

Relicensing Study 3.3.6

IMPACT OF PROJECT OPERATIONS ON SHAD SPAWNING, SPAWNING HABITAT AND EGG DEPOSITION IN THE AREA OF THE NORTHFIELD MOUNTAIN AND TURNERS FALLS PROJECTS ADDENDUM

Study Report

**Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)**

Prepared for:



Prepared by:



OCTOBER 2016

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LIST OF ABBREVIATIONS

| | |
|-----------------------|--|
| cfs | cubic feet per second |
| CRWC | Connecticut River Watershed Council |
| FERC | Federal Energy Regulatory Commission |
| FirstLight | FirstLight Hydro Generating Company |
| MADIFW | Massachusetts Division of Fisheries & Wildlife |
| MW | megawatts |
| NMFS | National Marine Fisheries Service |
| TFD | Turners Falls Dam |
| TNC | The Nature Conservancy |
| Turners Falls Project | Turners Falls Hydroelectric Project |
| USFWS | United States Fish and Wildlife Service |

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1 INTRODUCTION

On March 1, 2016, FirstLight filed with the Federal Energy Regulatory Commission (FERC) Study Report No. 3.3.6 *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects*. On March 16, 2016, FirstLight held its study report meeting in which Study No. 3.3.6 was discussed. FirstLight Hydro Generating Company (FirstLight) filed its meeting minutes on March 31, 2016 and stakeholders had until April 30, 2016 to file comments. Comments on Study No. 3.3.6 were received from the United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Massachusetts Division of Fisheries & Wildlife (MADFW), The Nature Conservancy (TNC), Connecticut River Watershed Council (CRWC) and Karl Meyer.

On June 29, 2016, FERC issued its Determination on Requests for Study Modifications and New Studies. In its Determination, FERC required FirstLight to conduct the following additional analysis:

Commission staff recommends that FirstLight expand the operation analysis presented in section 4.1 of study 3.3.6 to include additional years (i.e., 2005-2009), operation of Station No. 1, and figures showing the temporal patterns in operational changes during the shad spawning period.¹ In addition, FirstLight should provide the raw project operation data from 8 p.m. to 2 a.m. for May 1 to June 30 during each of the years from 2005 to 2015. This additional analysis will allow staff and stakeholders to determine when changes in project operation occur relative to peak spawning. This analysis would require minimal additional cost (section 5.9(b)(7)) and would provide information needed for staff's environmental analysis (section 5.9(b)(5)). FirstLight should file this information as an addendum to the study report by October 14, 2016.

¹ For each individual year, FirstLight should prepare a histogram plotting the change in total project discharge (i.e., maximum discharge minus minimum discharge) between 8 p.m. and 2 a.m. against the date (i.e., May 1 to June 30). For all years pooled, FirstLight should prepare a histogram plotting the mean change in project discharge between 8 p.m. and 2 a.m. against the date (i.e., May 1 to June 30). FirstLight should also prepare similar histograms plotting percent change in discharge against the date for individual and pooled years.

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2 HISTORIC OPERATIONS AND FLOW DATA

Operational analysis was expanded for FirstLight Study No. 3.3.6 to include additional years (2005-2009) (Table 1), Station No. 1, and figures showing temporal patterns in operational changes during the shad spawning period for all years 2005 through 2015, in response to FERC's Determination.

2.1 Methods:

The report for Study No. 3.3.6 filed on March 1, 2016, included a table (Table 4.1-1) summarizing the historical generation (MW) and flow (cfs) changes at Cabot Station during May and June based on operations data from 2010 through 2014. Additional historical operations data were retrieved and added to this addendum for 2005 through 2009 and a summary is located in [Table 1](#).

For each individual year (2005 to 2015), a histogram was prepared plotting the change in total project discharge (i.e., maximum discharge minus minimum discharge) between 8 p.m. and 2 a.m. against the date (May 1 to June 30). Total Project discharge included summed operations data from Cabot Station, Station No. 1 and Turners Falls Dam. Operations data were provided in Megawatts (MW) at Cabot Station and Station No. 1 and a conversion factor ($\text{MW} \times 1000 \times 0.2214$ for Cabot and $\text{MW} \times 1000 \times 0.3706$ for Station No. 1) was used to report data in cubic feet per second (cfs), respectively. Turners Falls Dam operational data were provided in cfs. Discharge at Turners Falls Dam via the bascule gates or tainter gates is based on rating curves. These three operations values were summed and a total discharge was reported for each hour from 8 p.m. to 2 a.m. The maximum and minimum Project discharges were then calculated within the six hour timeframe and change in discharge was computed and plotted for each day. The date reported is the date the six hour period started, e.g. May 1 denotes the period between 8 p.m. on May 1 and 2 a.m. on May 2.

Additional analysis included preparing similar histograms plotting percent change in discharge against the date for individual and pooled years. Percent change was calculated on a day to day basis (i.e., $\frac{\text{May 2}^{\text{nd}} \text{ change in discharge} - \text{May 1}^{\text{st}} \text{ change in discharge}}{\text{May 1}^{\text{st}} \text{ change in discharge}} \times 100$). Positive values indicate a percentage increase and negative values represent a percentage decrease in daily discharge change. Note that in [Figures 13](#) through [23](#) the y-axis changes from graph to graph to better visualize percent change for each year. Some graphs may look skewed due to one or two daily high percentage increases, making the rest of the values difficult to visualize.

2.2 Results:

[Figures 1](#) through [11](#) represent the total daily change (May 1 to June 30) in Project discharge from 2005 to 2015, respectively. [Figure 12](#) is the mean daily change in Project discharge for all years pooled. There seems to be some variability year to year, however; when the mean daily change in total project discharge is plotted for all years combined, there is little variability in daily change of total project discharge from May 1 to June 30 ([Figure 12](#)). The analysis done for additional years did not appear to change any results and/or conclusions that were previously stated in the original report. When all years (2005 to 2015) are pooled, total daily change in Project discharge remained stable and consistent between May 1 and June 30.

[Figures 13](#) through [23](#) represent the percent daily change in discharge (May 1 to June 30, 8 p.m. to 2 a.m.) from 2005 to 2015, respectively. [Figure 24](#) is the mean daily percent change in Project discharge for all years pooled. Some of these graphs indicate large percent changes from one day to the next but it is important to note that one day may have very minimal daily change in Project discharge. If that were the

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case, and the following day daily change in Project discharge changed thousands of cfs, that would account for an extremely large percent change from one day to the next. Percent daily change in discharge does not seem to follow any temporal pattern from year to year. In other words, some days the operational changes are minimal while the next day the operational changes may be much more apparent. When all years are pooled, there are several large percent increases in change from one day to the next ([Figure 24](#)).

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Table 1: Summary of Historical Generation (MW) and Flow (cfs) changes at Cabot Station during May and June Based on Operations Data from 2005 through 2009

| Generation Changes (MW) | Discharge Changes (cfs) | 2005 | 2006 | 2007 | 2008 | 2009 | Total | % of Total |
|----------------------------|-------------------------|------|------|------|------|------|-------|------------|
| No. of MW Decreases | | | | | | | | |
| 40 to 30 | 10,440-7,836 | 1 | 0 | 0 | 0 | 3 | 4 | 0.6 |
| 30 to 20 | 7,836-5,220 | 1 | 0 | 9 | 11 | 8 | 29 | 4 |
| 20 to 10 | 5,220-2,630 | 27 | 6 | 16 | 37 | 28 | 114 | 15.7 |
| 10 to 0 | 2,630-0 | 59 | 34 | 74 | 93 | 76 | 336 | 46.3 |
| No. of MW Increases | | | | | | | | |
| 0 to 10 | 0-2,630 | 23 | 33 | 22 | 25 | 35 | 138 | 19 |
| 10 to 20 | 2,630-5,220 | 9 | 5 | 2 | 10 | 8 | 34 | 4.7 |
| 20 to 30 | 5,220-7,836 | 11 | 0 | 10 | 15 | 8 | 44 | 6.1 |
| 30 to 40 | 7,836-10,440 | 4 | 0 | 9 | 5 | 8 | 26 | 3.6 |

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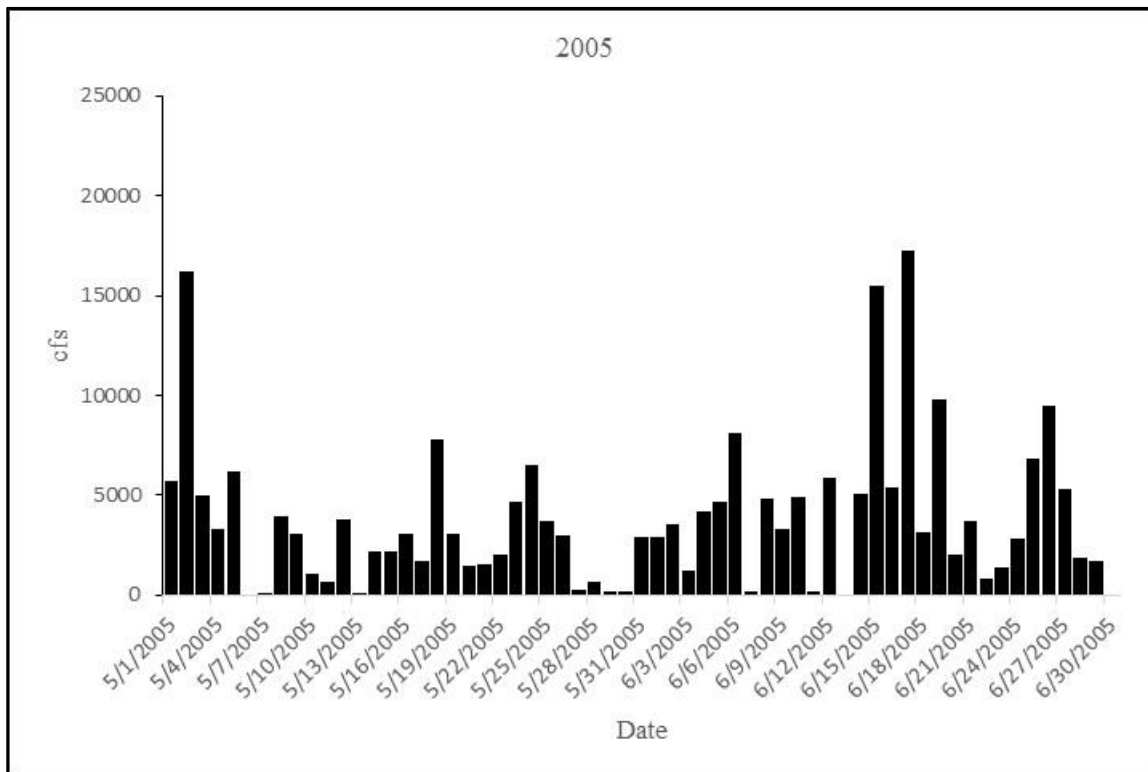


