey of residents was done on the lake and its associated ecosystems means that DES has based the LRWMPR on incomplete information. Without complete information on likely watershed impacts above the dams, manipulating water levels to achieve downstream goals could damage the lake environment if implemented, even for a test or pilot period.

Some effects on the lake would be:

1. Decreased spring and summer lake levels would threaten loon habitat during the spring and summer nesting season. That season extended from late May until July 28 in 2010 (the date of the last hatch on Pawtuckaway). One of the pairs on Pawtuckaway nests on an island not far from Dolloff Dam. The lowering of water over a 48-hour period, even by a few inches, could strand loon nests and prevent incubating and hatching.

2. Decreased lake levels will affect water quality within the lake. The lowering of lake levels will have a measureable effect on the water quality in Pawtuckaway Lake. The lake already experiences algal blooms and E. coli and cyanobacteria outbreaks in the summer months. To lower water levels without any study of the potential impact is dangerous to both wildlife and public health. The state park beach on Pawtuckaway is already subject to beach advisories and closures due to fecal coliform in the summer. Shallower, warmer water from the summer drawdowns proposed in the LRWMPR will only increase the likelihood of beach advisories.

3. Decrease in lake levels would create a dangerous situation for boaters. Recreational use of this lake would suffer if the water level is lowered. This is a shallow lake with many rock outcroppings.

4. Increased overwinter levels will cause damage to property along the shore. Improvements to property and docks on the lake would be destroyed by ice if this plan is implemented, even on a test or pilot basis.

5. Increased overwinter levels have the potential to promote the spread of invasive weeds. The overwinter lowering of lake levels protects this lake from weed infestation. Any weed infestation would ruin the fisheries in this lake and the lake as a general recreation resource.

None of the above items seem to have been considered in the report. These items need to be addressed before anything is finalized.

Comment 5

The report is so narrow in scope that it doesn't consider the effect the actions it proposes will have on anything outside its limited view. In answering questions on the report at the public hearing, the consultant hired stated that things were "outside the scope of this study" even when the questions asked concerned the water resources they were proposing be reallocated. The scope that the consultant used was only a segment of the stream. He didn't seem familiar with Pawtuckaway Lake and didn't consider the upstream effect of the increased or decreased flows on Pawtuckaway Lake or its environs. Any conclusions in this report that have been drawn without the benefit of an environmental impact study are irresponsible. This study did not achieve its goal and should therefore be scrapped.

Comment 6

The public hearing on this plan, which was held in Durham, was not well publicized. The abutters on Pawtuckaway Lake were not notified. The town of Nottingham Board of Selectman and the Nottingham Recreation Director were unaware that the hearing would involve changes to the water level at Pawtuckaway Lake and Mendum's Pond because the hearing notice did not mention either water body. None of the neighborhood associations on Mendum's Pond were notified, nor were the people in charge of the University of New Hampshire's 200-acre Recreation Center on Mendum's Pond in Barrington. The UNH facilities include a brand new boat house for sailing and the university’s crew team, a beach, and a summer day camp.   It also appears that various state agency advisory committees and environmental organizations with a stake in the outcome of the plan were not asked to provide input.

During the 5/24 meeting Wayne Ives stated that “they could not find any lake associations on Mendum’s Pond”. In one afternoon we were able to identify three neighborhood associations (Holiday Shores, Mendum’s Landing, and McDaniel Shore), as well as the UNH people responsible for the facilities on Mendum’s Pond.   Draw your own conclusions here, but in my view this is an attempt to do just the minimum to pass the legal hearing requirements. Could it be that the report is so flawed the authors didn’t want it to be subject to public scrutiny?

Conclusions
The report uses inaccurate assumptions.
The report contains miscalculations.
The report considers only effects on the river environment and downstream water users with only minimal consideration given to the watershed as a whole and Pawtuckaway Lake and Mendum’s Pond in particular.
The report is incomplete.
Public comments were not solicited from all stakeholders as required.

For these reasons I respectfully request that this plan not go forward.

Furthermore I ask that the recommendations contained in this report to adjust the water flows out of Pawtuckaway Lake be studied fully before anything is implemented.

Sincerely,

Edward T. Kotowski
14 Indian Run
Nottingham, NH 03290

Pawtuckaway Lake
Draw Down Exposure

Table 1 (page 11 of the report)						**Table B.5** (page 136 of the report)	**Calculated fields**			
TIME PERIODS		RARE FLOW (RF)								
FROM	TO	RF (cfs)	RF(CFSM)	ALLOWABLE DURATION	CATASTOPHIC DURATION	CHANGE IN WATER LEVEL PER RELEASE	DAYS WITHIN BIOPERIODS	POTENTIAL # RELEASES WITHIN BIOPERIOD	POTENTIAL LOWERING OF LAKE LEVELS	SPRING AND SUMMER LOWERING OF LAKE
12/9/99	2/28/00	73	0.4	7.3	30	0.33	81.00	2	0.66	
3/1/00	5/4/00	146	0.8	4	9	0	64.00	7	0	
5/5/00	6/19/00	57	0.31	2	10	0.14	45.00	4	0.56	0.56
6/20/00	7/4/00	16	0.087	5	3	0.02	14.00	4	0.08	0.08
7/5/00	10/6/00	16	0.087	6	15	0.05	93.00	6	0.3	0.3
10/7/00	12/8/00	20	0.11		11	0.09	62.00	5	0.45	
					TOTAL	0.63		TOTAL	2.05	0.94

June 20, 2011

Mr. C. Wayne Ives
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

Dear Mr. Ives:

Over the years I've been very impressed with the quality of the reports, plans, fact sheets, and other documents produced by the NH Department of Environmental Services. As a NH resident, I have also been proud of the effectiveness of DES's programs and the dedication and professionalism of the staff who carry them out. Therefore, I have high expectations for what the instream flow program needs to accomplish and want to know that the science and planning methodology used by DES are the best possible, not only for the Lamprey River but also for the other designated rivers in New Hampshire that will have instream flow plans developed for them by DES.

Attached are my comments regarding the DRAFT Lamprey River Water Management Plan Report (NH DES-R-WD-11-9) dated April 11, 2011. Unfortunately I consider this plan to be far from adequate. There is a tremendous amount at stake here for the Lamprey River, the 14 municipalities in the watershed, and the two recreational lakes in Nottingham and Barrington that are targeted to support downstream water users and anadromous fish habitat.

Thank you very much for considering my comments.

Sincerely,

Elizabeth S. Kotowski
Nottingham

My husband and I first visited Pawtuckaway Lake in 1992. After that we came every September to camp, orienteer, and canoe with friends. Finally, in 2006, we bought a year-round log home on the lake. Although we still work full-time, our life on Pawtuckaway has been a joy. We listen to loons as we fall asleep; we watch a variety of other birds, including eagles, pileated woodpeckers, and great blue herons; and we love to get up in the morning and slip our kayaks in the water to explore the lake. We also enjoy the fact that half of Pawtuckaway's shoreline and most of the islands are part of a state park that's visited by thousands of families every year. The state also owns a public boat launch on the north end of the lake. On an average weekend day, even as early as May, hundreds of people are out enjoying the lake… paddling canoes, fishing for bass, swimming, jumping into the water from boulders, laughing as they're pulled behind motor boats, camping on the shore, and just plain relaxing.

