Cape Fear River Basin Model Instream Flow Analysis

This document contains the complete set of charts and tables developed during the analysis developed as part of the March 2008 study of future water use in the Cape Fear River Basin.

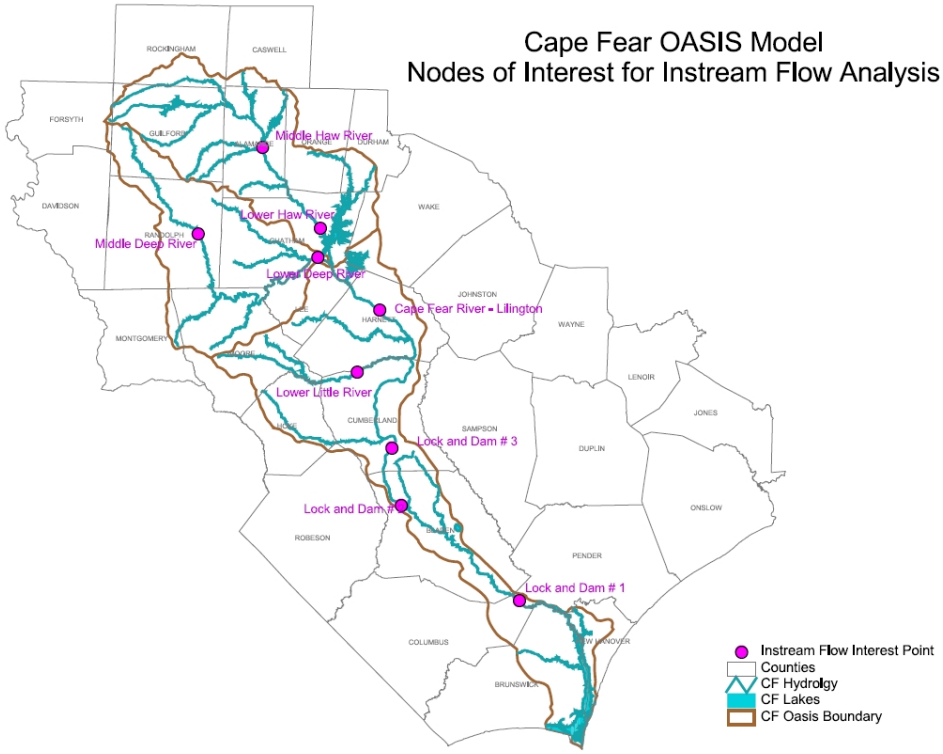
VI. Instream Flow Evaluation

Predicted stream flows at certain points of interest were evaluated. The purpose of examining instream flows is to evaluate potential impacts on aquatic ecosystems - including fish and other aquatic organisms - that could be caused by changes in flows resulting from reservoir operations or water supply withdrawals. The following table shows the nodes of interest that were identified through discussions with the NC Wildlife Resources Commission. NCWRC also expressed interest in assessing instream flows on Rockfish Creek, Upper Little River and Rocky River, but because of the way the system is modeled, this was not possible.

Table: Nodes of Interest for Instream Flow

River	Location / Section	Node
Deep River	Middle portion	280
Haw River	Middle portion	360
Haw River	Lower portion	410
Cape Fear River	Lillington	550
Deep River	Lower portion	640
Little River	Lower portion	720
Cape Fear River	Lock and Dam #3	780
Cape Fear River	Lock and Dam #2	790
Cape Fear River	Lock and Dam #1	820

The following map shows the geographic locations of the points of interest.



Analysis of Instream Flows

An adaptation of the Tennant Method[1] for evaluating instream flows was used for evaluating the modeled instream flows. Under this method, daily stream flows are compared to the historical average annual flow at the point of interest. The historical average annual flow was determined using the model under the unimpaired scenario.

Depending on the percentage of annual flow, the Tennant Method provides guidelines for evaluating the adequacy of the flow for the given time of the year. Table 2 summarizes these guidelines.

[1] *Instream Flows for Riverine Resource Stewardship: 2004 Revised Edition, Multiple Authors* .

