Relicensing Study 3.3.18

IMPACTS OF THE TURNERS FALLS CANAL DRAWDOWN ON FISH MIGRATION AND AQUATIC ORGANISMS ADDENDUM

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



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LIST OF ABBREVIATIONS

cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
ILP	Integrated Licensing Process
Northfield Mountain Project	Northfield Mountain Pumped Storage Project
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
SD1	Scoping Document 1
SD2	Scoping Document 2
SPDL	Study Plan Determination Letter
Turners Falls Project or Project	Turners Falls Hydroelectric Project
USGS	United States Geological Survey
VY	Vermont Yankee Nuclear Power Plant

1 INTRODUCTION

In 2014, Kleinschmidt Associates conducted a fish stranding survey within the lower Cabot Power Canal during the annual drawdown. The objective of the survey was to assess the impact of the drawdown on fish and aquatic organisms. The study focused primarily on the presence and condition of juvenile American shad, American eel, sea lamprey, and freshwater mussels. The survey team also recorded the presence and condition of resident fish species collected in pools sampled.

On March 31, 2015, FirstLight posted to its relicensing website Study Report No. 3.3.18 *Impacts of the Turners Falls Canal Drawdown on Fish Migration and Aquatic Resources*. On September 14, 2015, the same report was officially filed with FERC. On September 29-30, 2015, FirstLight held its Updated Study Report (USR) meetings in which Study No. 3.3.18 was discussed. FirstLight filed its USR meeting minutes on October 14, 2015 and stakeholders had until November 13, 2015 to file comments. Comments on Study No. 3.3.18 were received from the United States Fish and Wildlife Service (USFWS), Connecticut River Watershed Council (CRWC), and Karl Meyer. In FirstLight's response to comments, filed with FERC on December 14, 2015, it agreed to file an addendum to the report with FERC to address information requested in the comments.

1.1 Goals and Objectives

The goal of this addendum is to provide additional information requested by stakeholders to more clearly document the location of stranded fishes; clarify the number of fish collected by species, zone, and pool; and identify, which pools were hydrologically connected within the study area.

2 METHODS

Photos taken during the study were used to identify: the location of stranding; stranded species and their abundance, and hydrologically connected pools. Stranding locations were identified via landmarks and note observations. Species and abundance were estimated from photos taken at all observed stranding occurrences. Hydrologically connected pools were identified through the analysis of photos and notes observations recoded at each pool.

3 RESULTS

3.1 Stranded Fishes

An estimated 766 fish, representing nine (9) species, were identified as stranded during the 2014 drawdown (Tables 3.1-1 and 3.1-2). Of those fish, 266 were unidentifiable due to the quality of the imagery and/or the fish were partially covered or obscured by other fish, debris, and/or substrate. Figures 3.1-1-3.1-16 document the stranding events. Figure 3.1-17 depicts the approximate location of stranding events. The numbered locations correspond to Figures 3.1-1-3.1-16. For example, the carp in Figure 3.1-2 corresponds to location 2 on the map, Figure 3.1-17.

Figure	Species	Number
Figure 3.1-1	sea lamprey	1
Figure 3.1-2	carp	1
F ' a 2.1.2	sea lamprey	1
<u>Figure 3.1-3</u>	American shad	34
Figure 3.1-4	American shad	135
	sunfish spp.	10
	yellow perch	12
Figure 3.1-5-3.1-7	American shad	77
	shiner spp.	12
	bass spp.	1
Figure 3.1-8	shiner spp.	50
Figure 3.1-9	unidentified	50
Figure 3.1-10	sea lamprey	2
E' 0.1.11	shiner spp.	12
<u>Figure 3.1-11</u>	banded killifish	1
Figure 3.1-12	unidentified	22
	white sucker	7
	bass spp.	3
Eigung 2 1 12	sunfish spp.	40
<u>rigure 3.1-15</u>	American shad	6
	yellow perch	1
	unidentified	17
	sunfish spp.	55
	yellow perch	5
Figure 3.1-14	bass spp.	5
	white sucker	2
	unidentified	82
	sea lamprey	1
Figure 3 1-15	yellow perch	6
<u>11guio 3.1 15</u>	sunfish spp.	19
	unidentified	95
<u>Figure 3.1-16</u>	sea lamprey	1
ТОТ	AL	766