Pawtuckaway Lake exists as it is today because of the creation of the state park. It is not a drinking water reservoir, although its level is controlled by a dam that was once used to power industries downstream. Sometime around 1955, hydropower was abandoned on the lake and the New Hampshire Electric Company approached the NH Water Resources Board to see if the Board would accept the lake and 800 acres of adjacent land. The Board agreed and also accepted responsibility for its dams for the benefit of present and future users of the lake shores. In 1957 the Legislature directed the State Planning and Development Commission to study how the property could be turned into a state park that would protect the lake and forest resources, benefit the public for recreation, and enhance the local economy.

From that point forward, a plan was set in motion that included acquiring more land, constructing recreational facilities, enhancing scenic beauty, promoting home development on part of the lake to generate tax revenue for the Town of Nottingham, developing a public boat launch, and creating of a town beach at the northern end of the lake for the residents of Nottingham.

When Governor King dedicated Pawtuckaway Lake State Park in 1966, he said in his speech, "We set aside natural resources like these and keep them as nature created them for our rest and relaxation.... Let all of you who have worked so hard to make today a reality take satisfaction not in anything I might say but rather in the solid knowledge that what you have done here will serve generations yet unborn.... that what you have done here will last forever."

The State of New Hampshire considers Pawtuckaway Lake State Park to be one of its flagship parks. It brings in an enormous number of visitors and significant revenue, some of which has been reinvested in its campground, beach and boating facilities, picnic area, new cabins, and educational programs. Although the park now includes 5500 acres and attracts hikers, mountain bikers, snowmobilers, and climbers, the lake is still the magnet that draws people to Pawtuckaway State Park. For that reason and because the lake is so important to the regional and local economy, the current and future use of Pawtuckaway Lake must be an important consideration in any water management or instream flow plan for the Lamprey River.

Pawtuckaway Lake is located in the middle of the 214-square-mile Lamprey River Watershed. As of June 7, 2011, when Governor John Lynch signed HB 149, most of the Lamprey River Watershed is now designated for river protection under the NH Rivers Management and Protection Program. The addition of 87.7 river miles to the original 12 miles in Lee and Durham extends the designated river out to Great Bay and protects the five main tributaries. This expansion means that watershed planning -- including instream flow planning -- must be handled in a new and much more comprehensive way.

The current draft Lamprey River Water Management Plan Report (NH DES-R-WD-11-9) is incapable of protecting the river resources of the Lamprey Watershed because it was always designed to manage instream flows for the narrow 12-mile corridor in Lee and Durham that was designated in 1990. Now, more than ever, the report should be shelved so that a more realistic, durable, and comprehensive instream flow plan can be developed that takes into consideration land management actions in addition to dam management, water use, and water conservation. It also need to consider all of the inputs and withdrawals to the river, with an eye toward not only protecting instream flow and water quality in the Lee-Durham stretch but all the way to Great Bay.

To rush this plan through with only part of the information necessary to put a meaningful plan in place would be very unfortunate. This is exactly the kind of decision making that William Odum described in his 1982 article titled "Environmental Degradation and the Tyranny of Small Decisions" in *BioScience* (vol. 32, no 9) in which he talked about the cumulative impacts of many individual decisions that affect the environment. He describes how the ecological integrity of the Florida Everglades was compromised in this way, as well as the destruction of the coastal marshland in Connecticut and Massachusetts between 1950 and 1970. Great Bay provides a more local example of how no one intended to cause such damage to the estuaries but it happened because of a lack of holistic planning. We have an opportunity to do better with the Lamprey now that the watershed has been designated.

It's understandable that with all the effort that has gone into the current water management plan, the authors would want to see it go forward. The plan is not adequate, however, even for the 12-mile stretch that it was intended to cover. Outside of the need for a better, more comprehensive plan that looks at all the water resources in the Lamprey, there are a number of reasons why this plan misses the mark. Some of those reasons are because of flaws in the design of the instream flow program more than 10 years ago. Others are because of budget constraints.

The bottom line, however, is that this plan serves the needs of the University/Durham Water System (UDWS) more than it does the river or its resources. No one on Pawtuckaway Lake or Mendums Pond even realized until last month that this effort to protect instream flows in the Lamprey was going to result in releases from their lakes for downstream uses. Even the final public hearing notice never mentioned its impact on lakes, which kept the level of comment down while the planning process proceeded quietly.

Deficiencies in the plan:

1. The scope is too narrow: It focuses on registered (large quantity permitted water users) and dam owners with little or no information about small water withdrawals on the river or information about wetlands retention. It also looks only at recreation, habitat, water quality and resources on the designated river, ignoring the lakes and tributaries. It never mentions the existence of Pawtuckaway State Park. It also never even mentions Great Bay, although protecting the bay was a major reason for the designation in the first place.

2. The water conservation plans and water use plans are too similar and redundant. They are also vague and unenforceable. The draft 2008 water conservation plan submitted by the UDWS when it submitted its preliminary permit for a second groundwater source is much more detailed.

3. The report is out of date and incomplete. It doesn't mention the expected expansion of the designated river to include almost 90 more miles of corridor. It doesn't mention the removal of Bunker Pond Dam in West Epping (which has already begun and will affect flow in the river downstream). It contains no information on impervious cover for seacoast communities, projected population growth by town, university expansion plans, stormwater management, or best management plans for recharge of aquifers and streams, It doesn't describe the ongoing anadromous fish restoration programs or the planned fish ladder for Wiswall Dam.

It also doesn't mention Durham's well-documented plans to withdraw ever-increasing amounts of water from the Lamprey River, including a recent 401 Water Quality Certification amendment that will allow Durham to draw down the Wiswall Reservoir by a total of 18" (from a previous 6" max) and allow the maximum daily drawdown to be increased from 0.5" to 1". Public documents also say that " The amendment allows for more than 35 to 40 days of continuous use of the reservoir during extreme low flow conditions." How does this fit in with the Lamprey instream flow plan? And how does the UDWS proposal to withdraw water from the Lamprey to artificially recharge a proposed groundwater source in the Spruce Hole Aquifer fit in with the instream flow plan. It's hard to understand why these issues were left out because they are all relevant and will affect the amount of water needed to maintain instream flow in the future. The shortcoming here is that the plan included information selectively and looks backward far more than it looks ahead.

4. The report appears to have been prepared in a vacuum. The composition of the advisory committee leans toward water suppliers and Durham town officials. Also, the report doesn't reference or attempt to integrate with other research and plans being developed by seacoast regional environmental groups, such as the Southeast Watershed Alliance, the Piscataqua Region Estuaries Partnership or UNH's excellent Water Resource Research Center, which includes scientists and grad students who are studying the Lamprey Watershed as part of its Lamprey Hydrology Observatory, which organizes an annual Lamprey River Symposium.

5. The report is poorly organized and incomprehensible to most readers. It bogs down in technical jargon and details about clupeid bioperiods. It includes scores of acronyms and doesn't include a glossary. It's hard to imagine how this will be received by the NH Legislature, which is composed of everyday citizens serving the state.

In the end, I see this as a report that provides some good information but needs much more content and true planning to be of value to the Lamprey River. I urge the Commissioner to reread his own 2010 - 2015 Strategic Plan and realize that the Lamprey River Water Management Plan is not consistent with his vision. DES needs to consider the big picture for the river, the lakes, and the watershed communities.

NEW HAMPSHIRE LAKES
Members dedicated to protecting lakes

June 20, 2011

Wayne Ives, Instream Flow Specialist
Watershed Management Bureau
NH Department of Environmental Services
PO Box 95
Concord, NH 03301

Dear Mr. Ives:

Please accept these comments on the Lamprey River Management Plan. The mission of the New Hampshire Lakes Association, a 501c(3) member supported organization representing approximately 1,4000 individuals and 150 lake association (and their combined approximately 26,000 members), is to protect New Hampshire's lakes and their watersheds.