Table 2: Modified Tennant Method Guidelines for Evaluating Instream Flows

	Description of Flow Levels	March to May	June to November	December to February
Level 1	**< 10% of QAA***	**Severe Degradation**	**Severe Degradation**	**Severe Degradation**
Level 2	**10 - 20% of QAA**	**Poor or Minimum**	**Fair or Degrading**	**Fair or Degrading**
Level 3	**20 - 30% of QAA**	**Fair or Degrading**	**Good**	**Good**
Level 4	**30 - 40% of QAA**	**Good**	**Excellent**	**Excellent**
Level 5	**40 - 50% of QAA**	**Excellent**	**Outstanding**	**Outstanding**
Level 6	**50 - 60% of QAA**	**Outstanding**	**Outstanding**	**Outstanding**
Level 7	**60 - 100% of QAA**	**Optimum**	**Optimum**	**Optimum**
Level 8	**100 - 200% of QAA**	**Optimum to Flushing**	**Optimum to Flushing**	**Optimum to Flushing**
Level 9	**>200 of QAA**	**Flushing or Maximum Flow**	**Flushing or Maximum Flow**	**Flushing or Maximum Flow**

*QAA is the Average Annual Flow

The Tennant method is used as a **preliminary screening device** to see how projected increases in water use will affect stream flows at selected locations. When new or increased water withdrawals are planned, the permitting process will require site-specific instream flow studies to determine required instream flow levels.

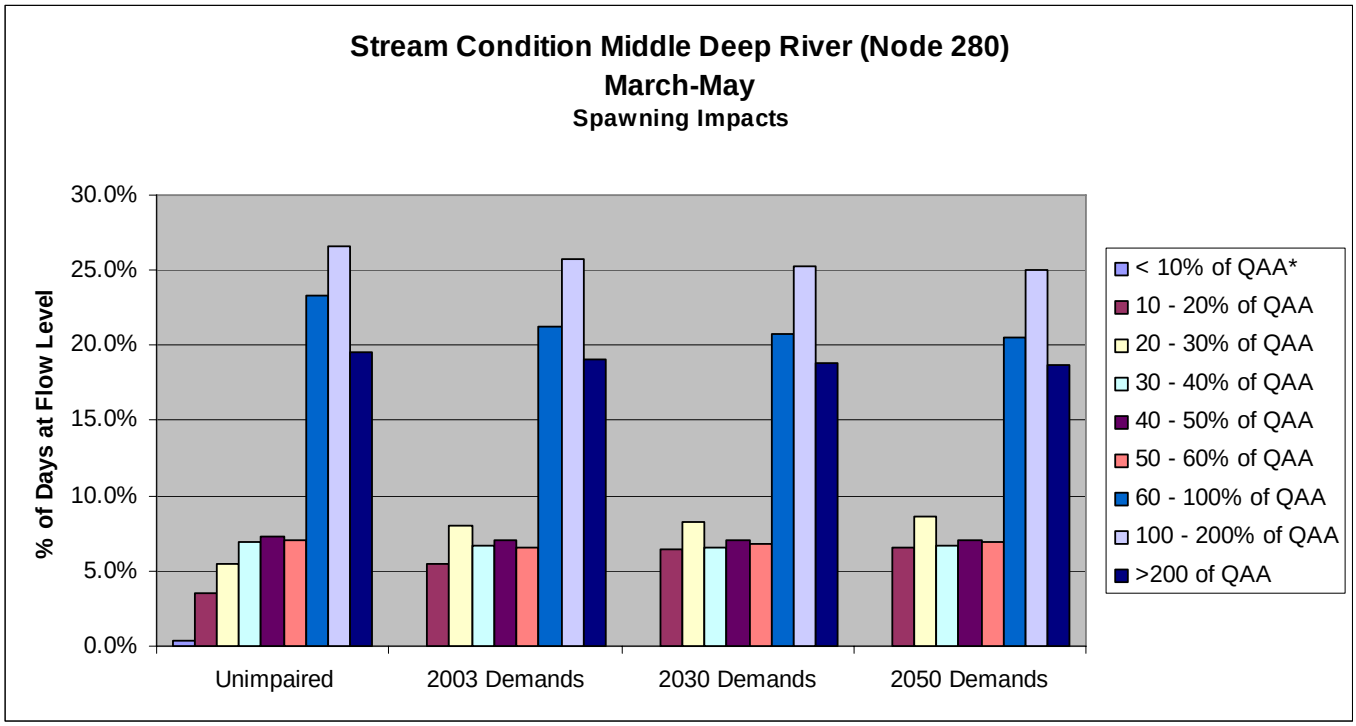
The following plots show an example of a summary of stream flow levels using the Tennant Method for one of the points of interests identified in Table 1. Daily stream flows at all points of interest were estimated using the model for the entire 75-year record. Then, the percentage of days over the 75-year period within each of the various stream flow ranges was calculated.