Table 3.1-1. Number of Fish identified in each Stranding Event

Species	Count
American shad	252
banded killifish	1
bass spp.	9
carp	1
sea lamprey	6
shiner spp.	74
sunfish spp.	124
unidentified	266
white sucker	9
yellow perch	24
Grand Total	766

Table 3.1-1. Species identified in Figures 3.1-1



Figure 3.1-1. Juvenile Sea Lamprey found Upstream of Cabot Station Emergency Spillway Gates



Figure 3.1-2. Mirror Carp found Upstream of Canal Access Ramp



Figure 3.1-3. Small Group of Stranded Fish beside the Thalweg, Upstream of Cabot Station, Downstream of Conte Lab



Figure 3.1-4. Stranded Fish along Bedrock Ledges, River left of the Main Thalweg, Upstream of Cabot Station, Downstream of Conte Lab



Figure 3.1-5. Stranded Fish in dried Pool across the Channel from Conte Lab, Picture from 9/29/2014



Figure 3.1-6. Stranded Fish in dried Pool across the Channel from Conte Lab, Picture from 10/3/2014



Figure 3.1-7. Dried Pool seen in Figures 5 and 6, Viewed from different Angles. Picture from 10/3/2014 (left); Picture from 9/29/2014 (right)



Figure 3.1-8. Stranded Fish among Bedrock, located Upstream of Cabot station, near Wall to river left



Figure 3.1-9. Stranded Fish in dried Pool located among Bedrock, Upstream of Cabot Station, near Wall to river left



Figure 3.1-10. Juvenile Sea Lamprey, found upstream of Cabot Station Emergency Spillway Gates



Figure 3.1-11. Stranded Fish in small Pools on Mudflats within wide section of Canal



Figure 3.1-12.Stranded Fish in small Pools on Mudflats within wide section of Canal



Figure 3.1-13. Stranded Fish in small Pool on Mudflats within widest reach of the Canal



Figure 3.1-14. Stranded Fish in dried Pool on Mudflats in wide section of Canal



Figure 3.1-15. Stranded Fish in dried Pool on top of Mudflat at wide section of Canal



Figure 3.1-16. Juvenile Sea Lamprey, found at the Upper End of the Study Site, where Canal Narrows



Path: W:\gis\studies\3_3_18\maps\Addendum_stranded_fish_locations.mxd

3.2 **Pool Connectivity and Species Abundance**

During the field survey conducted in 2014, the study team observed that some pools were hydrologically connected such that flow persisted throughout the week of the drawdown.

Pool connectivity and Zone location are depicted in Figure 3.2-1. Pools 1, 2, 3, 6, 7, 8, 10, 11, 12, 13 and 14 were connected (Figure 3.2-2-3.2-4, 3.2-7-3.2-9, and 3.2-11-3.2-15). Pools 4, 5, and 9 were hydrologically isolated (Figures 3.2-5, 3.2-6 and 3.2-10).

Each pool was sampled twice during the study. The first sample occurred at the beginning of the drawdown on September 29 or 30, 2014 (Day 1), and again at the end of the week, October 3, 2014 (Day 2). Electrofishing and seining efforts resulted in collecting 6,101 fish, representing 28 species, over the two days of sampling. <u>Table 3.2-1</u> is the abundance of species documented in each pool, as well as the zone in which each pool was located.