Figure 1: Change in Total Project discharge in 2005 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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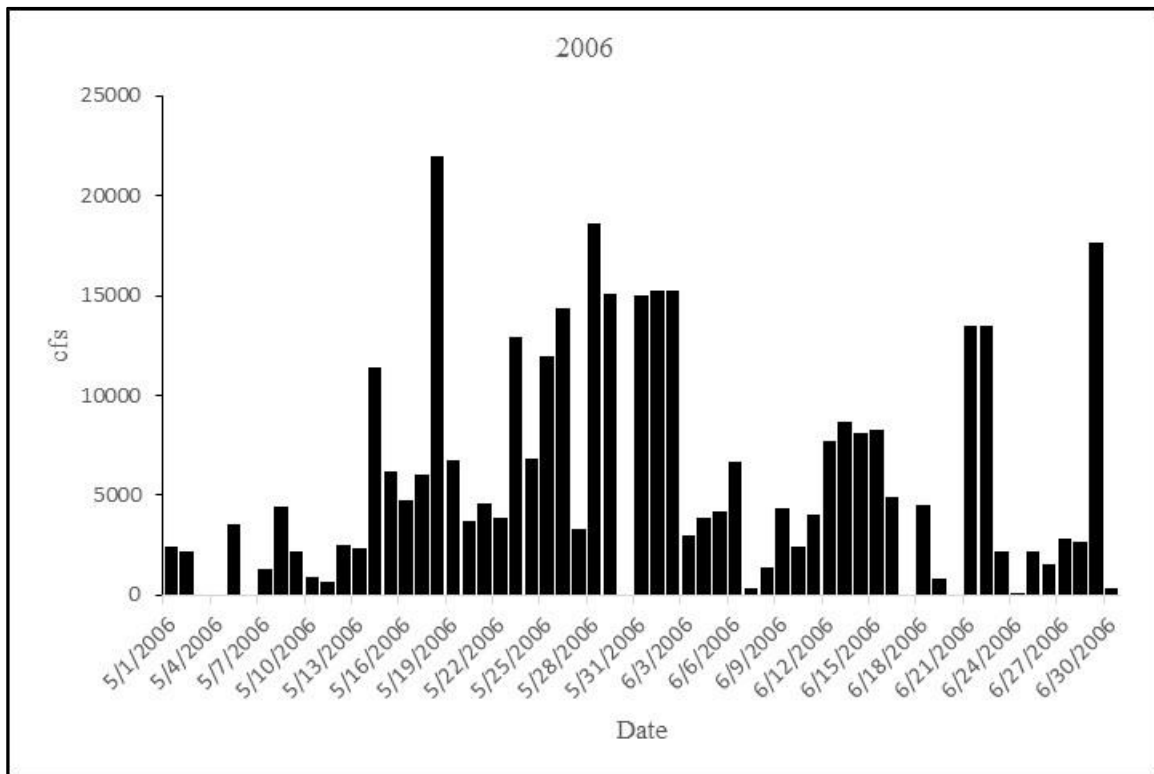


Figure 2: Change in Total Project discharge in 2006 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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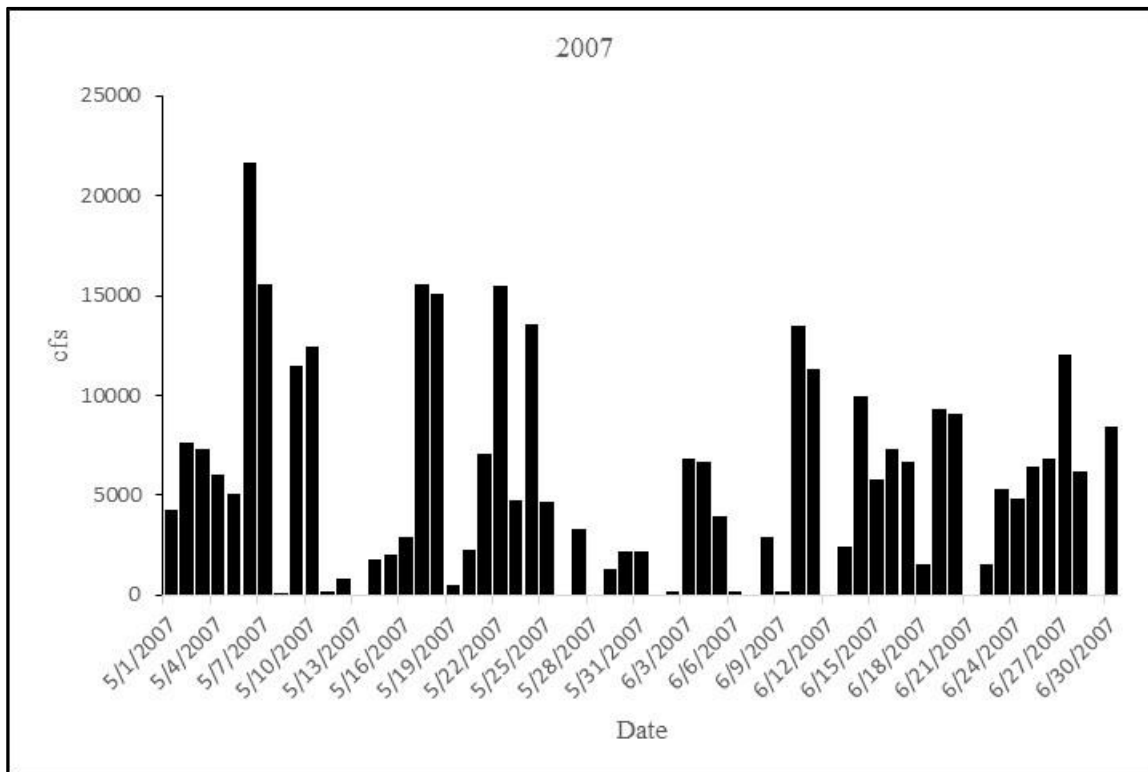


Figure 3: Change in Total Project discharge in 2007 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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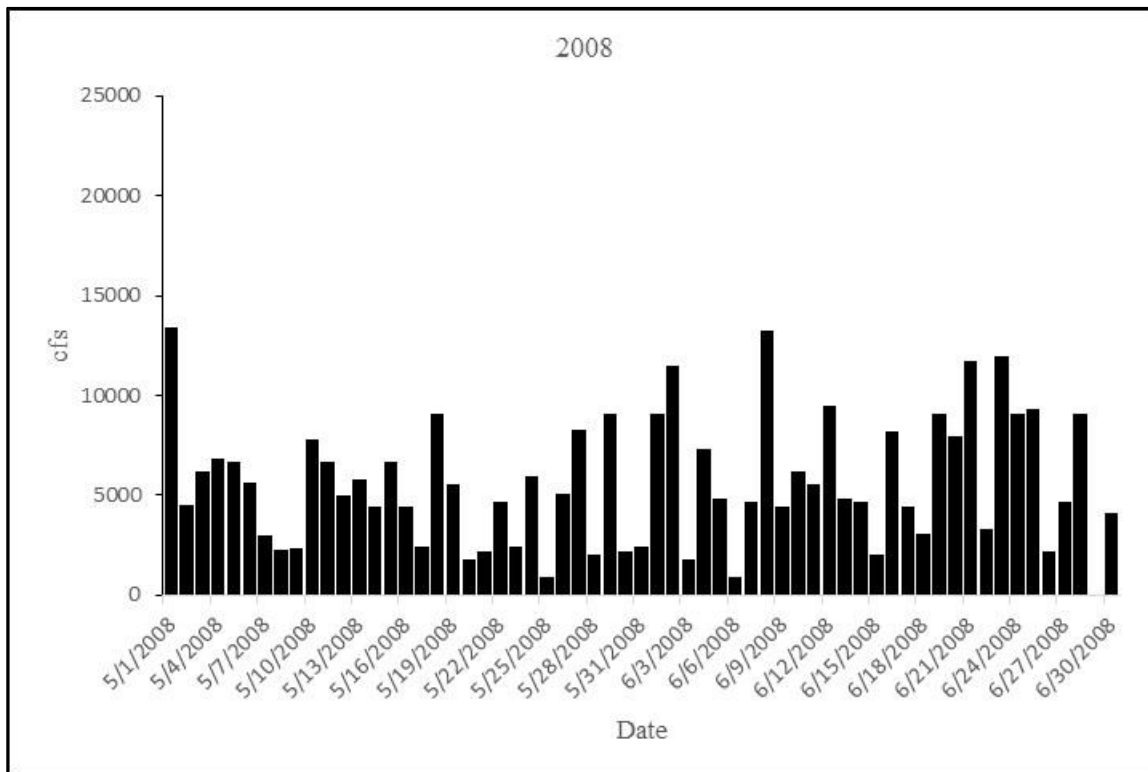