The complete summary of results at all points of interest will be made available on the Division of Water Resources website under Cape Fear River Basin Planning.

***QAA (average annual flow) at Node 280 = 227 mgd**

Table: Stream Condition: Middle Deep River (Node 280)

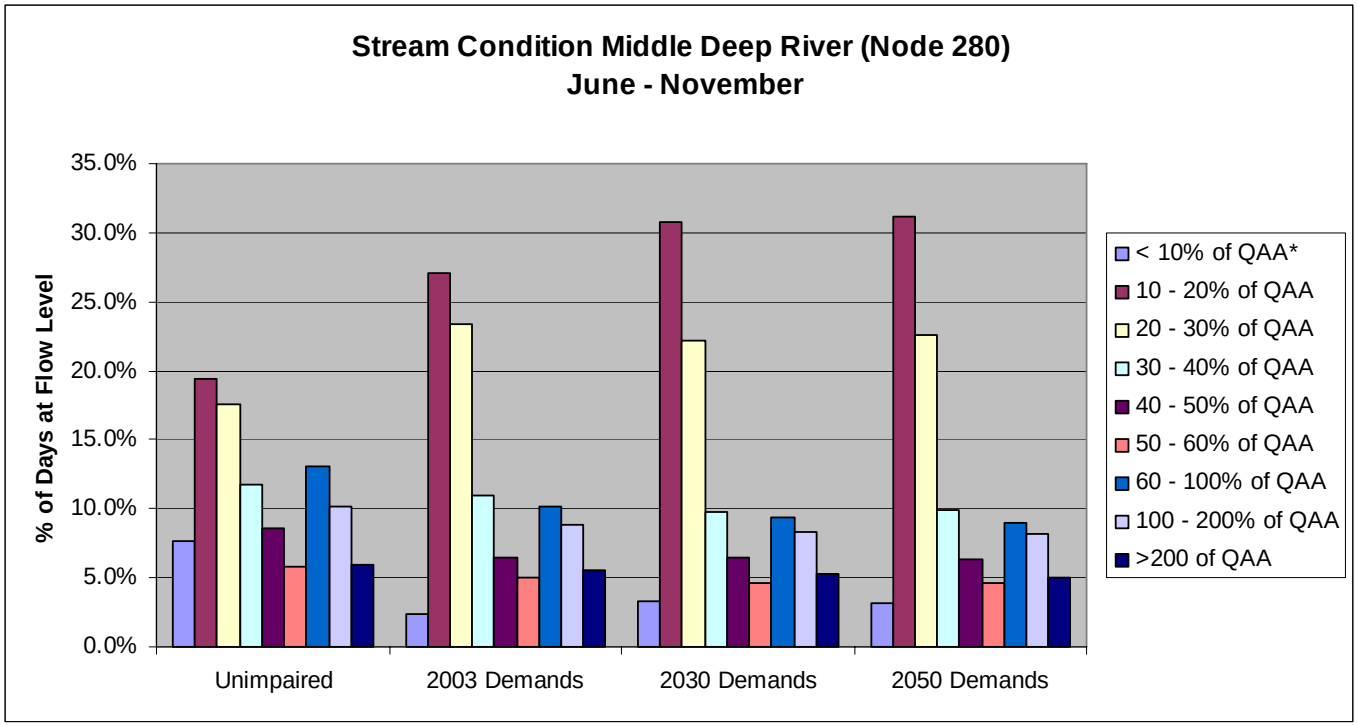
Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.3%	0.2%	0.1%	0.1%
2	10 - 20% of QAA	1.9%	2.9%	4.1%	4.0%
3	20 - 30% of QAA	5.3%	6.7%	7.1%	7.8%
4	30 - 40% of QAA	6.5%	6.8%	6.6%	6.8%
5	40 - 50% of QAA	6.2%	6.1%	6.8%	6.8%
6	50 - 60% of QAA	6.8%	6.6%	6.8%	7.1%
7	60 - 100% of QAA	23.6%	22.5%	21.6%	21.0%
8	100 - 200% of QAA	28.4%	27.6%	26.7%	26.5%
9	>200 of QAA	20.9%	20.5%	20.2%	19.9%