We support studies and policies rooted in sound-science while working with stakeholder groups implementing protection projects and developing management plans that improve the quality and enjoyment of New Hampshire's lakes, while also balancing drinking water supply needs and requirements for native organisms and habitat. We appreciate the efforts that the New Hampshire Department of Environmental Services has gone through to develop the Lamprey River Watershed Management Plan.

We recommend that additional study be conducted to assess the impact that drawdown during the summer and higher water levels during the winter would have on the quality, enjoyment, and economic value of Pawtuckaway Lake and Mendums Pond. For example, could drawdown during the summer cause boat ramps on these waterbodies to become unusable? Could higher water levels during the winter cause property damage to shoreline structures? What would the effect of lower water level during the summer have on water quality, benthic organisms, and boating safety? Could lower summer water levels contribute to increased cyanobacteria blooms or reduced dissolved oxygen concentrations in Pawtuckaway Lake?

Thank you for the opportunity to comment.

Sincerely,

Andrea LaMoreaux

Andrea LaMoreaux
Vice President, Education & Communication

cc: Jacquie Colburn, Lake Management Advisory Committee
Susan Goodwin, NH LAKES Association
Peter Goodwin, NH LAKES Association
Liz Kotowski, Pawtuckaway Lake Improvement Association

Andrea Lawson
45 Horizon Dr.
Bedford, NH 03110
and
39 Sach's Road
Nottingham, NH
603-236-1669
May 20, 2011

Dear Wayne Ives,

As a summer resident of Pawtuckaway Lake, I agree with the problems listed below concerning changing the water levels to help the downstream issues. I would no longer be able to "beach " my pontoon boat on the sand for the winter as I have done for the last 12 years if the lake level is left two feet higher in the winter. Also my dock would be ruined by ice damage.

1. Although I applaud the intent of creating a plan that takes into account water management, conservation, and damn management, I find the plan lacking in the very essence of its stated purpose, which is to protect the integrity of surface waters and in-stream flows in the Lamprey watershed area. No study or impact of the entire watershed area, more specifically Pawtuckaway Lake, has been done. The single minded focus on the lower lamprey area in my estimation makes this entire report invalid as a guideline for all three stated goals.
2. It seems remarkably evident that the study and those involved have little or no local knowledge of the Pawtuckaway Lake. During a drought, the lake levels are in as much stress as the lower Lamprey River. The water levels are usually 6 to 8 inches lower than full pond. If DES is going to drain another 3 inches of water, this would further exasperate the situation. There is no inflow to replenish the water levels. The lake loses up to one quarter of an inch of water daily due to evaporation. By releasing more water, this would impact the shallows and make it virtually impassable for boating.
3. I own Property on Pawtuckaway, Lake and have never been notified of any surveys in the year 2000 or even notified that this committee was being formed to address any proposals related to the lake level -- summer or winter.
4. I am against changing the drawdown in the winter months. It will affect the ability of residents to repair docks. It will affect the quality of the water; weeds will not be killed off as in the past. It will increase property damage that the state is so concerned about during the spring floods while there is ice on Lake. That would be in direct contradiction to previously stated policy.
5. The evidence in this report does not support keeping additional water in this lake during the winter.
6. The entire report fails to consider the same stress related to the Pawtuckaway Lake that the plan is proposing to draw water from. Has there been a study to the impact of a drought to the Pawtuckaway Lake area, tributaries and upper watershed? It's quite possible that these areas would have a greater requirement for water than the lower Lamprey area.
7. Why does the lower Lamprey River area take precedence to the Pawtuckaway Lake area?

8. If water is added to the lower Lamprey area during stressful times, is there any data to suggest that the marine life and other bio-features will be impacted? What kind of damage to the lake biology would occur at the lake areas where the water is taken from? No study addresses this.
9. Conservation and water management plans are a positive step for entities that take water from the watershed area, but the idea of trying to adjust bio habitats by controlled dam releases might have a temporary positive impact on one area, but adversely affect another. Leave Mother Nature to resolve these issues by herself. She usually does a great job.
10. You stated that there is no study to the impact on the lake biology. This needs to be addressed to have a comprehensive plan in place. The premise of having a water management, conservation, dam management plan in place without taking into consideration the impact of the entire watershed would be grossly irresponsible at best.
11. The entire report characterizes the lake areas as storage impoundments. These are not just water storage areas that can be used at your leisure. Every lakefront property will be affected and they need to be notified in writing just as any abutter is notified when a building permit or septic permit is requested for an adjacent property that would affect their property value and border. This lake is my adjacent property.
12. It is my understanding that the water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date. I think this entire plan needs to go back to the drawing board or be scrapped.
13. There are large numbers of No Wake areas on the lake due to shallow water. The intent of a no wake area is to protect the shoreline as well as protect the bottom from being turned up by boat propellers. Turning up the bottom releases phosphorous and other sediments that were deemed harmful to plant and fish life. These are state mandated areas and enforced by Fish& Game and Marine Patrol. By lowering the water level, these areas should be banned from boating altogether. This would mean closing the public boat ramp in the Fundy Area and canceling all scheduled fishing tournaments. All this to protect the bio-areas which is the plans stated goals.
14. My confidence and the ability to have the State to be in charge of controlled water releases during the summer is suspect at best. I have been living on this lake for over 20 years and have seen the State: A. forget that there are 2 dams on Pawtuckaway and miss the spring rains leaving the lake 1-1/2 feet below full pond for the summer and: B. Put the boards in the dam upside down leaving tremendous leakage and again leaving the lake below full pond for the summer. There should be more local contact / input for any dam issued whether it might be a drawdown or fill in the spring.

-----Original Message-----
From: Victor Maslov [mailto:victrm@earthlink.net]
Sent: Monday, June 20, 2011 12:05 PM
To: Ives, Wayne
Cc: Duffy, Tom
Subject: Comment on Lamprey River Plan

Mr. Wayne:

I am opposed to allowing any additional bureaucratic tampering with the level of Pawtuckaway Lake in order to meet the perceived needs of the Lamprey River.

The Water Management Plan Report states that "...several meetings were held with the Lamprey River Water Management Planning Area Advisory Committee (LR WMPAAC) to solicit comments from stakeholders regarding the development of the Water Management Plan."

If the potential beneficiaries of the Plan help to design the Plan, it is obvious who will gain and who will lose.

The Plan Report further states that the protected entities in the Lamprey River watershed include: "boating; recreation (fishing, swimming); hydropower; public water supply; archeological resources; the natural riparian corridor ecosystem; rare, threatened, and endangered species; and aquatic flora and fauna."

The same can be said of the protected entities of Pawtuckaway Lake. It is not clear why the river should take priority over the lake

The Plan further states that "Low flows and floods are expected to occur as natural conditions and occur within the range of natural flows. Typical human influences tend to reduce flow variability by removing floods and droughts. This may make the availability of stream flow more reliable for human use, but is detrimental to biological integrity."

Exactly so. If your purpose is to allow flows to vary in accordance with the Natural Flow Paradigm, the Paradigm should not *exclude* "low flows and floods", which the Plan seems to do in an effort to minimize their effects.

Finally, it is in the nature of bureaucracies to start with modest goals to gain the approval of the citizenry, but I fear that there is a danger that today's modest drawdown goals will inevitably grow with time.

I oppose this Plan.