Zone	Pool No.	Species	Day 1 (9/29-30/2014)	Day 2 (10/3/2014)
		American eel	1	0
		American shad	20	0
		Black crappie	7	0
		bluegill	28	0
		brown bullhead	0	1
		channel catfish	4	0
		common carp	0	1
		common shiner	1	0
		fall fish	10	0
		golden shiner	2	0
1	1	juvenile blue gill	0	3
1	(connected)	juvenile largemouth bass	0	1
		juvenile smallmouth bass	0	2
		largemouth bass	5	0
		rock bass	0	1
		sea lamprey	6	2
		smallmouth bass	4	0
		spottail shiner	79	5
		tessellated darter	3	22
		walleye	1	0
		white sucker	28	0
		yellow perch	4	0
		American eel	4	1
		American shad	392	545
		black crappie	0	2
		blue gill	10	0
		brown bullhead	0	69
		channel catfish	0	1
	-	common carp	1	0
1	2 (connected)	golden shiner	2	3
	(connected)	juvenile bluegill	26	142
		juvenile largemouth bass	10	0
		juvenile smallmouth bass	75	16
		juvenile white sucker	3	14
		juvenile yellow perch	19	55
		largemouth bass	1	0
		mudpuppy	0	1

Table 2.2-1. Number of Fish Collected by Species, Pool and Zone

Zone	Pool No.	Species	Day 1 (9/29-30/2014)	Day 2 (10/3/2014)
		rock bass	1	48
		smallmouth bass	13	0
		spottail shiner	130	95
		tessellated darter	1	263
		walleye	1	9
		white perch	0	6
		yellow perch	5	0
		American eel	1	2
		American shad	12	10
		black crappie	1	0
		fall fish	0	9
		golden shiner	0	6
		juvenile bluegill	4	8
		juvenile largemouth bass	0	9
		juvenile smallmouth bass	8	15
		juvenile white sucker	3	135
2	3 (connected)	juvenile yellow perch	9	21
	(connected)	mudpuppy	0	1
		rock bass	1	2
		smallmouth bass	1	0
		spottail shiner	4	59
		tessellated darter	0	27
		walleye	0	1
		white perch	1	0
		white sucker	1	0
		yellow perch	7	0
		American eel	1	1
		American shad	3	2
		banded killifish	0	1
		brown bullhead	1	9
		channel catfish	0	2
		golden shiner	2	2
2	4 (isolated)	juvenile bluegill	6	8
	(Isolated)	juvenile largemouth bass	0	1
		juvenile smallmouth bass	0	5
		juvenile white sucker	3	5
		rock bass	13	28
		sea lamprey	21	39
		smallmouth bass	1	0