***QAA (average annual flow) at Node 280 = 227 mgd**

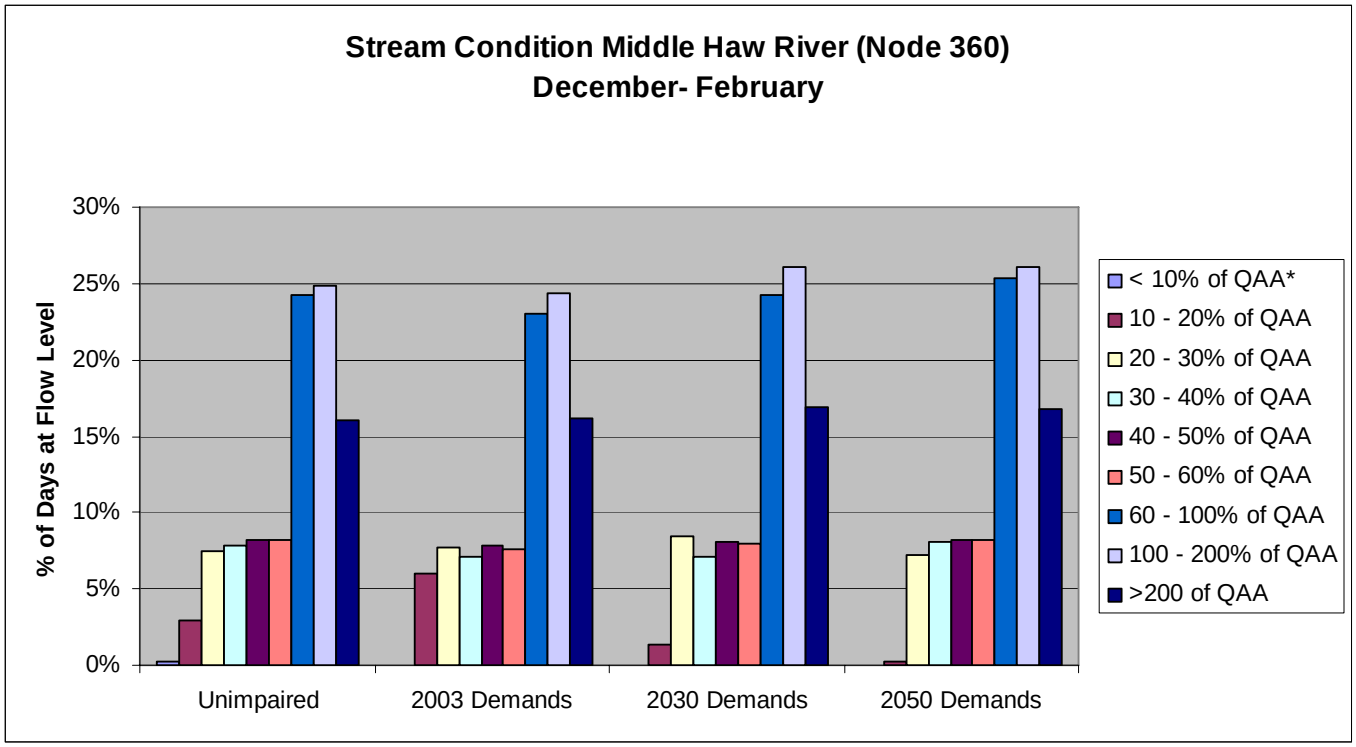
Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
< 10% of QAA*	0.3%	0.0%	0.0%	0.0%
10 - 20% of QAA	3.5%	5.5%	6.5%	6.5%
20 - 30% of QAA	5.4%	8.0%	8.3%	8.6%