Thank you,

Victor Maslov
87 Shore Drive
Nottingham, NH

June 17, 2011

C. Wayne Ives
Instream Flow Specialist
Watershed Management Bureau
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

Re: Lamprey Designated River Proposed Water Management Plan

Dear Mr. Ives:

Thank you for this opportunity to provide NH Fish and Game Department's (NHFGD) comments on the Proposed Water Management Plan for the Lamprey River. NHFGD has been very fortunate to be a long-term (>10 years) active partner in the Instream Flow Program, and that is certainly due to NHDES' efforts to make sure that NHDES and NHFGD have a strong, working relationship.

NHFGD's understanding is:

1) The objective is to potentially provide instream flow by the release of water from Pawtuckaway Lake and Mendum's Pond to meet water quality standards during extreme low water conditions (e.g. drought) in the Lamprey River.
2) NHDES has completed a great deal of analyses on this new procedure to determine when and why water should be released, how much water would be released, over what period of time, and what that would do to water surface elevations in Pawtuckaway Lake and Mendum's Pond, and
3) To accommodate a possible winter instream flow recharge event, Pawtuckaway Lake is proposed to be lowered 5.5 feet instead of the current 7 feet during the normal winter drawdown.

NHFGD has identified several topics relative to this proposal and offers the general comments below. At this time, because the Department plans to continue our discussions with NHDES on the details of the proposal, we are not able to provide specific comments for some topics.

Summer release of water (potential issues):

a. **Loons**: there is one loon nest in the northern part and one in the southern part of Pawtuckaway Lake. Lowering of water levels during the nesting period could prevent the loons from being able to return to their nests as they can only slide their bodies across the ground. Therefore significantly lowered water levels should not happen between May 15 and July 15. Any lowering of water levels deemed necessary during this timeframe should be communicated and reviewed with NHFGD staff in advance, in order to evaluate whether there would be impacts to loons. Winter drawdowns should not commence until after October 15 to allow chicks to fledge. Drawdowns to offset low water conditions before May 15 and after July 15 should have no impact on the loons. NHFGD wants DES and others to understand that the comments we offer here are for this specific proposal and at Pawtuckaway Lake <u>only</u>. These comments <u>do not apply</u> to any other waterbody.

b. **Diadromous fish**: to conduct the proposed release at Pawtuckaway Lake approximately two, 8-inch boards would be pulled from the dam for about two days. This has the potential to provide attraction flow to juvenile alewife at a time (summer) when inhospitable conditions would exist in the Lamprey River. NHFGD would not want the alewife to swim downstream into the Lamprey River until they are either mature enough or conditions are optimal for them to migrate directly to the ocean. The management objective is to keep them in Pawtuckaway Lake and grow till October at which time they migrate downstream into the Gulf of Maine. NHFGD and NHDES discussed the potential to use metal screens to ensure that juvenile alewives do not leave Pawtuckaway Lake during a release of water in the summer.

c. **Water temperatures**: there is the concern that the release of surface water from Pawtuckaway Lake in the summer could increase the water temperatures downstream and cause impacts to aquatic fauna. NHFGD requests that continuous (hourly) water temperature data be collected in summer 2011 in order to make informed decisions on this topic. There are 2006 data for several places in the Lamprey River watershed, but not from at the Pawtuckaway Lake dams. NHFGD is pleased to assist in this, and may be able to allocate water temperature loggers to this effort.

d. **Cumulative lowering of Pawtuckaway Lake water levels**: at this time, NHDES has not analyzed under what conditions there exists the potential for multiple releases that could lead to impacts to fish and wildlife from the lowering of water levels. NHFGD plans to continue to work cooperatively with NHDES on this topic.

e. **Fundy Cove area**: being a shallow cove the lowering of water levels could be an issue to fish and wildlife residing there; as well as, limiting the utilization of the Department's existing public boat launch. This also applies to other shallow areas around the lake or pond that would be more dramatically affected on a horizontal level by a proposed vertical drop in water elevation. NHFGD plans to continue to work cooperatively with NHDES on this topic.

Please feel free to contact Mr. John Magee, Fish Habitat Biologist, at 603-271-2744 or john.a.magee@wildlife.nh.gov with questions or concerns. We look forward to our continued progress on meeting water quality standards and the conservation of fish and wildlife resources in New Hampshire.

Sincerely,

Glenn Normandeau
Executive Director

cc: Cheri Patterson
Emily Brunkhurst
Mike Marchand
Kim Tuttle
John Magee
Carol Henderson

Town of Nottingham
P.O. Box 114
Nottingham NH 03290

Office 603-679-5022
Fax 603-679-1013

June 9, 2011

Mr. C. Wayne Ives
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095

Subject: Comments from the Nottingham Board of Selectmen on the Draft Lamprey River Water Management Plan Report (NHDES-R-WD-11-9)

Dear Mr. Ives,

The Town of Nottingham may face the largest impact from DES's instream flow management plan of any municipality in the headwaters of the Lamprey River. Specifically:

- The North River begins at the north end of town and flows through Nottingham for approximately 12 miles.
- More than half of the Little River is located in Nottingham.
- The Pawtuckaway River originates in Nottingham and passes through town wetlands.
- The entirety of Pawtuckaway Lake is within our town borders. This heavily used recreational and residential lake would be DES's primary source of relief flows under the proposed plan for managing instream flow in the lower Lamprey River.
- The Nottingham Town Beach, located at the north end of Pawtuckaway Lake, was deeded to the Town by the State when Pawtuckaway State Park was created in the 1960s. Lower lake levels and degraded water quality in the summer could make the Town Beach unsafe and unusable.

- There are 394 taxable waterfront and water access parcels around Pawtuckaway Lake (16% of the total for Nottingham). Of that number, 357 have year-round or seasonal homes on them (17.7% of the total for Nottingham). A reduction in the water quality and water quantity of Pawtuckaway Lake could affect real estate tax assessments and significantly erode the local tax base. In addition, these homes rely on private wells that could be affected by lower lake levels during periods of drought.
- For several years, the Town has allocated thousands of dollars for the Lake Host Program to prevent exotic weeds from entering the lake at the public boat launches.
- The Town was awarded a 319 Watershed Improvement Grant from DES in 2006 to evaluate phosphorus and sediment loading and apply best management practices at 12 sites to improve water quality on Pawtuckaway Lake.

The Town of Nottingham's water resources are highly valued by residents and visitors alike. They define our town in terms of its rural character, environmental quality, economic stability, and regional identity. Therefore, Nottingham's concerns must be thoroughly considered and clearly addressed by DES prior to making any determinations or changes that would affect our environment.

Unfortunately, it is clear from a review of the report and from comments presented at the public hearing and submitted in writing that the draft Lamprey River Water Management Plan Report is deficient in many ways. It is also clear that the report reaches its conclusions to reallocate water resources from Nottingham without adequately studying the environmental and economic consequences to the town, the region, or the watershed as a whole.

Comments made before this Board at our past two meetings indicate that lowering the water levels in Pawtuckaway Lake could be damaging to water quality and to the creatures that inhabit the lake, including loons, turtles, frogs, and fish. With respect to human impacts, the increased over winter levels behind Dolloff Dam would diminish the value of lakefront property by preventing winter maintenance and causing ice damage in the spring to docks and other structures that rely on the long-standing 7-foot drawdown in the fall. Those impacts must be considered and avoided to the greatest extent possible.

As guardians of our Town's water resources and the rights of our residents, we have to ask: What will happen to water quality and the volume of Pawtuckaway Lake if DES orders a series of 48-hour water releases from Dolloff Dam through the spring and summer, especially in years of drought? How will DES respond to water quality degradation in the lake if it occurs as a result of the draw downs? How will DES address riparian rights for property owners on the lake and tributaries? These questions can't simply be ignored or pushed aside to be addressed after a couple of years of "adaptive management" of the dam. We all have a right to know that this plan is grounded in reality, both scientifically and politically.