Figure 4: Change in Total Project discharge in 2008 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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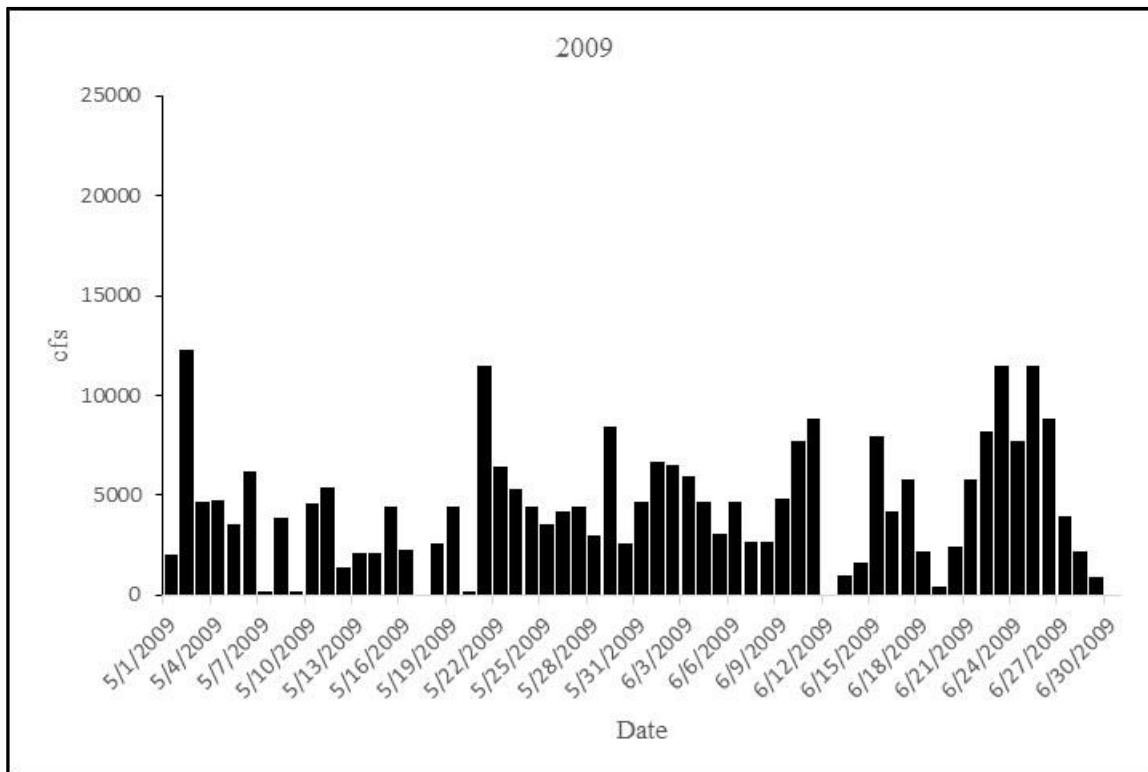


Figure 5: Change in Total Project discharge in 2009 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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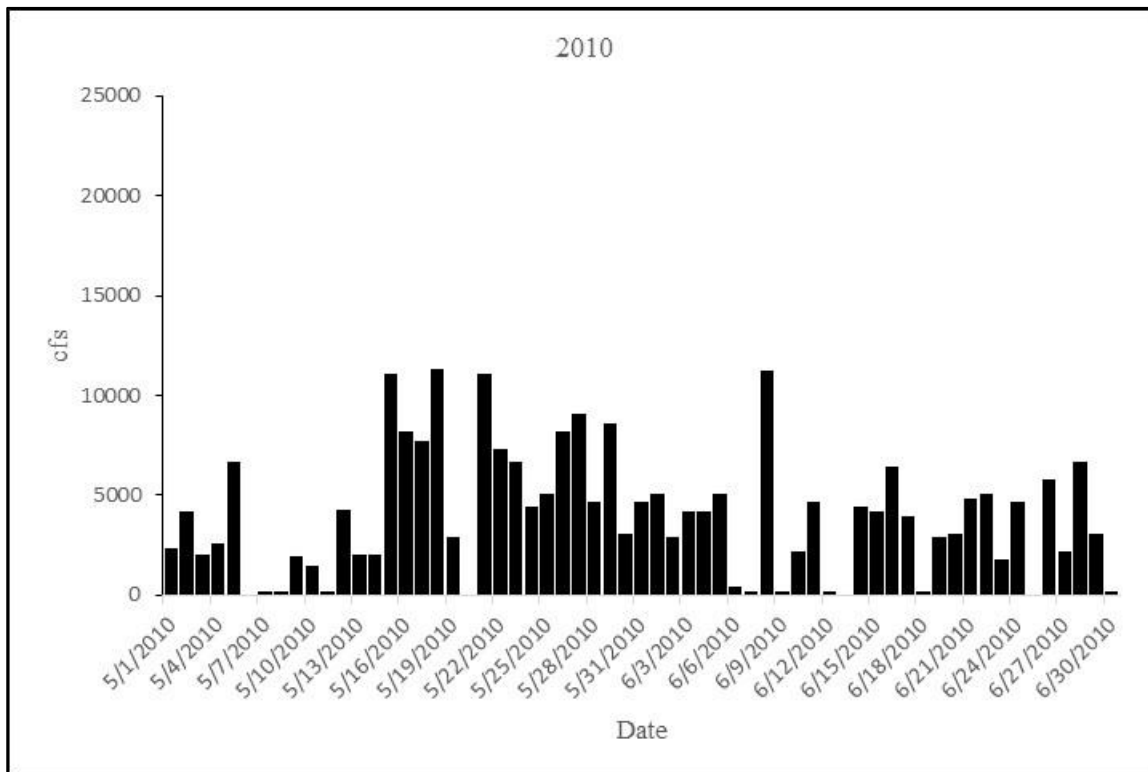


Figure 6: Change in Total Project discharge in 2010 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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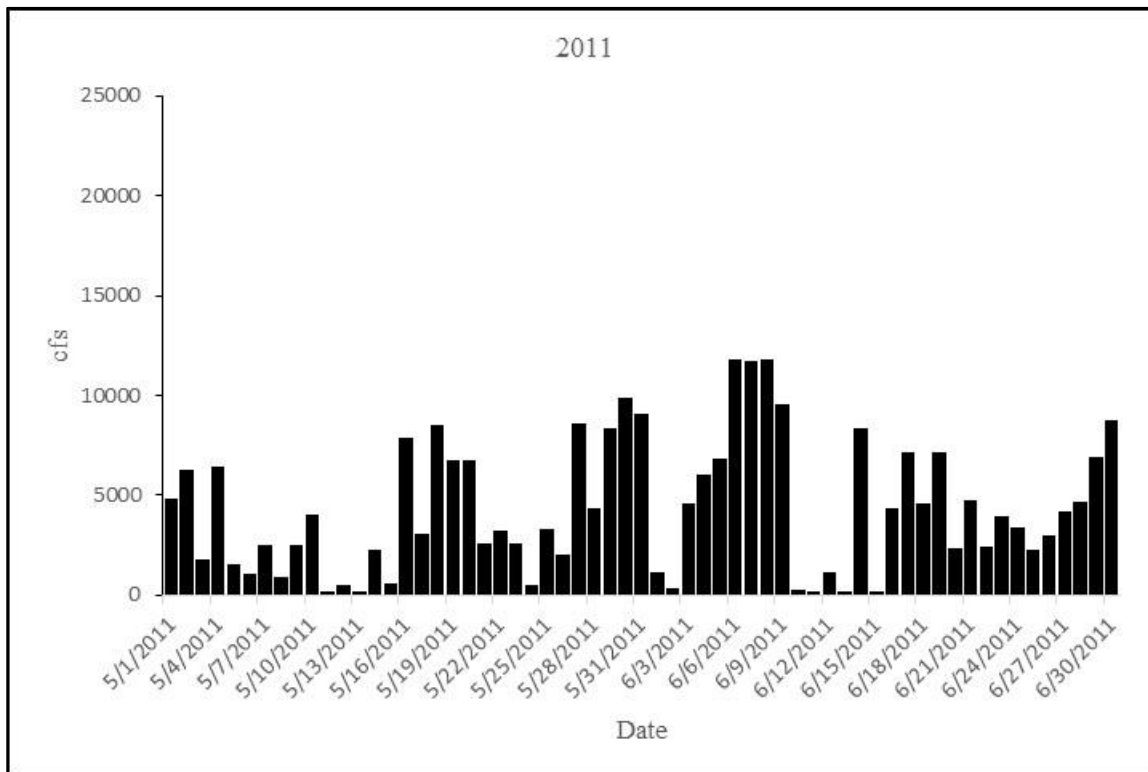