30 - 40% of QAA	6.9%	6.7%	6.6%	6.7%
40 - 50% of QAA	7.3%	7.1%	7.1%	7.1%
50 - 60% of QAA	7.1%	6.5%	6.8%	6.9%
60 - 100% of QAA	23.3%	21.3%	20.8%	20.5%
100 - 200% of QAA	26.6%	25.8%	25.2%	25.0%
>200 of QAA	19.5%	19.1%	18.8%	18.7%



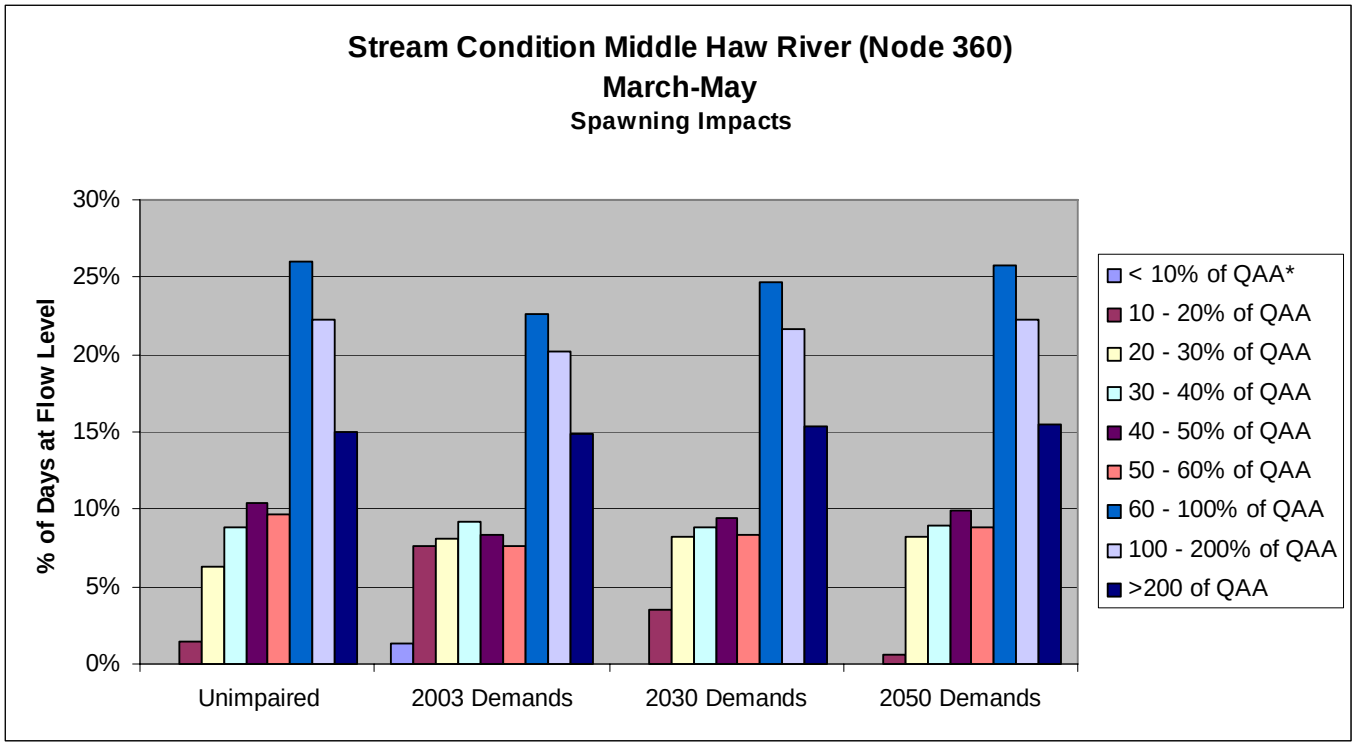
***QAA (average annual flow) at Node 280 = 227 mgd**

June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
< 10% of QAA*	7.7%	2.4%	3.3%	3.2%
10 - 20% of QAA	19.5%	27.1%	30.8%	31.1%
20 - 30% of QAA	17.6%	23.4%	22.1%	22.6%
30 - 40% of QAA	11.8%	10.9%	9.8%	9.9%
40 - 50% of QAA	8.6%	6.5%	6.4%	6.3%
50 - 60% of QAA	5.8%	5.0%	4.6%	4.6%
60 - 100% of QAA	13.0%	10.2%	9.4%	9.0%
100 - 200% of QAA	10.1%	8.9%	8.3%	8.1%
>200 of QAA	6.0%	5.6%	5.2%	5.0%