We are also concerned because the Town of Durham has been allowed to take increasingly large water withdrawals from the Lamprey River despite DES's stated need to maintain minimum flows for aquatic habitat. The Lamprey River was originally used by the University of NH/Durham Water System (UDWS) as a reserve supply for drinking water. By 2009 the Lamprey had become the primary drinking water source for the growing university and town. Public documents show that in September 2010, the UDWS was given the right by DES to drawdown the water level behind Wiswall Dam much further than in the past to meet its needs (from 6" to 18"). In addition, the UDWS is proposing to withdraw water from the Lamprey River during high flows to artificially recharge the Spruce Hole Aquifer, a groundwater source that is being developed as a second well. Information about potential transfers of water from the Lamprey to Spruce Hole must be included in this plan.

We believe that by continuing to expand its use of the Lamprey River for drinking water supply, Durham may be taking an unreasonable share from the river, thereby diminishing water resources for all other municipalities above and below their withdrawal point. We cannot support drawing down Pawtuckaway Lake to meet growing drinking water demand in Durham at the same time DES's water management plan does not address the well-known effects of impervious cover on base flow, flooding, stream quality, aquatic habitat, and groundwater recharge. The UNH Lamprey River Hydrologic Observatory, the UNH Stormwater Center, and the Piscataqua Estuaries Regional Partnership could all assist in expanding the instream flow strategies to include best management practices at key watershed locations that would enhance groundwater recharge and augment stream flow.

With respect to all of these concerns, the Nottingham Board of Selectmen respectfully requests that there be no changes in the management of water levels in Pawtuckaway Lake and no reallocation of water resources done before a complete and adequate environmental impact study of the Lamprey River Watershed is completed. That study should also consider economic impacts of the plan, including the potential effects on visitation to Pawtuckaway State Park and the likely real estate impacts from diminished property value. All of this is especially important in light of the passage of HB149 which will expand the Designated Lamprey River to include the North River, Little River, and Pawtuckaway River in Nottingham.

Thank you for the opportunity to comment.

Sincerely,

Gary A. Anderson ____________________

Mary L. Bonser Mary L. Bonser

Hal W. Rafter ____________________

Selectmen, Town of Nottingham

Cc: Nottingham Conservation Commission
Nottingham Planning Board
Pawtuckaway Lake Improvement Association (via email)

-----Original Message-----
From: jmrohrer@comcast.net [mailto:jmrohrer@comcast.net]
Sent: Monday, June 20, 2011 4:05 PM
To: Ives, Wayne
Subject: Pawtuckaway Lake

Hi,
My name is Jim Rohrer. I live at 133 Deerfield Rd., Nottingham, NH 03290.
I am not in favor of the proposed plan to lower the water level in Pawtuckaway Lake. I do not live on the lake.
I use the boat ramp at Fundy Cove and it is already too shallow during the drier summer months.
Propellers cost a lot of money and I don't think it is fair to subject the public to increased hazards caused by shallow water levels.

Please consider other options and leave Pawtuckaway as is.

Thank You,

Jim Rohrer
603-734-2389

There are 3 main issues with the plan:

1. There is no limit on how much water can be drawn from Pawtuckaway Lake.
2. There is no benchmark on when Pawtuckaway Lake is too low to draw water from it.
3. There is no reason in the report to change the winter drawn down levels, and the reports assumption that lakefront property owners do not object to changing the winter draw down is incorrect.

1. I attended the meeting in Epping. It was brought up in that meeting that using the numbers in the report, more than 1 foot of water could be drawn at any one time. The 1 foot number wasn't disputed by the DES but it was suggested that it would not happen. If that's the case, then why isn't a maximum water draw explicitly stated along with the method that will be used to assure the maximum water draw isn't exceeded?
2. Pawtuckaway Lake loses about 8 inches of water by evaporation during a normal summer season. Why is that significant? It means that the rivers and streams supplying the lake are not able to maintain (never mind replenish) the lake during a normal summer season. More significantly, the lake will not likely be able to recover any of the water that is released during a summer containing a cataclysmic event.

   In addition, Pawtuckaway Lake has a history of cyanobacteria blooms, the most recent in 2010. Water temperature plays a role in cyanobacteria blooms. The lower the lake level, the warmer the lake will become and the more likely a cyanobacteria bloom will occur. Lowering the lake even a few inches will raise its temperature and very possibly cause and/or aggravate a cyanobacterial bloom. The DES website recommends people not wade, swim, or drink the water if a cyanobacterial bloom is present, which clearly affects all users and property owners abutting the lake.

   If a cataclysmic event is threatening the Lamprey River, it is most likely affecting Pawtuckaway Lake as well. There needs to be a determination made about when the water level in Pawtuckaway Lake is too low to allow draw downs to prevent a cataclysmic Lamprey River event.
3. The survey done with property owners in 2000 is invalid. More than half of the property owners back then failed to respond to the survey. According to the MLS realty website, approximately one quarter of the Pawtuckaway lakefront properties have been sold since 2000. Your assumption that current lakefront owners do not object to changing the winter draw down is simply incorrect. I know I and my neighbors are very much against changing the drawdown, and I have owned lakefront property since 2004.

It's clear from attending the meeting and from reading the comments that little thought has gone into how Pawtuckaway Lake and the surrounding area will be affected by the proposed lake draw downs. That itself should raise a red flag that more work needs to be done before any water management plan is implemented.

I respectfully request, as a New Hampshire tax payer and Pawtuckaway lakefront property owner, that this plan not be implemented. Pawtuckaway Lake is a state of New Hampshire resource to be enjoyed and protected, not a reservoir of water that the DES has the right to use for any reason.

Respectfully submitted, James Rosborough

Version: 5/16/11

Comments Received From:

Mr. Thad Russell
ESC/HBGB MP-RTIP
Radar Development & Integration
781-377-6796 DSN 478 FAX 1172
Nova Technology Solutions - ETASS
Thad.Russell.ctr@hanscom.af.mil
Thaddeus.Russell@hanscom.af.smil.mil

Source: email dated May 13, 2011

I am a home owner on Pawtuckaway Lake so I am definitely affected by the NHDES-R WD-11-9 plan.

Comment RUS-1:

I do not agree with not having a 7 foot drawdown in the winter. Per page 61 of your report it is rare that flow rates will be needed in the winter months so why do it.

Response:

Comment RUS-2:

The 7 foot drawdown accomplishes the following: Keeps the invasive weeds from growing as it kills them each year, Allows for shore and dock maintenance, Keeps the ice from destroying the docks on the east and south shore due to ice pile up from the north wind, If you don't use 7 foot many of the weeds would be covered in water and stay alive and active, It allows for water turn over in the spring, It provides room for runoff in the wet/high snow springs. A few years ago the water was 3 feet over the summer level in the spring and resulted in lots of property damage. It ruined my dock but some folks lost their houses!

Response:

Comment RUS-3:

Changing from 7 feet to 5 feet is drastic and not warranted by the data in the draft plan. I can't see that holding it just in case for a winter release is needed at all.

Response:

Comment RUS-4:

The water management plan has passed its legislative statute and was not approved or adopted by the 30 Sept 10 required date therefore should be null and void.