spottail shiner 7 19 tessellated darter 36 97 American shad 1 0 banded killfish 11 7 brown bullhead 8 2 fall fish 2 0 golden shiner 4 2 juvenile smallmouth bass 4 1 juvenile smallmouth bass 4 1 golden shiner 380 549 ressellated darter 9 7 white sucker 6 0 American shad 0 1 brown bullhcad 1 0 juvenile largemouth bass 3 0 American shad 0 1 brown bullhcad 1 0 juvenile largemouth bass 3 0 2 6 0 1 juvenile largemouth bass 3 1 2 6 0 1 1 0 1 0	Zone	Pool No.	Species	Day 1 (9/29-30/2014)	Day 2 (10/3/2014)
tessellated darter3697American shad10banded killifish117brown bullhead82fall fish20golden shiner42juvenile bluegill4325juvenile sualmouth bass41juvenile sualmouth bass21sea lamprey85spottal shiner380549tessellated darter97white sucker60American shad01brown bullhead10juvenile bluegill63juvenile bluegill63juvenile bluegill6326juvenile bluegill66juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile bluegill10sea lamprey3061tessellated darter10juvenile bluegill1612.37juvenile largemouth bass138American shad10juvenile bluegill1611juvenile bluegill1611juvenile bluegill1611juvenile bluegill </td <td></td> <td></td> <td>spottail shiner</td> <td>7</td> <td>19</td>			spottail shiner	7	19
American shad 1 0 banded killifish 11 7 brown bullhead 8 2 fall fish 2 0 golden shiner 4 2 juvenile bluegill 4 3 2 5 juvenile white sucker 21 9 rock bass 2 1 sea lamprey 8 5 spottal shiner 380 549 tessellated darter 9 7 white sucker 6 0 0 1 0 1 yuvenile withe sucker 6 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 1 0 1 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 <td< td=""><td></td><td></td><td>tessellated darter</td><td>36</td><td>97</td></td<>			tessellated darter	36	97
$ \begin{array}{ c c c c } & banded killifish & 11 & 7 \\ brown bullhead & 8 & 2 \\ fall fish & 2 & 0 \\ golden shiner & 4 & 2 \\ juvenile bluegill & 4 & 3 \\ juvenile smallmouth bass & 4 & 1 \\ juvenile white sucker & 21 & 9 \\ rock bass & 2 & 1 \\ sea lamprey & 8 & 5 \\ spottal shiner & 380 & 549 \\ tessellated darter & 9 & 7 \\ white sucker & 6 & 0 \\ American eld & 4 & 0 \\ American eld & 4 & 0 \\ American eld & 1 & 0 \\ juvenile bluegill & 6 & 3 \\ juvenile bluegill & 6 & 1 \\ juvenile bluegill &$			American shad	1	0
brown bullhead 8 2 fall fish 2 0 glovenile bluegill 4 2 2 5 juvenile bluegill 4 1 juvenile white sucker 21 9 9 rock bass 2 1 5 spottal shiner 380 549 tessel laed darter 9 7 white sucker 6 0 American cel 4 0 Juvenile bluegill 6 3 juvenile smallmouth bass 3 0 2 6 juvenile smallmouth bass 3 1 0 10 10 1 0 10 10 1 0 10 10 1			banded killifish	11	7
fall fish20golden shiner42juvenile bluegill4325juvenile smallmouth bass41juvenile smallmouth bass21sea lamprey85spottall shiner380549tessellated darter97white sucker60American eel40American shad01brown bullhead10juvenile sucker3026juvenile smallmouth bass326juvenile smallmouth bass30juvenile smallmouth bass311pumpkinseed5001pumpkinseed5001pumpkinseed5001pumpkinseed50010spottal shiner306110spottal shiner306110spottal shiner1001juvenile bluegill161102-37juvenile bluegill1611juvenile bluegill16101juvenile bluegill16110juvenile bluegill16110juvenile smallmouth bass1010juvenile smallmouth bass1010sea lamprey0<			brown bullhead	8	2
2 5 (isolated)ijuvenile smallmouth bass432 5 (isolated)juvenile smallmouth bass41 2 9 7 9 7 7 8 5 380 549 8 5 380 549 8 5 380 549 8 6 0 0 8 7 8 6 8 6 0 0 8 7 8 7 8 7 9 7 8 7 7 8 8 7 7 7 8 7 7 7 8 7 7 7 9 7 7 7 9 7 7 7 9 7 7 7 9 7 7 7 9 7 7 7 9 7 7 7 10			fall fish	2	0
2 $\frac{5}{(isolated)}$ juvenile bluegill432juvenile smallmouth bass41juvenile sucker219rock bass21sea lamprey85spottail shiner380549tessellated darter97white sucker60American cel40American shad01juvenile bluegill63juvenile bluegill63juvenile bluegill63juvenile sucker302 $\frac{6}{(connected)}$ juvenile sucker301pumpkinseed51sea lamprey1010spottail shiner3061tessellated darter4470American shad10golden shiner3061tessellated darter4470American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass1juvenile shiner10juvenile shiner10juvenile shiner10juvenile bluegill1612-37juvenile largemouth bass1juvenile shiner10juvenile shiner10juvenile shiner10juvenile shiner10juvenile shiner<			golden shiner	4	2