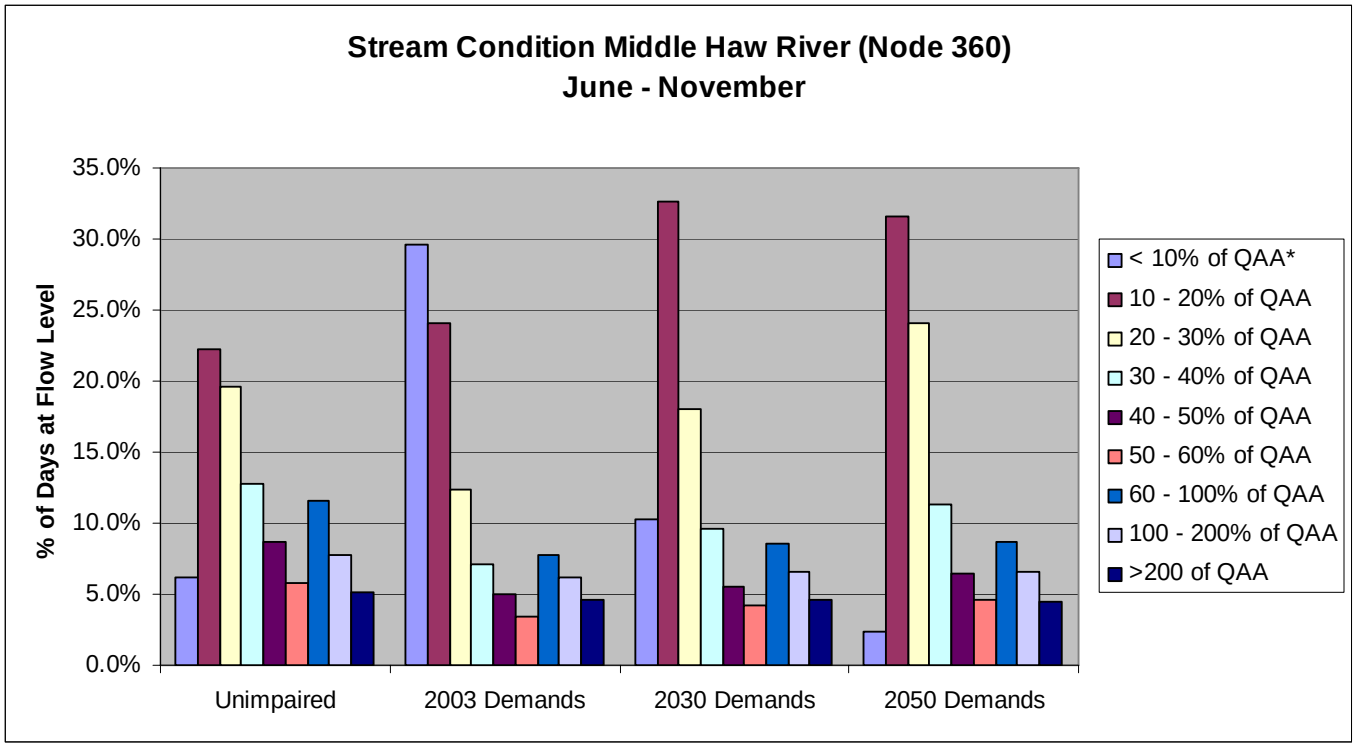
***QAA (average annual flow) at Node 360 = 526 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.3%	0.0%	0.0%	0.0%
2	10 - 20% of QAA	2.9%	6.0%	1.4%	0.2%
3	20 - 30% of QAA	7.5%	7.8%	8.4%	7.2%
4	30 - 40% of QAA	7.8%	7.1%	7.0%	8.0%
5	40 - 50% of QAA	8.2%	7.9%	8.0%	8.2%
6	50 - 60% of QAA	8.2%	7.6%	8.0%	8.2%
7	60 - 100% of QAA	24.3%	23.0%	24.2%	25.4%
8	100 - 200% of QAA	24.8%	24.4%	26.0%	26.1%
9	>200 of QAA	16.0%	16.2%	16.9%	16.8%