Response:

House Bill 63, an act extending the instream pilot program for one year (from September 1, 2010 to September 1, 2011) was passed by the House and Senate and then signed by the Governor (Chapter 0034) on May 9, 2011. The Final Lamprey River Water Management Plan will be submitted to the DES Commissioner prior to September 1, 2011 for his consideration and adoption.

Comment RUS-5:

There is a problem with loons in the spring/summer which you have not addressed. Loons use the same nests year after year. Both higher water and draw downs will cause them to abandon the nests or be vulnerable to predators. Loons are threatened species in Michigan and New Hampshire and endangered in Vermont so we must be careful.

Response:

Comment RUS-6:

Did you consider the effect on Bass and pan fish by spring draw downs. Their nests are in shallow water and we can’t even fish for smallmouth from 15 May to 15 June so they can spawn. Is seems you are considering the fish in the Lamprey but not the lake.

Response:

Comment RUS-7

If you draw down the lake too much in the summer many of the hundreds of rocks will be closer to the surface and be a danger to boating. I could not tell from the chart on page 28 or the report how many draw downs are expected or what depth would be included. This will also affect use of the state boat ramp and churn up plants in the now wake area where the loons live. It is only 3 feet deep up there in the summer now past twin islands to the Bay of Fundy area.

Response:

Comment RUS-8

There should be some kind of feedback from the residents not just the Campground which is essentially closed in the winter or the dam owners, who are the state and have other agendas.

Response:

Comment:

This lake is one of the gems of New Hampshire and not just a storage impoundment for water so we need to be careful. There should be rules for how many or how much is drawn down besides what the downstream rules in your plan say.

Response:

Comment:

I don’t think the evidence in the plan supports keeping an extra two feet of water in the winter.
12. The lake owners were not polled in 2000 as the plan states that 55% agreed with the lesser drawdown. This has been discussed at our annual meeting with the state and the overwhelming majority (almost everyone attending) always want to keep 7 feet. If you change it to 5.5 feet many docks will be crushed by the ice.

From:	Collins, Luke
To:	rydeen@comcast.net
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Lamprey Designated River Water Management Plan
Date:	Monday, May 16, 2011 3:14:34 PM

Dear Mr. Deen,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

-----Original Message-----
From: rydeen@comcast.net [mailto:rydeen@comcast.net]
Sent: Thursday, May 12, 2011 8:36 PM
To: Ives, Wayne
Subject: Your plans for our lake

How often is "infrequently" (for water releases during critical dry periods)?

Damage to docks and other problems from a smaller fall draw down

Effect of winter releases

Danger to loon habitat and nesting areas

Health of lake wildlife

Water quality

Boating dangers and safety concerns in low level water

What about notice to property owners before any water release (only the dam "owners" are to be notified, in our case the State--Ha!)

What about a monitoring program that assesses the overall impact of releases beyond measuring how much the lake level has dropped

Shouldn't there be a mechanism for feedback from lake residents and users after these programs are implemented, **because nothing is actually known about what the impact on the Pawtuckaway ecosystem will be**

Comments on Lamprey River Water Management Plan Report

By Stephen Soreff, MD

I live on Lake Pawtuckaway

Sunday, June 12, 2011

First four thanks. 1. For a start a developing a comprehensive plan; 2. For Wayne Ives presentation at the PLIA 6-11-11, -very informative; 3. For extending the comment period and 4. For being open to comments.

My concern: As I understand it, once a Plan has been adopted, it would mean an automatic initiation of a series of steps for certain set-written levels of water conditions. This situation reminds me an analogy. In healthcare there was a living will whereby an individual would detail in that person's will certain conditions that would result in specific responses. For example, if you have irreversible head trauma or cancer, than you might say if you were on a respirator 'do not resuscitate. This proved unworkable since it was clear one could never cover all possible contingencies. Medical advances kept changing as well as your own health status since the will was drafted and signed . The future is nor will it be really possible to predict in all situations.

Hence, my concern with a Lamprey River Water Management Plan which calls for future initiation based on current known projections. I would like to see a human being control at the point of action. This would guard against changes in the world/area not anticipated in 2011.

Stephen Soreff, MD

32 Dolloff Dam Road

LAMPREY RIVER WATERSHED ASSOCIATION

September 20, 2011

C. Wayne Ives
NH Department of Environmental Services
PO Box 95
29 Hazen Drive
Concord, NH 03302-0095

Northwood
Barrington
Deerfield
Candia
Raymond
Freemont
Epping
Brentwood
Exeter
Nottingham
Lee
Newfields
Durham
Newmarket

Dear Mr. Ives:

The Lamprey River Watershed Association is honored to have the Lamprey River be one of two rivers selected to study the management of flow in the river to prevent catastrophic situations occurring during times of low flow. We have reviewed the proposed Lamprey River Water Management Plan dated April 11, 2011 and are providing the following comments so that the final report will be more widely understood and accepted.

Pertaining To The Release Of This Proposed Plan And The Review Process

While the Lamprey River "designated" in only the towns of Lee and Durham at the time of the in-stream flow study, affected water users and the lakes to implement the water management plan are in other towns of the watershed. This plan should have been widely distributed within all of the Lamprey River watershed towns. In addition, although the RSA required only one public hearing, additional hearings and/or listening sessions, or other means of public outreach would have been valuable to the residents of all of the towns. For example, Nottingham selectmen thought it only pertained to downstream and just recently realized that this included levels on Pawtuckaway Lake, a valuable water resource to the town. Mendums Pond is one of the two lakes proposed to be used for augmenting flow yet the lake association and also the University of New Hampshire were not notified for comment on the plan.

Other general comments are that the entire watershed's ecosystem does not appear to have been addressed as the management plan becomes implemented. What connection is there to the lake shore protection act? Was the effect on lakes and lake edges taken into consideration as the management plan was developed?

Was there an internal review within the Department of Environmental Services and the other state agencies outside the Department that have roles in natural resources?

Executive Summary

Please revise this to reach a lay audience and set the context for which this management plan is written. Those not familiar with the entire project may not know that this is being developed as a result of an RSA or that phase 1 has already been completed. The RSA should be referenced and quoted from such as the definition of protected instream flow in 483.4.16 "Protected instream flow" means a constant minimum stream flow level established to maintain water for present and future instream public uses. That definition, simplistic as it is in view of all the years this study has been in process, is critical.

Who is plan intended for? The Executive Summary should also spell out that this is a DES plan intended for the *state* to use as a management tool to protect the “designated” section of the river, assist with water quality standards, and to maintain the biological and physical integrity of the river.

An effective executive summary can make or break acceptance of a study. We recommend that you also draw from the plan's summary (page 58) and expand the executive summary. Include that this plan is subject to change after review and testing in situ.

A glossary with this term and all the other terms and abbreviations used in this report is an absolute necessity and should be included.

Introduction

Be consistent when referring to the three subparts of this plan by listing in order each time: Conservation Plans, Water Use Plans and Dam Management Plan.

In part A of the Introduction, do not depend upon readers to reference RSA 483; give them some specific language and expand the first paragraph on page 2.

Paragraph 5 (page 2) sounds like Public water supplies have been dismissed entirely and the two sentences appear to contradict; this is not your intention. It is important to be aware that concern over public water supplies and how they will be affected is primary in the mind of most readers. Expand this paragraph with more information from the body of the plan. (See page 4 where Public water Supply is last; consider moving up to come first.)

The final paragraph in part A (top of page 3) needs reorganization for clarity.