Figure 7: Change in Total Project discharge in 2011 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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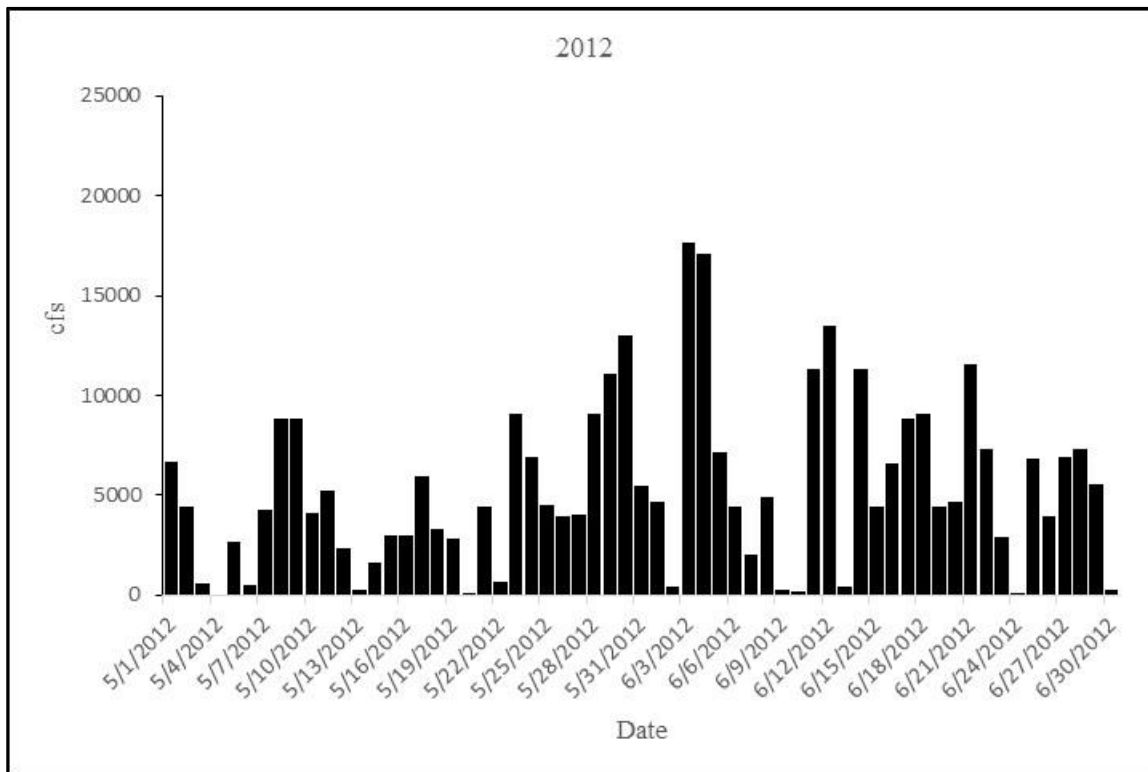


Figure 8: Change in Total Project discharge in 2012 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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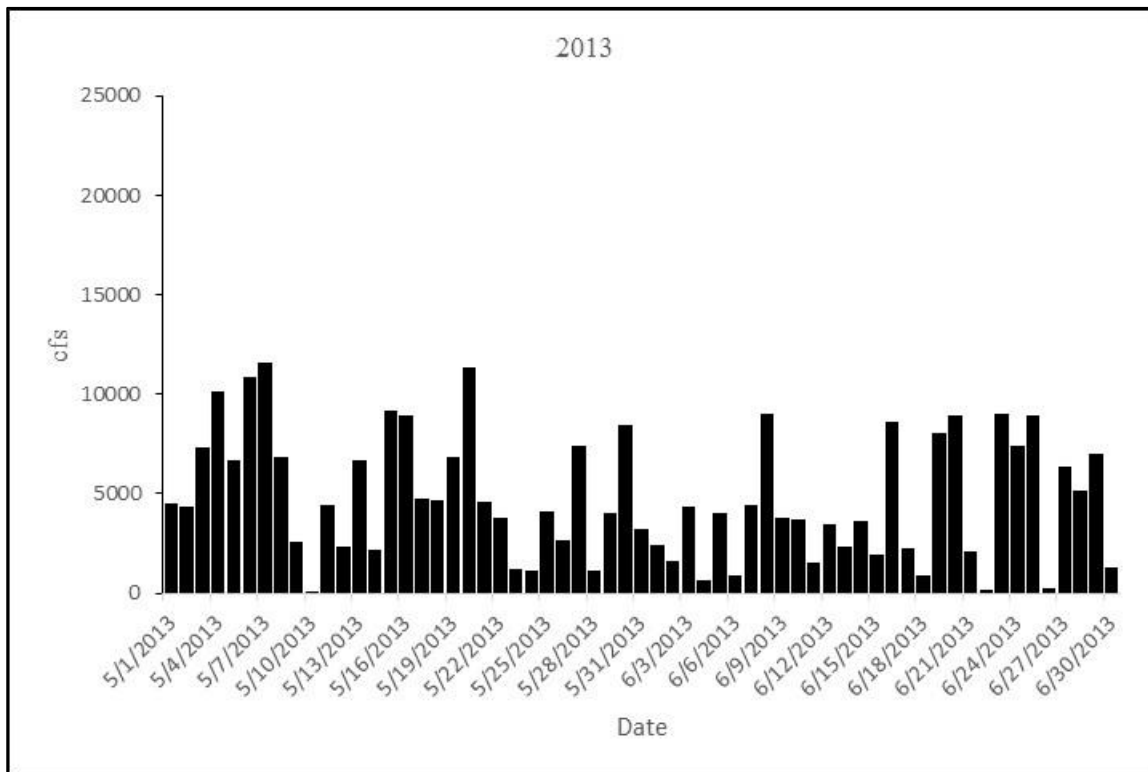


Figure 9: Change in Total Project discharge in 2013 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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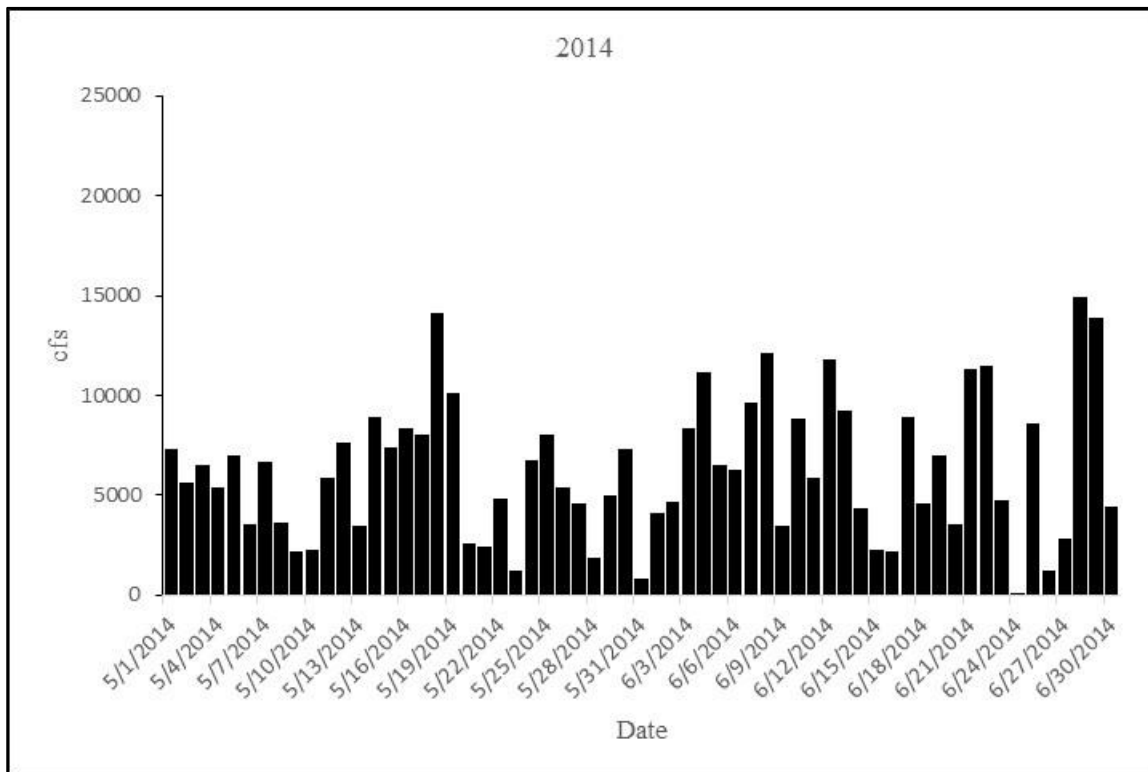


Figure 10: Change in Total Project discharge in 2014 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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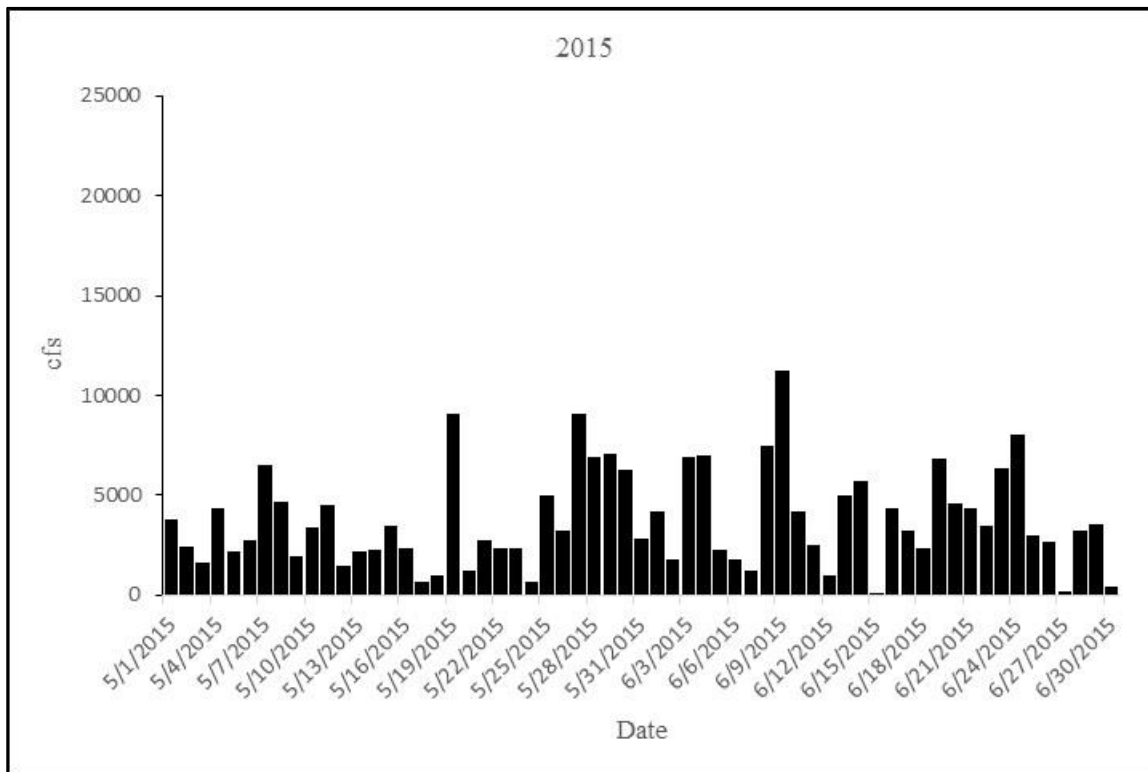