2 5 (isolated) juvenile smallmouth bass 4 1 juvenile white sucker 21 9 rock bass 2 1 sea lamprey 8 5 spottail shiner 380 549 tessellated darter 9 7 white sucker 6 0 American cel 4 0 American shad 0 1 brown bullhead 1 0 juvenile bluegill 6 3 juvenile smallmouth bass 5 1 juvenile bluegill 6 3 2 6 (connected) juvenile smallmouth bass 5 1 pumpkinseed 5 0 rock bass 3 1 1 2 6 (connected) juvenile white sucker 30 61 juvenile smallmouth bass 3 1 0 1 4 70 American eel 1 0 2.3 7 <t< td=""><td></td><td></td><td>juvenile bluegill</td><td>4</td><td>3</td></t<>			juvenile bluegill	4	3
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rock bass 2 1 sea lamprey 8 5 spottail shiner 380 549 tessellated darter 9 7 white sucker 6 0 American eel 4 0 American shad 0 1 brown bullhead 1 0 juvenile blaegill 6 3 juvenile smallmouth bass 5 1 punpkinseed 5 0 rock bass 3 1 sea lamprey 0 1 punpkinseed 5 0 rock bass 3 1 sea lamprey 10 10 spottail shiner 300 61 tessellated darter 44 70 American shad 1 0 golden shiner 1 0 juvenile largemouth bass 1 0 golden shiner 1 0 juvenile largemouth bass 1 <t< td=""><td></td><td>(Isolated)</td><td>juvenile white sucker</td><td>21</td><td>9</td></t<>		(Isolated)	juvenile white sucker	21	9
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spottal shiner 380 549 tessellated darter 9 7 white sucker 6 0 American eel 4 0 American shad 0 1 brown bullhead 1 0 juvenile largemouth bass 5 1 juvenile smallmouth bass 3 0 1 juvenile white sucker 3 0 2 6 juvenile white sucker 3 0 1 pumpkinseed 5 1 pumpkinseed 5 0 1 pumpkinseed 5 0 10 sea lamprey 10 10 10 spottal shiner 30 61 1 tessellated darter 44 70 1 2.3 7 juvenile buggill 16 1 juvenile largemouth bass 1 0 1 0 juvenile vellow perch 1 0 1 0 j			sea lamprey	8	5
tessellated darter 9 7 white sucker 6 0 American eel 4 0 American shad 0 1 brown bullhead 1 0 juvenile bluegill 6 3 juvenile smallmouth bass 5 1 juvenile white sucker 3 0 1 pumpkinseed 5 0 rock bass 3 1 0 sea lamprey 10 10 10 spottail shiner 30 61 1 tessellated darter 44 70 7 American shad 1 0 1 golden shiner 1 0 1 golden shiner 1 0 1 juvenile largemouth bass 1 0 1 golden shiner 1 0 1 0 juvenile largemouth bass 1 0 1 0 juvenile smallmouth bass 1			spottail shiner	380	549
white sucker60American eel40American shad01brown bullhead10juvenile bluegill63juvenile largemouth bass51juvenile white sucker30mudpuppy01pumpkinseed50rock bass31sea lamprey1010sea lamprey1010golden shiner3061tessellated darter44702.37juvenile largemouth bass1juvenile bluegill161juvenile bluegill161juvenile bluegill1612.37juvenile smallmouth bass1juvenile smallmouth bass10juvenile sea lamprey02tessellated darter701838American eel2 <t< td=""><td></td><td></td><td>tessellated darter</td><td>9</td><td>7</td></t<>			tessellated darter	9	7
American eel 4 0 American shad 0 1 brown bullhead 1 0 juvenile bluegill 6 3 juvenile largemouth bass 5 1 juvenile smallmouth bass 3 0 2 6 juvenile white sucker 3 0 2 6 juvenile smallmouth bass 3 0 3 0 10 10 10 9 pumpkinseed 5 0 10 10 spottail shiner 30 61 1 1 0 American shad 1 0 1 0 golden shiner 1 0 1 1 0 1 0 1 1 0			white sucker	6	0
American shad 0 1 brown bullhead 1 0 juvenile bluegill 6 3 juvenile largemouth bass 5 1 juvenile smallmouth bass 3 0 2 6 juvenile white sucker 3 0 1 pumpkinseed 5 0 1 1 pumpkinseed 5 0 10 1 sea lamprey 10 10 10 1 tessellated darter 44 70 10 2-3 7 juvenile bluegill 16 1 1 2-3 7 juvenile argemouth bass 1 0 1 2-3 7 juvenile largemouth bass 1 0 1 0 1 juvenile smallmouth bass </td <td></td> <td></td> <td>American eel</td> <td>4</td> <td>0</td>			American eel	4	0
brown bullhead 1 0 juvenile bluegill 6 3 juvenile largemouth bass 5 1 juvenile smallmouth bass 3 0 2 6 juvenile white sucker 3 0 1 pumpkinseed 5 0 1 1 pumpkinseed 5 0 10 1 sea lamprey 10 10 10 spottail shiner 30 61 1 0 1 essellated darter 44 70 1 0 2.3 7 juvenile largemouth bass 1 0 1 0 2.3 7 juvenile bluegill 16 1 1 1 2.3 7 juvenile largemouth bass 1 1 0 1 <td></td> <td></td> <td>American shad</td> <td>0</td> <td>1</td>			American shad	0	1
juvenile bluegill 6 3 juvenile largemouth bass 5 1 juvenile smallmouth bass 3 0 2 6 juvenile white sucker 3 0 1 mudpuppy 0 1 pumpkinseed 5 0 rock bass 3 1 sea lamprey 10 10 spottail shiner 30 61 tessellated darter 44 70 American eel 1 0 golden shiner 1 0 juvenile bluegill 16 1 2-3 7 juvenile largemouth bass 1 0 juvenile smallmouth bass 1 0 1 0 juvenile smallmouth bass 1 0 1 0 golden shiner 1 0 1 0 juvenile smallmouth bass 1 1 0 juvenile smallmouth bass 1 0 2 ea lampre			brown bullhead	1	0