B Natural Flow Paradigm (page3): This is really quite a simple concept but the opening paragraph meanders! If you can make this section clearer, you will help the integrity of the science. Some will find Poff, et al ,easy to understand, and you might want to draw a little more from that rather than assuming that readers are familiar with the article and the concept of "natural flow regime" (*natural flow* makes sense; *regime* will muddy the water for most readers.) (For more experienced readers, you might want to include the Poff article in the appendix in its entirety if you can get permission, or at least give the www. location.)

Also with regard to the integrity of the science, the first mention of the 30-year stream flow record occurs on page 27. Something about this should go into the executive summary and introduction.

Please define *de minimis flow* the first time you mention it (as you do on page 30) and place this term in the yet to be developed glossary. Also, *7Q10* is not clearly defined (and redefined) and the reader will have to hunt to figure out that line, so get it up front and include with the explanation of the 90% issue. As was mentioned at the meeting, if you have a chart, define the abbreviations; even though everyone knows GRAF, it does not hurt to bow to the lay reader and define it in the footnotes of the chart more than once.

One possible error is on page 59: The sense of the sentence is the last paragraph would be: The state regulations do NOT clearly delineate what data set is used to define the 7Q10, not how and when the value is updated.

Misspelled words, typos and grammatical corrections were overlooked in order to comment on the more important substance issues. We recommend using a good editor before the final report is issued.

General Issues

What is the process for implementing the plan, conservation plans and initiating the release of pulses? While the document includes each affected water user's Conservation Plan and Dam Management Plans, either in the body of the report or as an appendix the steps involved by DES in order to release water to mitigate low flow should be widely known (who, what, when, where) in order to have confidence that the process is working. Postings to a DES website on the status of flow and actions taken would ease concerns during drought conditions.

We continue to be concerned that when low flow is occurring in the river and water conservation plans must be underway that the UNH/Durham system is allowed an additional 10 days before implementing a Stage 4 Alert. Just as the water levels are most dire, UNH/Durham is allowed to continue on as if there is not a serious problem. Each affected water user should be held to the same standard throughout the watershed. Further, there appears to be no difference in action between the UNH/Durham Stage 3 Alert and the Stage 4 Alert. Is something missing?

Thank you for your effort to be available and provide answers to our questions throughout this process. We understand that this is a pilot and has yet to be tested in the field. The Lamprey River Watershed Association is fully supportive of a proactive approach to maintaining the integrity of the river and we look forward to working with the Department of Environmental Services as this pilot goes forward to ensure that the plan is effective.

Carl F Spang

Carl F. Spang
President

From:	Collins, Luke
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Pawtuckaway Lake & Lamprey River Water Mgmt Report
Date:	Monday, May 16, 2011 3:03:58 PM

Dear Mr. Stephens,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

-----Original Message-----
From: Dennis Stephens [mailto:Dennis@stephensmarquis.com]
Sent: Sunday, May 15, 2011 3:24 PM
To: Ives, Wayne
Subject: Pawtuckaway Lake & Lamprey River Water Mgmt Report

Mr C. Wayne Ives
NH Dept. of Environmental Services

Dear Mr. Ives,

I am writing to express my concern in using Pawtuckaway Lake resources in the water management of the Lamprey River. I respect the need to manage the Lamprey River resources, but I feel the impact to other resources in the water shed area has not been fully considered. I would like to comment on a few things:
- The 7' draw down of Pawtuckaway Lake is essential to protect lake front property. Annual repairs from winter ice damage are standard practice, and a lower draw down would cause extensive destruction.
- Draw down of Pawtuckaway Lake during the summer concerns me even more. I would like to know the impact to the Pawtuckaway wildlife, water quality, property, and recreation. Pawtuckaway supports a large ecosystem, that is not always in the best condition. Water level is always a major concern in our constant management of the water quality, temperature, algae plumes, Loon habitat, boating danger (rocks), and other issues. Endangering one resource to help another may not seem as practical when looked at from other perspectives.
- It would seem a thorough study has been performed on the Lamprey River ecosystem, but not on the areas where proposed water management changes may have a detrimental impact. Please correct this before considering implementing components of the Lamprey water management plan.

I am a member of the Pawtuckaway Lake Improvement Association. The PLIA is active in all activities around the lake to preserve its natural resources. I urge you to keep the PLIA informed on activities that affect Pawtuckaway and to seek feedback from its members. The PLIA consists of some the most experienced conservationist in the area, and are very knowledgeable on the Pawtuckaway ecosystem.

Respectfully,

Dennis Stephens, PE

36 Whites Grove Rd.
Nottingham, NH
603-759-3602 (cell)

-----Original Message-----
From: Ives, Wayne
Sent: Tuesday, May 17, 2011 2:31 PM
To: Collins, Luke
Subject: FW: Request for Comment Period Extension for Lamprey River Water Management Plan

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C. Wayne Ives, P.G., Hydrogeologist
Instream Flow Specialist
http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/index.htm

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-----Original Message-----
From: therese.thompson1@comcast.net [mailto:therese.thompson1@comcast.net]
Sent: Tuesday, May 17, 2011 2:26 PM
To: Ives, Wayne
Subject: Re: Request for Comment Period Extension for Lamprey River Water Management Plan

Wayne,

The emails have been insane, I try to explain to them, this includes a release from Mendums Pond, it is very little water level change and will ONLY occur, if realllllllllly needed.

Please bring my attached letter of concerns to our May 20th meeting, I can not attend,
and if you want to post these comments on your website too.

thanks again,

Therese Thompson
><{{{{"> =^..^=

May 17, 2011
Dear Wayne and Lamprey River WMPAAC,
I am sorry I cannot attend our May 20th meeting, I have to be at work for graduation.
I wanted to give you some of my comments on the *Water Mgmt Plan for the Lamprey River*:

At our July 7, 2010 meeting, pg. 3 Al Larsen stated "They draw it down 7 feet every year in the fall and there was a proposal to limit the draw-down to 3 feet. There were surveys done and the consensus was that most people wanted it left at 7 feet [Of the 141 surveys returned, 63 preferred the existing 7 ft drawdown; 78 preferred a drawdown of 6 ft or less (8 for 6ft, 45 for 5 ft, 24 for 0-4 ft or no preference)." the lake front owners of Pawtuckaway Lake were surveyed in the year 2000 about the yearly drawdown and the Commissioner decided to leave the draw down at 7 feet for the winter. After this meeting I asked the officers of the Pawtuckaway Lake Improvement Association, if they were aware of this survey, and I received no response. Yet at the **public hearing** on May 11th, I believe, it was presented that lowering the lake less than 7 ft was preferred by this survey in 2000. (If you add up the returns of this survey, they do not add up to 141) ?

As stated on pg. 2 of the July 7, 2010 meeting minutes, I am pleased that **USA Springs** will have to provide a **conservation plan** during an extended drought period.

At our **Feb. 11, 2011** meeting the chart for **<u>Change in Water Level</u>** read

Overwintering Dec. 9-Feb 28 = **0.33 feet**

Salmon spawning Oct. 7- Dec. 8 = **0.09 feet**

At the **public hearing** meeting of May 11, 2011

Overwintering Dec. 9-Feb 28 = **1.53 feet** retained in storage

Salmon spawning Oct. 7- Dec. 8 = **1.53** feet retained in storage

These amounts are not the same.

Pawtuckaway Lake is listed as having 900 acres in the **July 7, 2010 & Feb. 11, 2011** meeting presentations. In Table 2 Flow Releases of the **public hearing** presentation it states 783 acres (I pointed this out in our meeting minutes for Feb. 11, 2011 pg. 8). I was glad to see the correct acres listed at the public hearing.