Figure 11: Change in Total Project discharge in 2015 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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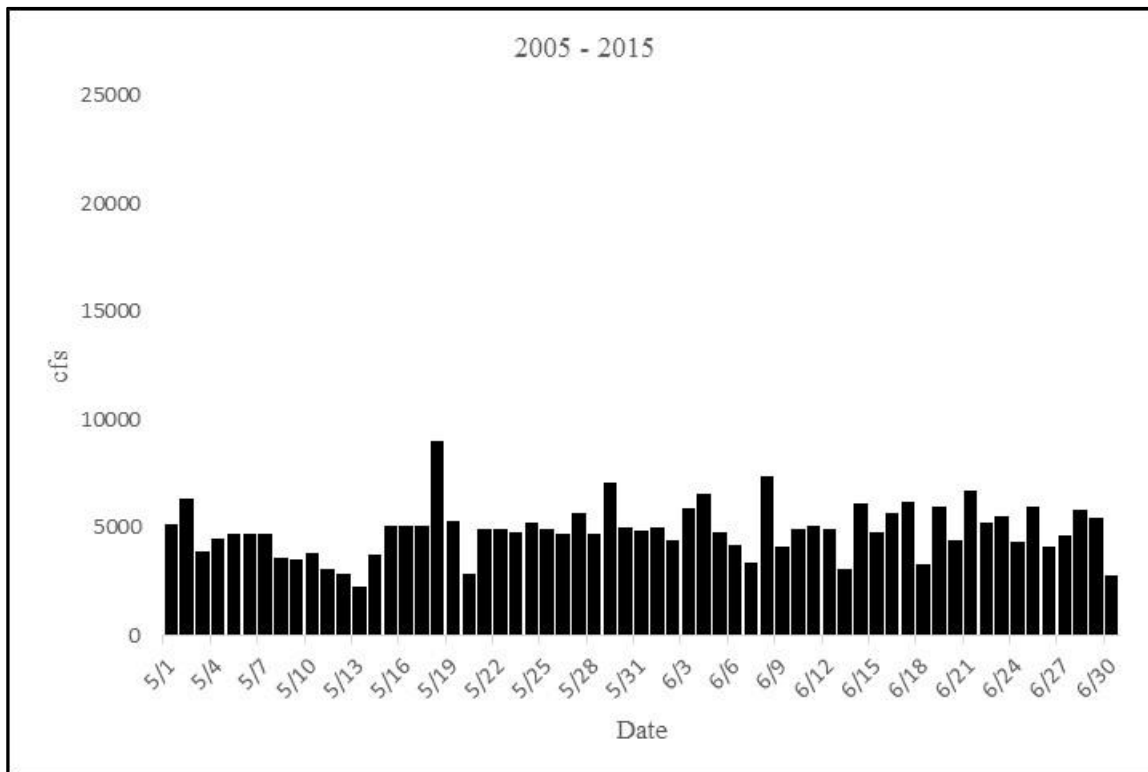


Figure 12: Mean daily change in Project discharge from 2005 to 2015 (maximum discharge – minimum discharge) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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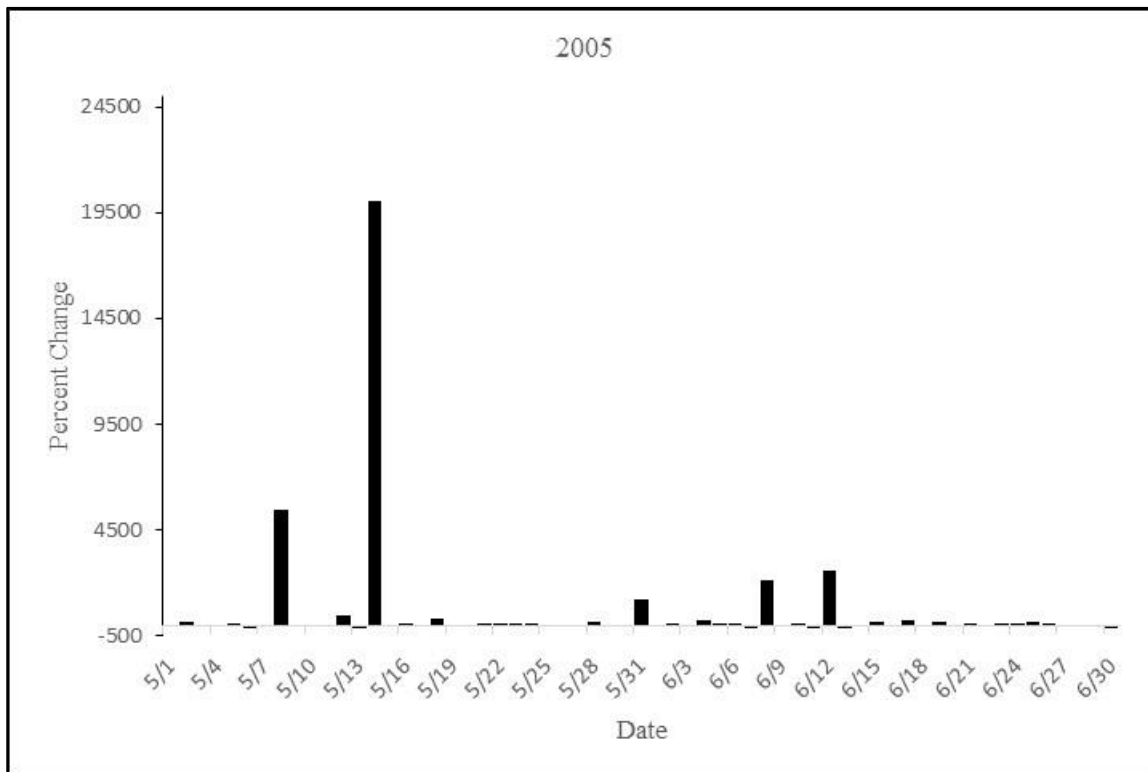


Figure 13: Percent daily change in Project discharge in 2005 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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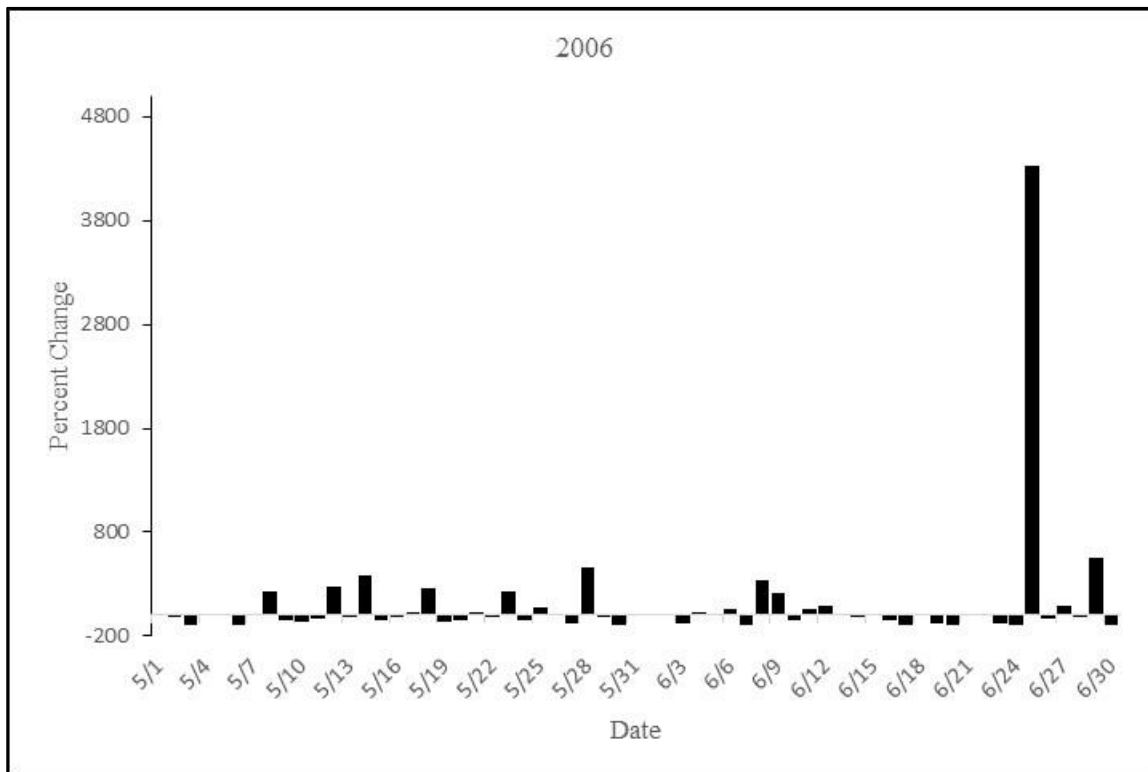