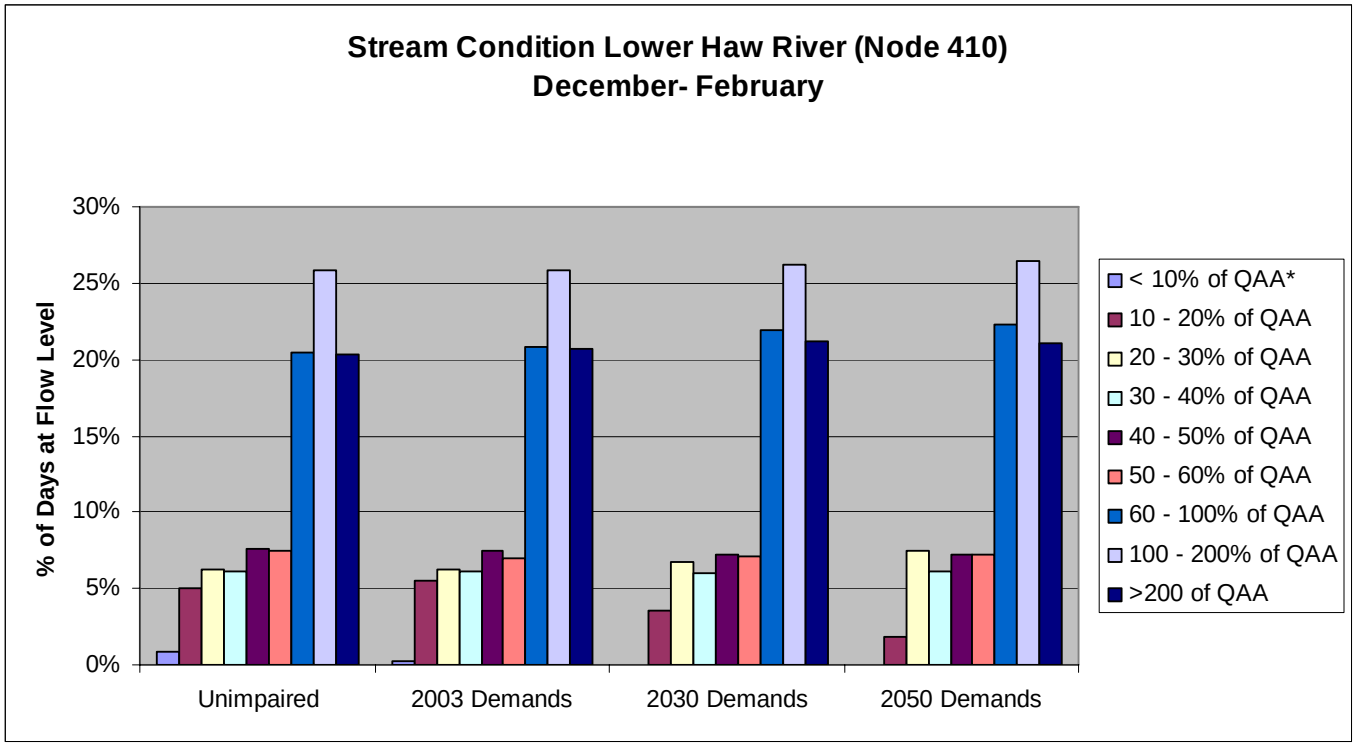
***QAA (average annual flow) at Node 360 = 526 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.1%	1.3%	0.0%	0.0%
2	10 - 20% of QAA	1.5%	7.6%	3.5%	0.7%
3	20 - 30% of QAA	6.3%	8.1%	8.3%	8.3%
4	30 - 40% of QAA	8.8%	9.2%	8.9%	8.9%
5	40 - 50% of QAA	10.4%	8.3%	9.4%	9.9%
6	50 - 60% of QAA	9.7%	7.7%	8.3%	8.8%
7	60 - 100% of QAA	26.1%	22.6%	24.7%	25.7%
8	100 - 200% of QAA	22.3%	20.3%	21.6%	22.3%
9	>200 of QAA	14.9%	14.9%	15.4%	15.4%