As I pointed out in meeting minutes of July 7, 2010 pg 2, my concern was of upstream the lake ie: streams, ponds, etc., having a negative effect on these creatures in these wetlands with a proposed drawdown during the summer, during a drought.

<u>My new concerns are:</u>

Can the Dam Bureau actually release only ~ 2.5 inches and prevent the flow of more water from Pawtuckaway Lake when needed during the summer during an extended drought? (the proposed 2.5 inches includes Mendums Pond)

Because Doloff Dam and Drowns Dam on Pawtuckaway Lake do not directly flow into the Lamprey River, Drowns Dam flows into the North River and Doloff Dam flows into the Pawtuckaway River. During an extended drought, will this ~2.5 inches of water released from the lake actually reach the Lamprey River or will it be used by the wetlands and rivers prior to the Lamprey River? Because during a drought all wetlands will be low.

Was anyone from Mendums Pond at the public hearing?

Thank you.

Sincerely,

Therese Thompson, Nottingham and lake front owner on Pawtuckaway Lake
tathompson@mountida.edu

C. Wayne Ives
NH Department of Environmental Services
PO Box 95 - 29 Hazen Drive
Concord, NH 03302-0095
Email wayne.ives@des.nh.gov

Additional Comments, Therese Thompson, June 20, 2011
Lamprey River Water Mgmt Plan

I am a member of:
Lamprey River Water Management Planning Area Advisory Committee
Representing Lake Associations
and a member of
Southeast Watershed Alliance
Representing Nottingham http://www.southeastwatershedalliance.org/members

I live in Nottingham, my concerns are the following:

1.) Health of Pawtuckaway Lake
2.) Health of the Aquatic Life and Habitat of streams, ponds, & marshes that enter the lake (Instream flows = RSA 483)
3.) Less Winter Drawdown, how will this affect our native mussels and protection against invasive aquatic plants getting established

With the expansion of the designated Lamprey River to include the major tributaries and the Lamprey below Durham to Great Bay, signed by the Governor on June 7, 2011, More studies need to be done prior to adopting or implementing this Water Mgmt. Plan.

I own property on Pawtuckaway Lake, with the introduction of **alewives** (anadromous fish), into our lake every Spring by NH Marine Fish & Game and the increase in **toxic algal (cyanobacteria) blooms** during the Summer and with the proposed release of water during an extended drought could make these problems worse. As recent as this May 27, 2011, Pawtuckaway State Park beach was closed due to cyanobacteria.

Background information:

Alewives

http://www.flyfishinginnh.com/vforum/showthread.php?t=3476
On the Lamprey River, a fish ladder was constructed at Macallen Dam in Newmarket, currently, some of these fish are trapped at the fish ladder, and transported to Pawtuckaway Lake. Alewives nursery habitat upstream from Wiswall Dam is inaccessible to these fish due to the lack of a fish passage at Wiswall Dam.

Cheri Patterson, NH Coastal Fish & Game, presentation 2nd slide,
quoted WWF: ***Fragmentation of river systems due to dams is the single greatest threat to the maintenance of ecosystem integrity.***
http://www.wildlife.state.nh.us/marine/marine_PDFs/Winnicut_R_diadromous_pres_1108.pdf

Dams

The number of dams in our state is very high, see the presentation from our June 13, 2005 meeting , slide # 24:
http://www.des.state.nh.us/organization/divisions/water/wmb/rivers/instream/lamprey/documents/20050613ipuocr_entities.pdf

Dams are being removed throughout the country, here are a few in NH:
Removal of Winnicut River Dam in Greenland 2009
http://des.nh.gov/organization/divisions/water/wmb/coastal/restoration/projects/winnicut.htm

Removal of Merrimack Village Dam 2008
http://www.habitat.noaa.gov/media/videos.html

Gonic Sawmill Dam & Removal of the Gonic Dam on the Cocheco River
http://des.nh.gov/organization/divisions/water/wmb/coastal/restoration/projects/documents/gonic-dams-feasibility-rpt.pdf

Swanzey, NH: Homestead Woolen Mills dam removal on the Ashuelot River 2008
http://www.fws.gov/r5crc/habitat/fish_passage.htm

Now, Newmarket is discussing the removal of the Macallen Dam

The Bunker Pond Dam in West Epping, was removed this month, I have already seen the effects of this removal, one day a pond in that area was dry, then after a rain, the pond gained water. Therefore, recalculating how much water may need to be removed from Pawtuckaway Lake during an extended May - Oct. drought, will have to be done.

-----Original Message-----
From: mountainpoetnh@aol.com [mailto:mountainpoetnh@aol.com]
Sent: Monday, June 13, 2011 12:39 AM
To: Ives, Wayne
Subject: RE Lamprey Water Management Plan

Thank you for the opportunity to comment on the Lamprey Water Management Plan and for extending the comment period so that other concerned persons will be able to post their comments.

As a resident of Pawtuckaway lake, I enjoy the many benefits - year round recreation opportunities ,wildlife observation, community service through weed watching and lake hosting, spiritual renewal (this really our "little bit of paradise") and a host of other things to numerous to mention. The health of the Lake is very important to me for these reasons. In addition, anything that affects the quality of the water or the ecosystems it supports has the potential of lowering property values on the lake.

I am concerned about the adoption of this plan ,especially in light of the fact that the impact on Pawtuckaway Lake has not been thouroughly studied.

Marguerite Tucker
32 Dolloff Dam Road
Nottingham, NH 03290

From:	Collins, Luke
To:	Pamela S. Walker
Cc:	alarson@normandeau.com; Ives, Wayne; tom.ballestero@unh.edu; Couture, Steve
Subject:	RE: Pawtuckaway Lake
Date:	Monday, May 16, 2011 1:32:09 PM
Attachments:	image001.gif image002.gif

Dear Ms. Walker,

Thank you for your comments. They have been received.

Luke Collins

Luke Collins, Intern
Watershed Management Bureau

-----Original Message-----
From: Pamela S. Walker [mailto:sledder@comcast.net]
Sent: Sunday, May 15, 2011 11:57 AM
To: Ives, Wayne
Subject: Pawtuckaway Lake

My husband and I have lived on this lake for 24 years and it was a camp prior to that owned by his Dad
so we are very familiar with the issue of not drawing the lake down by 7 feet and not having enough water
to put our boat in etc. We disagree with taking the water level down in lesser amounts as it does do damage
to our docks in the winter and also does not allow maintenance in and around the water. We have the feeling
that other smaller interest parties have a play in this and parties who do not care what our concerns are
and none of us here on the lake have been asked how we feel about this project. We pay the HIGHEST taxes
in Nottingham and the major reason for that is the lake. Now others get to play around with the lake and if the
lake get dangerously low and we have to remove our watercraft which may happen if the people tracking
these periodic draw down we will be the ones to “suffer”. We understand your intent is NOT to cause us
and animals in this area, such as loon nests any issue but this plan will cause more harm to us as well.
We also understand the Lamprey gets low during the summer, but so does our lake.

Some areas of concern might be:
How often is "infrequently" (for water releases during critical dry periods)?
Damage to docks and other problems from a smaller fall draw down
Effect of winter releases
Danger to loon habitat and nesting areas
Health of lake wildlife
Water quality
Boating dangers and safety concerns in low level water

What about notice to property owners before any water release
What about a monitoring program that assesses the overall impact of releases beyond measuring how much the lake level has dropped
Shouldn't there be a mechanism for feedback from lake residents and users after these programs are implemented, **because nothing is actually known the impact this will have on the Pawtuckaway ecosystem**

Thank you for taking time to hear our concerns.

Sincerely,

Duane & Pam Walker