Figure 14: Percent daily change in Project discharge in 2006 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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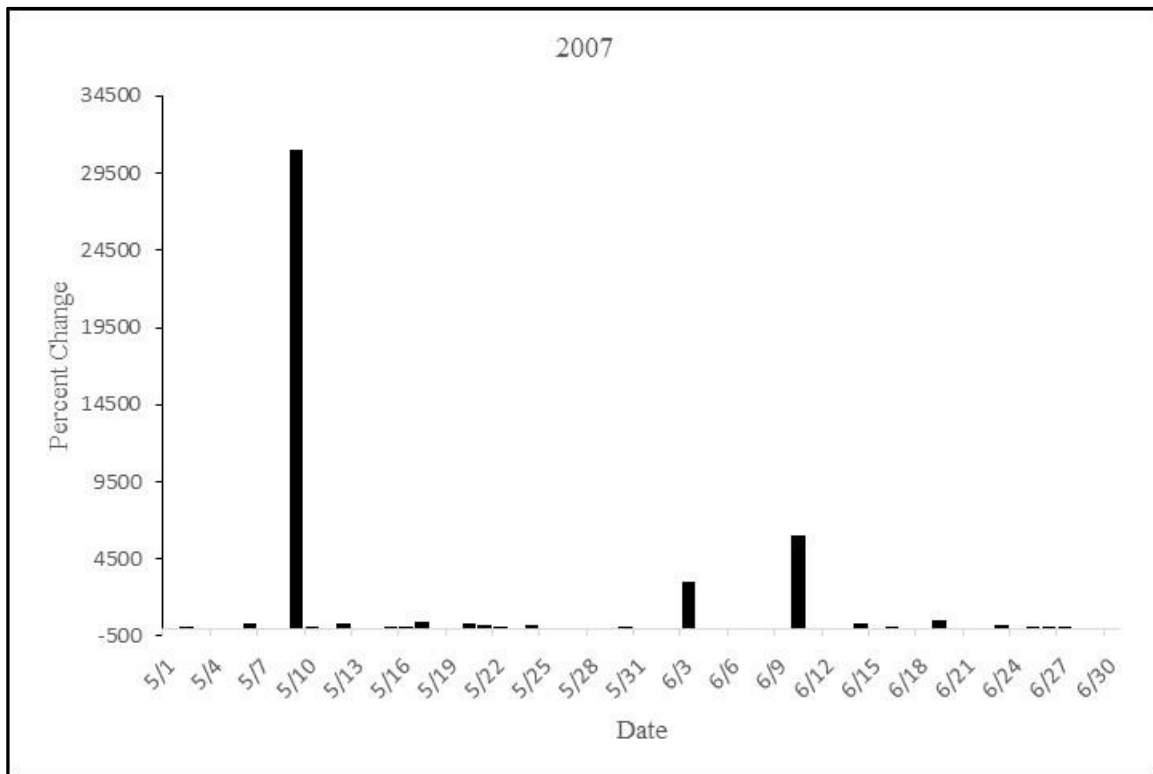


Figure 15: Percent daily change in Project discharge in 2007 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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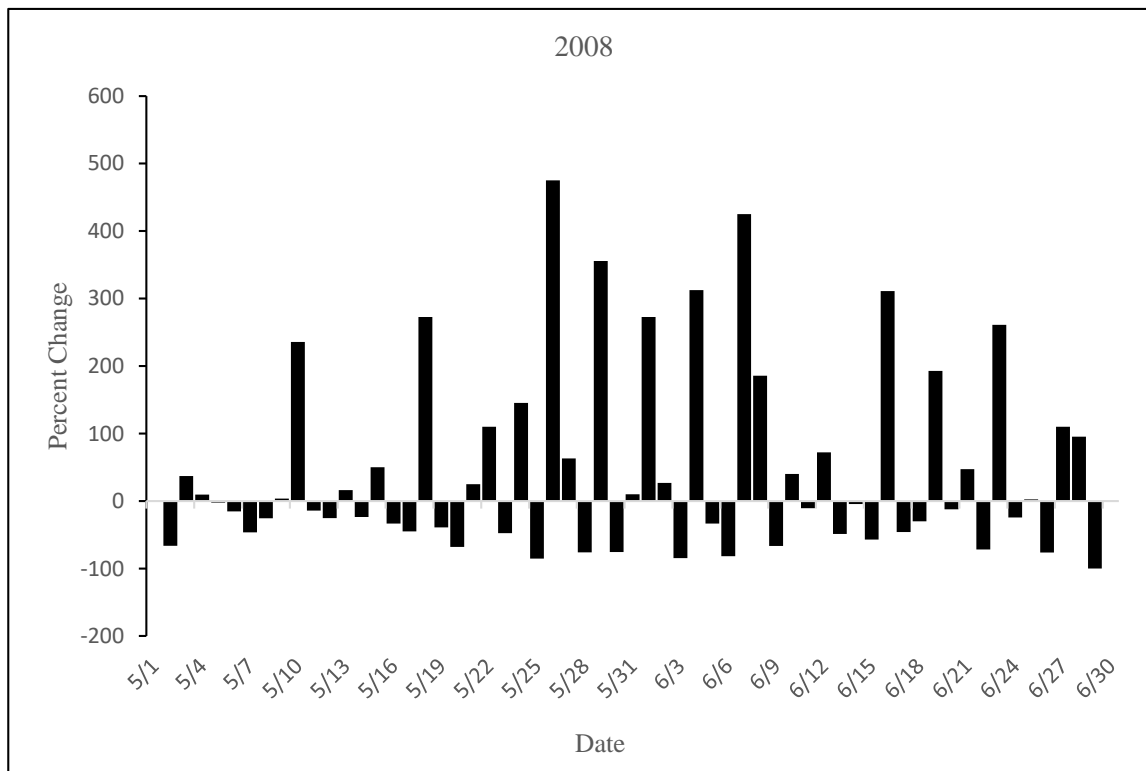


Figure 16: Percent daily change in Project discharge in 2008 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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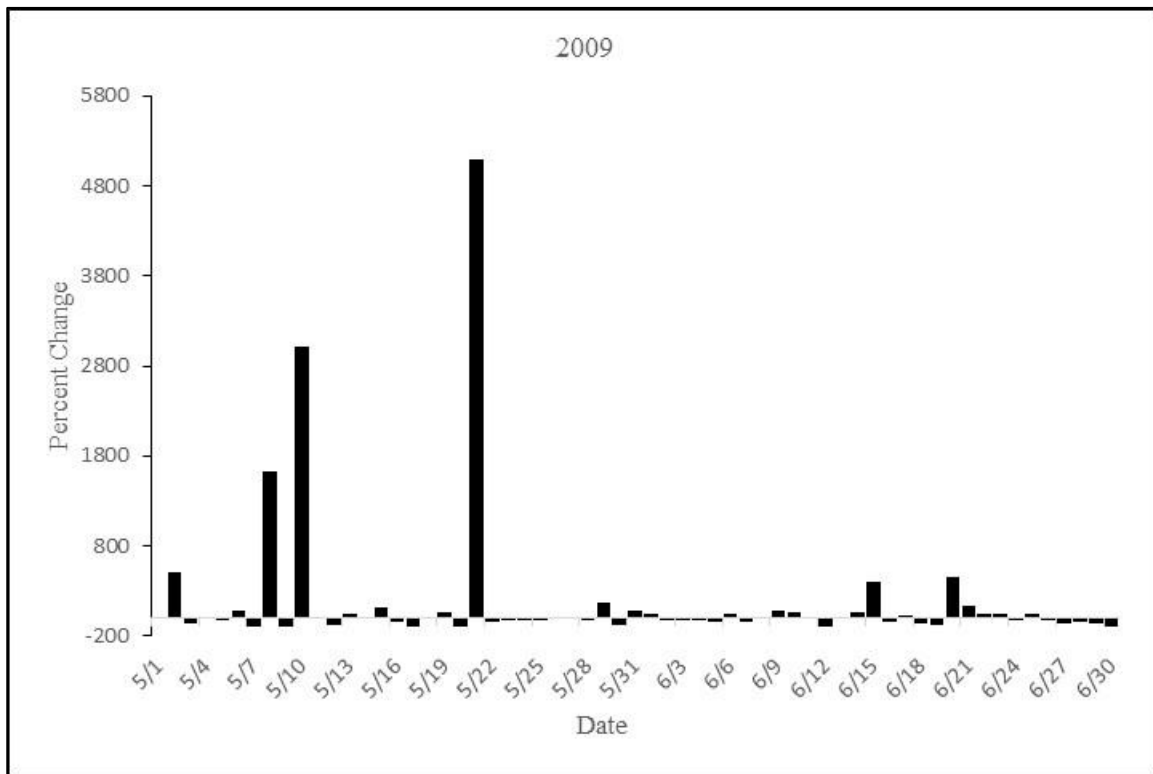


Figure 17: Percent daily change in Project discharge in 2009 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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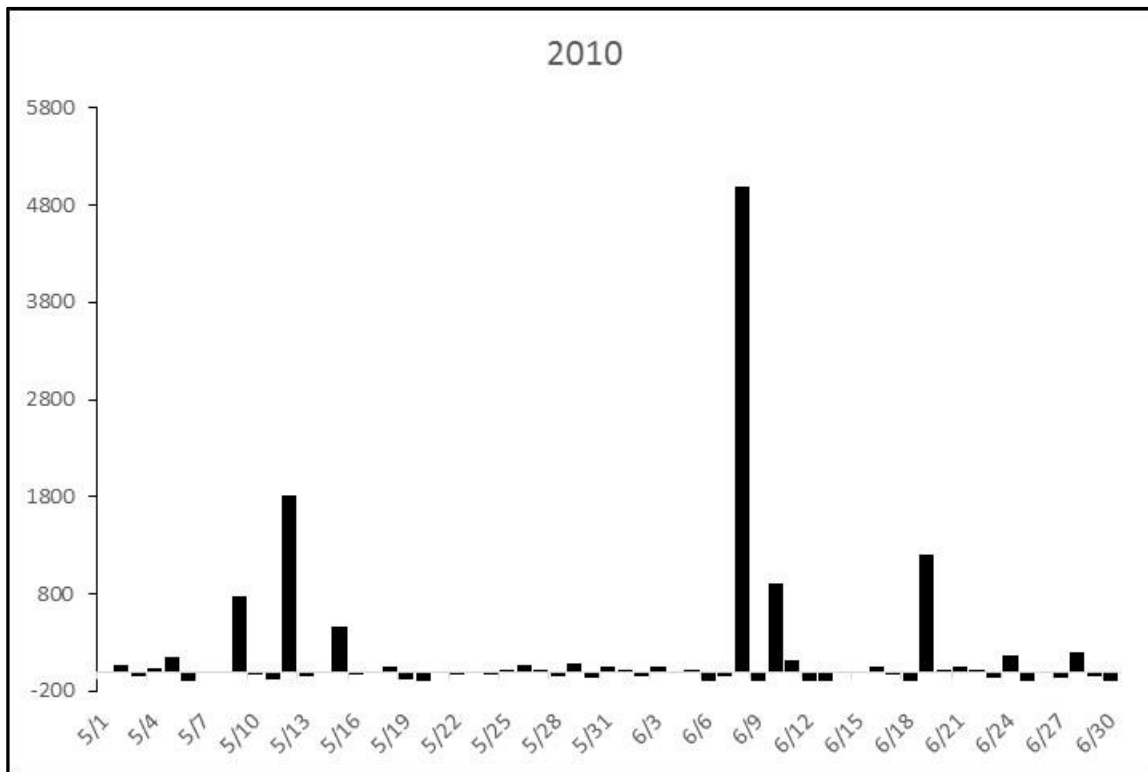