juvenile largemouth bass 5 1 2 6 (connected) juvenile smallmouth bass 3 0 1 mudpuppy 0 1 0 1 mudpuppy 0 1 1 pumpkinseed 5 0 1 rock bass 3 1 1 sea lamprey 10 10 1 sea lamprey 10 10 1 essellated darter 44 70 1 essellated darter 1 0 1 golden shiner 1 0 1 juvenile bluegill 16 1 2-3 7 juvenile smallmouth bass 1 0 1 juvenile smallmouth bass 1 1 0 2-3 7 juvenile smallmouth bass 1 0 1 juvenile smallmouth bass 1 0 1 2-3 7 juvenile smallmouth bass 1 0			juvenile bluegill	6	3
$\begin{array}{c c c c c c c } 2 & \begin{array}{c} 6 \\ (connected) & juvenile smallmouth bass & 3 & 0 \\ juvenile white sucker & 3 & 0 \\ mudpuppy & 0 & 1 \\ pumpkinseed & 5 & 0 \\ rock bass & 3 & 1 \\ sea lamprey & 10 & 10 \\ spottail shiner & 30 & 61 \\ tessellated darter & 44 & 70 \\ \hline & & & & & & & & & & & \\ & & & & & &$			juvenile largemouth bass	5	1
$\begin{array}{c c c c c c c } 2 & \begin{array}{c c c c c } 6 & & & & & & & & & & & & & & & & & & $			juvenile smallmouth bass	3	0
mudpuppy 0 1 pumpkinseed 5 0 rock bass 3 1 sea lamprey 10 10 spottail shiner 30 61 tessellated darter 44 70 American eel 1 0 golden shiner 1 0 golden shiner 1 0 juvenile bluegill 16 1 2-3 7 juvenile largemouth bass 1 0 juvenile smallmouth bass 1 0 0 1 2-3 7 juvenile yellow perch 1 0 juvenile smallmouth bass 1 0 2 tessellated darter 70 2 2 3 8 American eel 2 2	2	6	juvenile white sucker	3	0
pumpkinseed 5 0 rock bass 3 1 sea lamprey 10 10 spottail shiner 30 61 tessellated darter 44 70 American eel 1 0 golden shiner 1 0 juvenile bluegill 16 1 2-3 7 juvenile largemouth bass 1 juvenile smallmouth bass 1 0 1 juvenile smallmouth bass 1 0 1 juvenile smallmouth bass 1 0 2 rock bass 1 0 2 1 3 8 American eel 2 2		(connected)	mudpuppy	0	1
rock bass31sea lamprey1010spottail shiner3061tessellated darter4470American eel10American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass1juvenile smallmouth bass10juvenile sea lamprey02tessellated darter701838American eel238American eel2			pumpkinseed	5	0
sea lamprey1010spottail shiner3061tessellated darter4470American eel10American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass1juvenile smallmouth bass10juvenile smallmouth bass10rock bass10sea lamprey02tessellated darter701838American eel2222			rock bass	3	1
spottail shiner3061tessellated darter4470American eel10American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass1juvenile smallmouth bass10juvenile smallmouth bass10cock bass10sea lamprey0238American eel238American eel2			sea lamprey	10	10
tessellated darter4470American eel10American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass10juvenile smallmouth bass110juvenile smallmouth bass101crock bass1002tessellated darter70181838American eel22			spottail shiner	30	61
American eel10American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass10juvenile smallmouth bass111juvenile vellow perch101rock bass102tessellated darter701838American eel22			tessellated darter	44	70
American shad10golden shiner10juvenile bluegill1612-37juvenile largemouth bass10juvenile smallmouth bass111juvenile yellow perch100rock bass102sea lamprey02tessellated darter701838American eel22			American eel	1	0
golden shiner10juvenile bluegill1612-37juvenile largemouth bass10juvenile smallmouth bass111juvenile smallmouth bass100juvenile yellow perch100rock bass102sea lamprey02tessellated darter701838American eel22			American shad	1	0
juvenile bluegill1612-37juvenile largemouth bass10juvenile smallmouth bass111juvenile yellow perch100rock bass100sea lamprey02tessellated darter701838American eel2			golden shiner	1	0
2-37juvenile largemouth bass10juvenile smallmouth bass111juvenile yellow perch100rock bass100sea lamprey02tessellated darter701838American eel2			juvenile bluegill	16	1
juvenile smallmouth bass 1 1 juvenile yellow perch 1 0 rock bass 1 0 sea lamprey 0 2 tessellated darter 70 18 3 8 American eel 2 2	2-3	7	juvenile largemouth bass	1	0
juvenile yellow perch 1 0 rock bass 1 0 sea lamprey 0 2 tessellated darter 70 18 3 8 American eel 2 2			juvenile smallmouth bass	1	1
rock bass 1 0 sea lamprey 0 2 tessellated darter 70 18 3 8 American eel 2 2			juvenile yellow perch	1	0
sea lamprey02tessellated darter701838American eel22			rock bass	1	0
tessellated darter701838American eel22			sea lamprey	0	2
3 8 American eel 2 2			tessellated darter	70	18
	3	8	American eel	2	2