Figure 18: Percent daily change in Project discharge in 2010 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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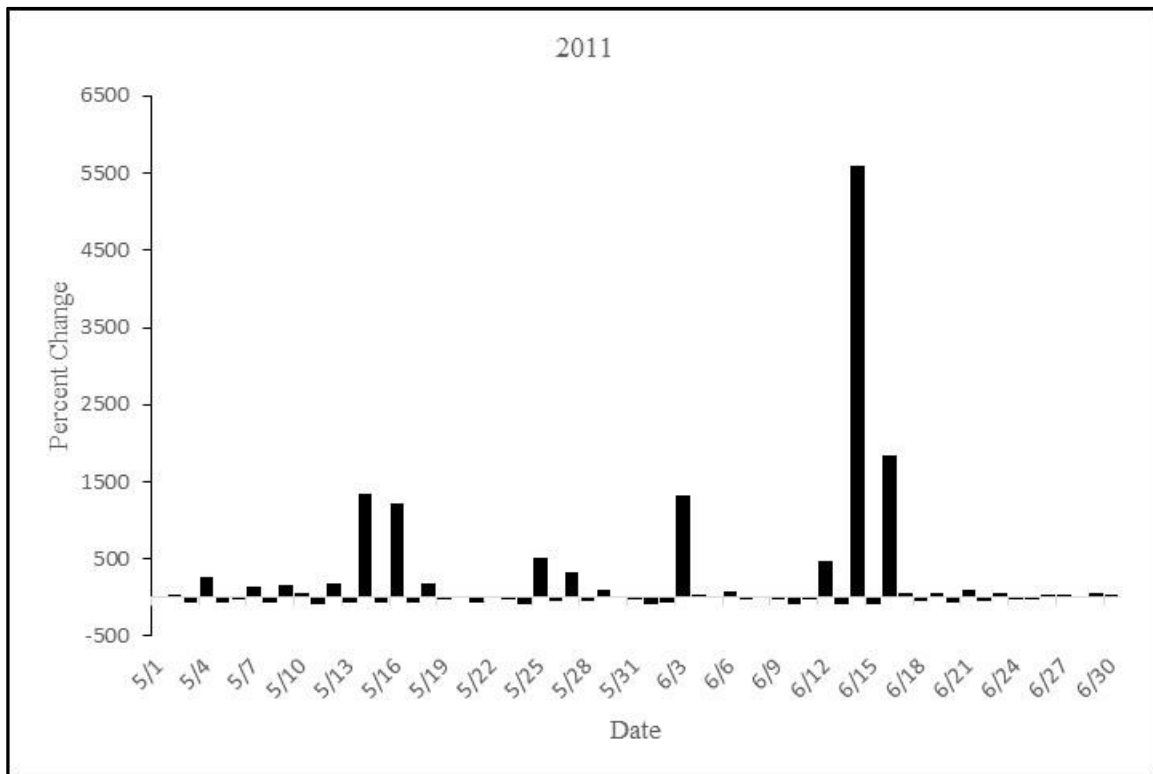


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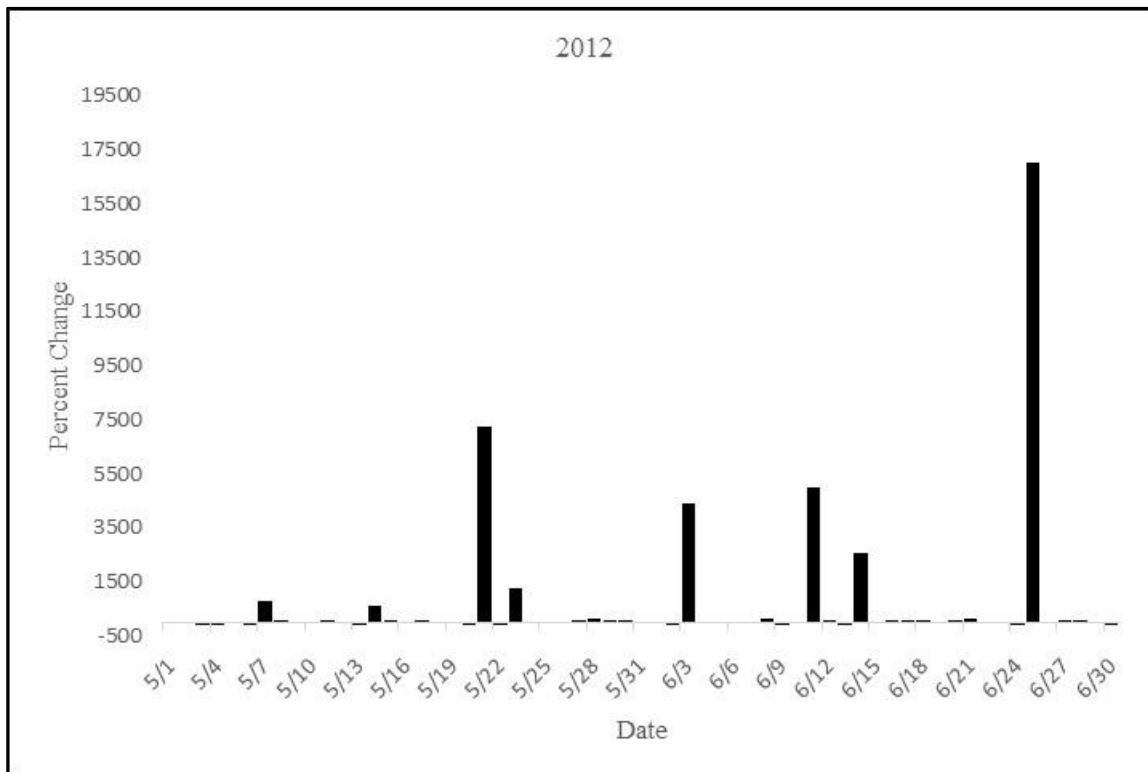


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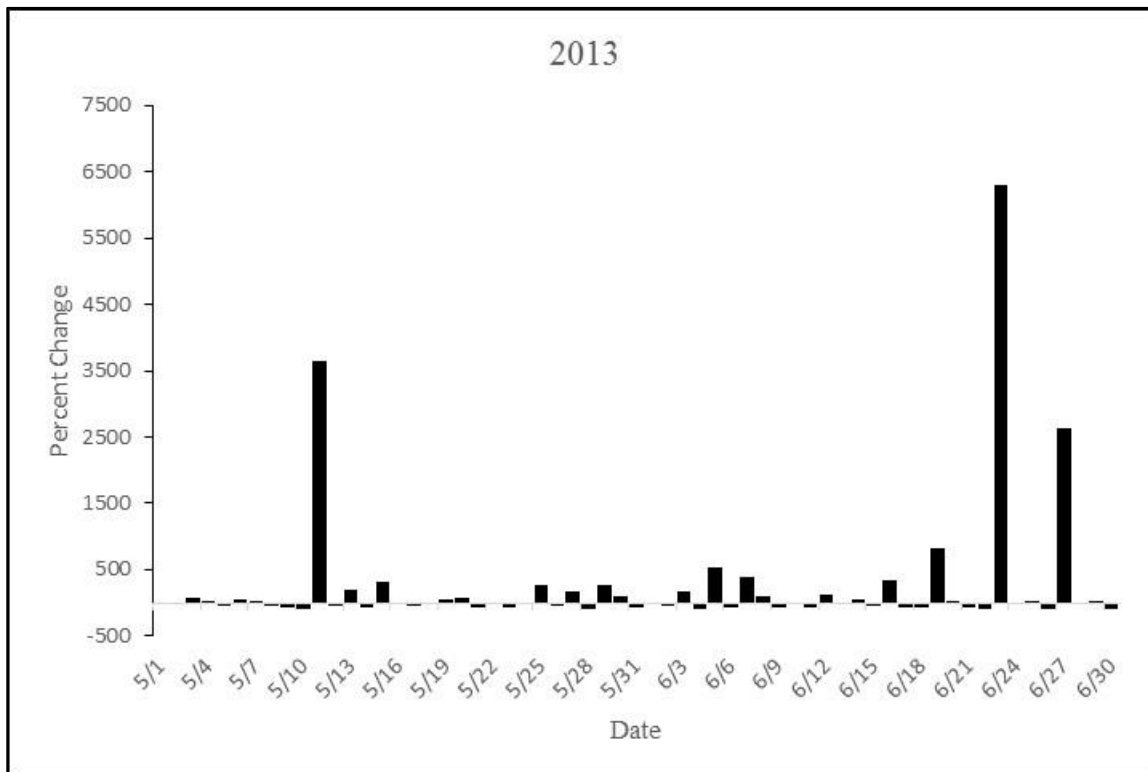