Zone	Pool No.	Species	Day 1 (9/29-30/2014)	Day 2 (10/3/2014)
	(connected)	American shad	1	0
		brown bullhead	5	4
		fall fish	0	1
		golden shiner	1	5
		juvenile bluegill	5	17
		juvenile largemouth bass	2	4
		juvenile smallmouth bass	1	6
		juvenile white sucker	0	46
		juvenile yellow perch	0	9
		sea lamprey	9	10
		spottail shiner	83	13
		tessellated darter	57	57
		juvenile bluegill	1	0
	0	juvenile largemouth bass	1	1
3	9 (isolated)	juvenile white sucker	0	1
	(Isoluted)	sea lamprey	0	9
		tessellated darter	1	0
		American eel	1	0
		American shad	2	0
		banded killifish	1	0
		brown bullhead	2	0
		juvenile bluegill	9	0
		juvenile largemouth bass	3	1
4	10	juvenile smallmouth bass	0	2
4	(connected)	juvenile white sucker	23	0
		juvenile yellow perch	4	0
		pumpkinseed	4	0
		rock bass	0	0
		sea lamprey	7	17
		spottail shiner	9	0
		tessellated darter	22	13
		American shad	6	25
		brown bullhead	21	7
		juvenile bluegill	14	12
4	11	juvenile largemouth bass	0	2
4	(connected)	juvenile smallmouth bass	7	5
		juvenile white sucker	116	121
		juvenile yellow perch	26	29
		sea lamprey	8	3