Figure 21: Percent daily change in Project discharge in 2013 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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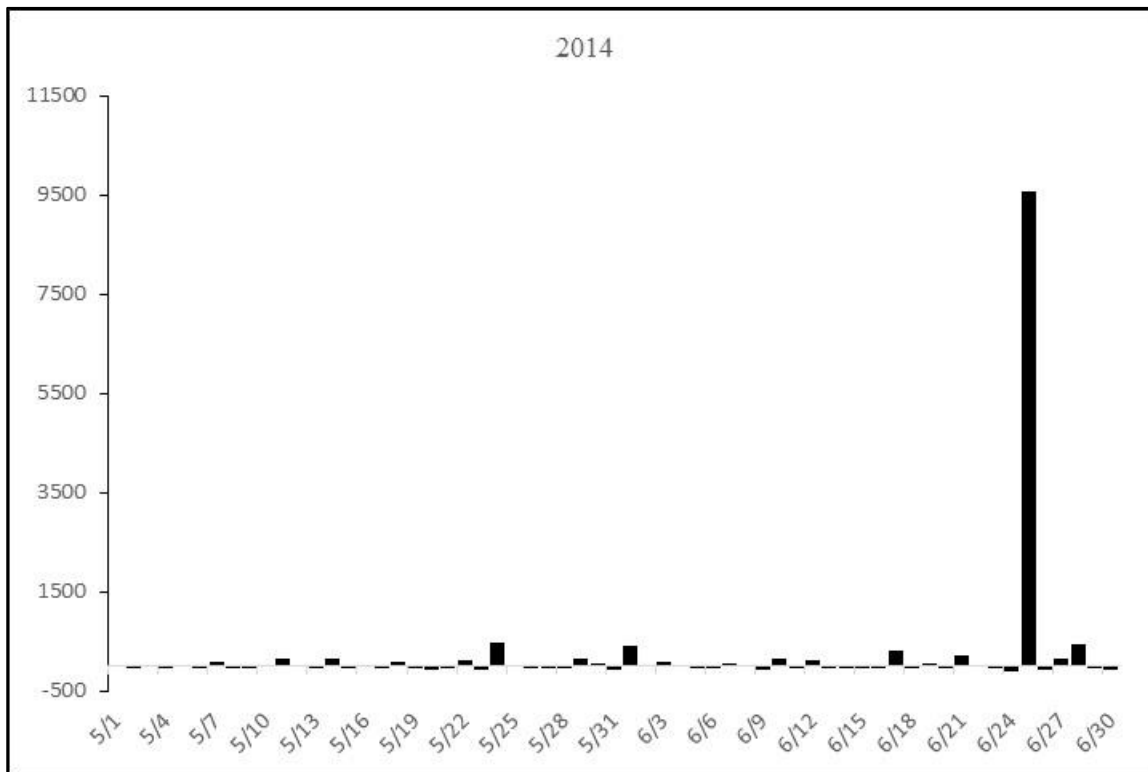


Figure 22: Percent daily change in Project discharge in 2014 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

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DEPOSITION IN THE AREA OF THE NORTHFIELD MOUNTAIN AND TURNERS FALLS PROJECTS-
ADDENDUM

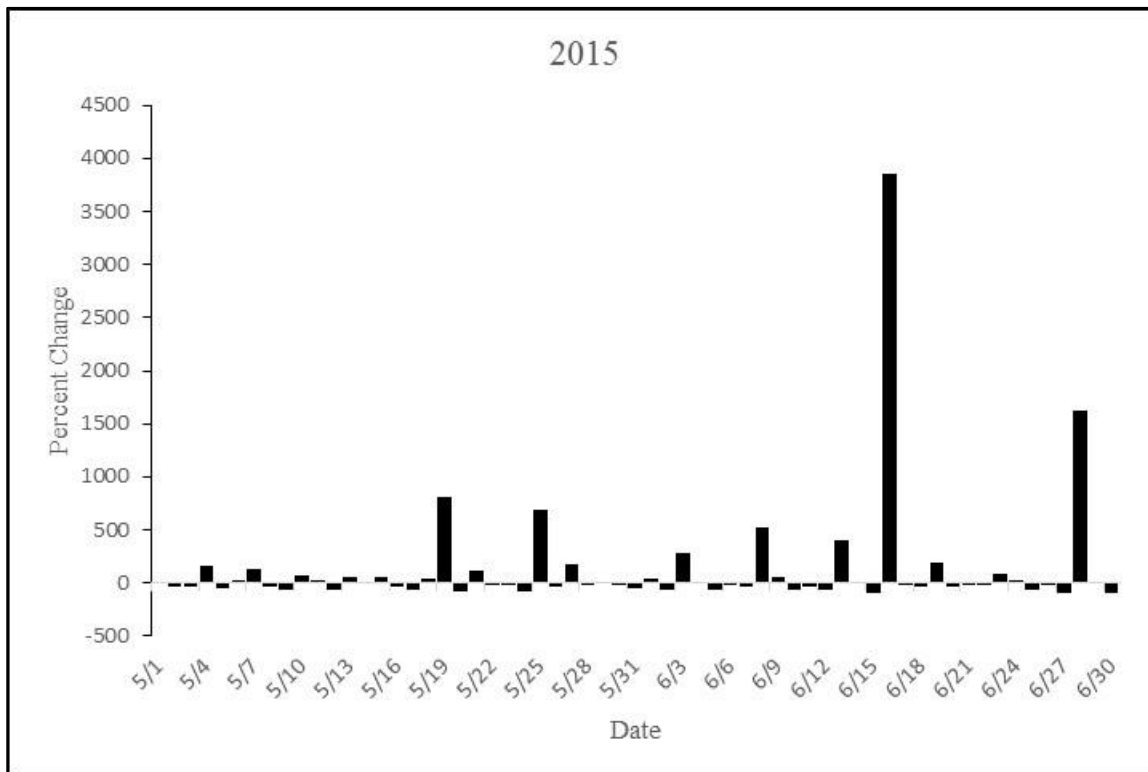


Figure 23: Percent daily change in Project discharge in 2015 at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

IMPACT OF PROJECT OPERATIONS ON SHAD SPAWNING, SPAWNING HABITAT AND EGG
DEPOSITION IN THE AREA OF THE NORTHFIELD MOUNTAIN AND TURNERS FALLS PROJECTS-
ADDENDUM

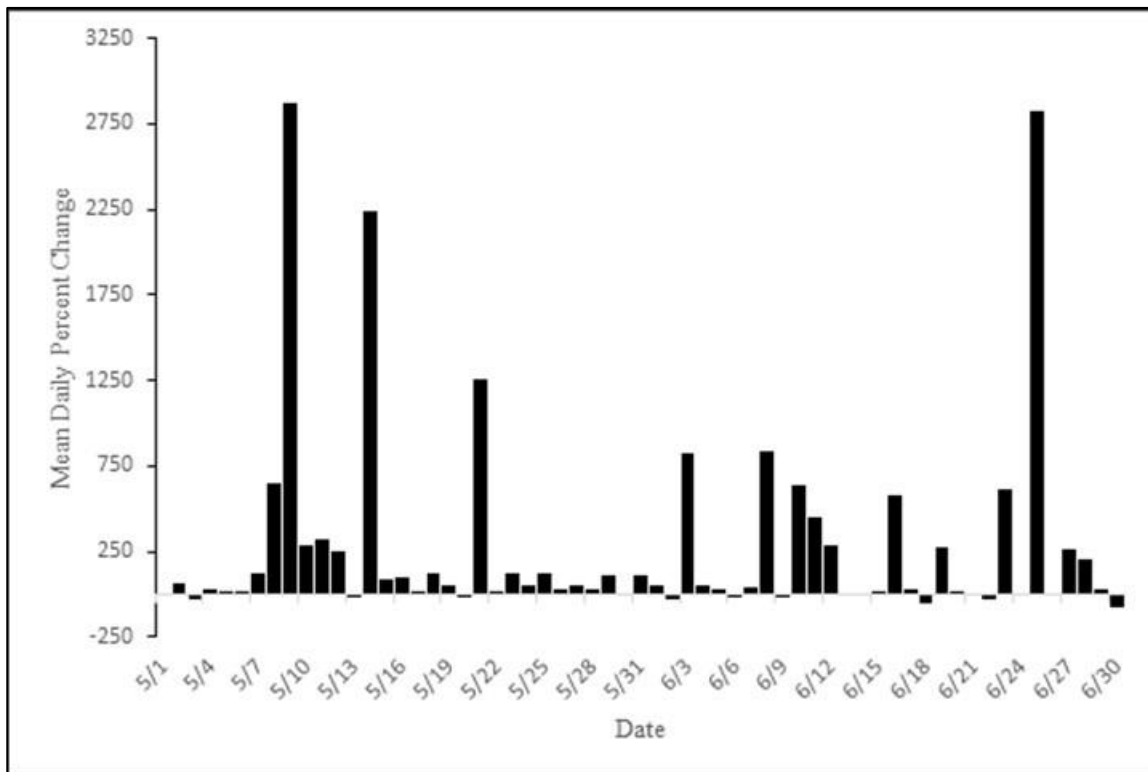


Figure 24: Mean percent daily change in Project discharge for all years pooled (2005-2015) at Turners Falls Dam, Station No. 1 and Cabot Station from 8 p.m. to 2 a.m.

**APPENDIX A:
RAW PROJECT OPERATION DATA
FROM 8 P.M. TO 2 A.M. FOR MAY 1 TO
JUNE 30 DURING EACH OF THE YEARS
FROM 2005 TO 2015**

IMPACT OF PROJECT OPERATIONS ON SHAD SPAWNING, SPAWNING HABITAT AND EGG
DEPOSITION IN THE AREA OF THE NORTHFIELD MOUNTAIN AND TURNERS FALLS PROJECTS-
ADDENDUM

Refer to Excel file titled *Appendix A-TotalOperationChanges2005-2015.xlsx*