Zone	Pool No.	Species	Day 1 (9/29-30/2014)	Day 2 (10/3/2014)
		spottail shiner	202	1
		tessellated darter	16	36
		white perch	1	0
		American eel	0	1
		American shad	27	1
		brown bullhead	5	6
		juvenile bluegill	21	3
4	12 (connected)	juvenile smallmouth bass	1	1
	(connected)	juvenile white sucker	14	4
		sea lamprey	1	3
		spottail shiner	8	0
		tessellated darter	10	66
		juvenile white sucker	1	1
4	13 sea lamprey (connected) tessellated darte	sea lamprey	1	2
		tessellated darter	0	2
		American eel	0	2
		American shad	6	24
		banded killifish	3	0
		brown bullhead	28	7
		common carp	1	1
		juvenile bluegill	16	79
		juvenile largemouth bass	7	8
		juvenile smallmouth bass	0	18
4-5	14 (connected)	juvenile white sucker	28	75
	(connected)	juvenile yellow perch	9	22
		mudpuppy	1	0
		pumpkinseed	0	2
		rock bass	1	0
		sea lamprey	4	10
		smallmouth bass	1	0
		spottail shiner	108	0
		tessellated darter	11	19



Path: W:\gis\studies\3_3_18\maps\Addendum_pool_connectivity.mxd



Figure 3.2-2: Pool 1, Hydrologically connected to Pool 2



Figure 3.2-3. Pool 2, Hydrologically connected to Pools 1 and 3



Figure 3.2-4. Pool 3, Hydrologically connected to Pool 2 and 6



Figure 3.2-5. Pool 4, Hydrologically isolated; Day 1 (Left); Pool 4, Day 2 (Right)



Figure 3.2-6. Pool 5, Hydrologically isolated





Figure 3.2-7. Pool 6, Hydrologically connected to Pools 3 and 7; Day 1 (Left), Day 2 (Right)



Figure 3.2-8. Pool 7, Hydrologically connected to Pool 6 and 8





Figure 3.2-9. Pool 8, Hydrologically connected to Pools 7 and 10; Day 1 (Left), Day 2 (Right)



Figure 3.2-10. Pool 9, Hydrologically isolated



Figure 3.2-11. Pool 10, Hydrologically connected to Pools 8 and 11





Figure 3.2-12. Pool 11, Hydrologically connected to Pools 10 and 12; Day 1, looking Upstream (Left); Day 2, looking Downstream (Right)



Figure 3.2-13. Pool 12, Hydrologically connected to Pools 11 and 13



Figure 3.2-14. Pool 13, Hydrologically connected to Pools 12 and 14







Figure 3.2-15. Pool 14, Hydrologically connected to Pool 13; Day 1 (Left); Day 2 (Right)