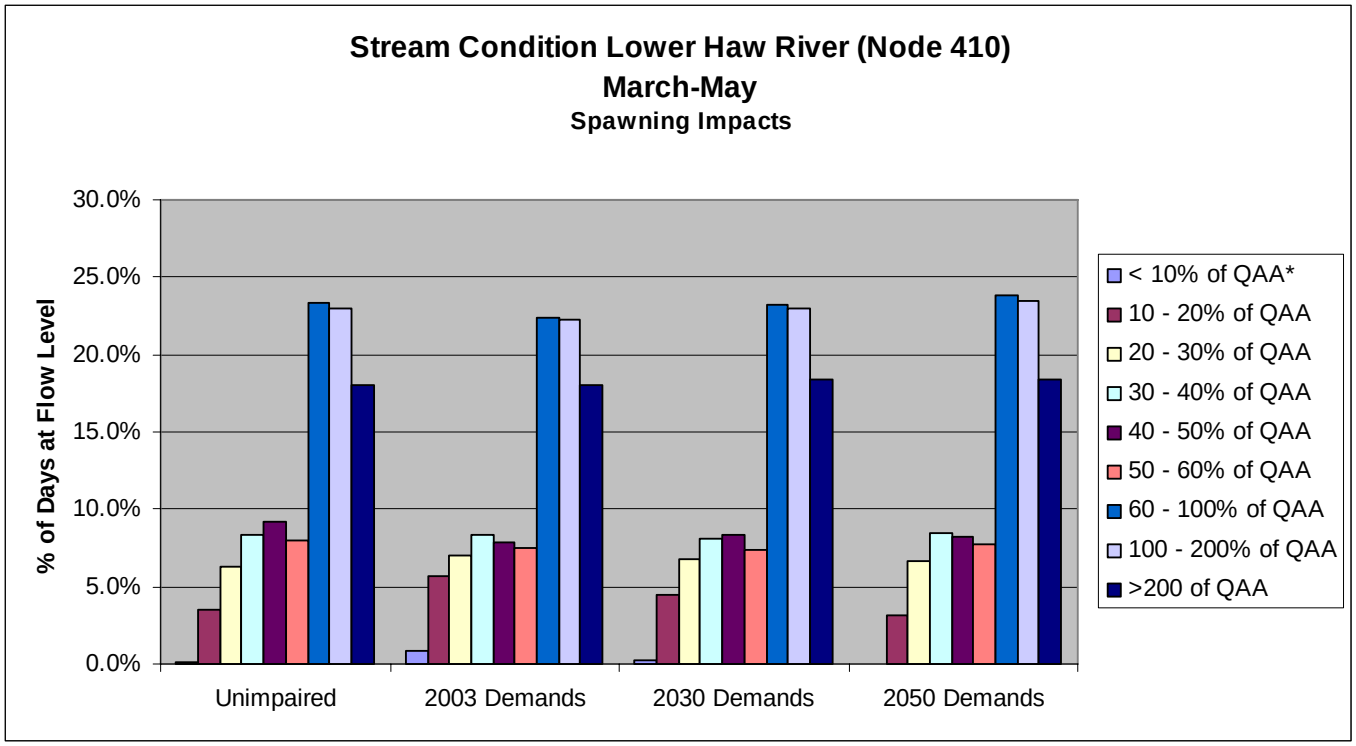
***QAA (average annual flow) at Node 360 = 526 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	6.2%	29.5%	10.2%	2.3%
2	10 - 20% of QAA	22.3%	24.1%	32.6%	31.6%
3	20 - 30% of QAA	19.6%	12.4%	18.0%	24.1%
4	30 - 40% of QAA	12.8%	7.1%	9.6%	11.3%
5	40 - 50% of QAA	8.7%	4.9%	5.6%	6.5%
6	50 - 60% of QAA	5.8%	3.4%	4.2%	4.6%
7	60 - 100% of QAA	11.6%	7.7%	8.5%	8.7%
8	100 - 200% of QAA	7.8%	6.2%	6.5%	6.5%
9	>200 of QAA	5.2%	4.6%	4.6%	4.4%



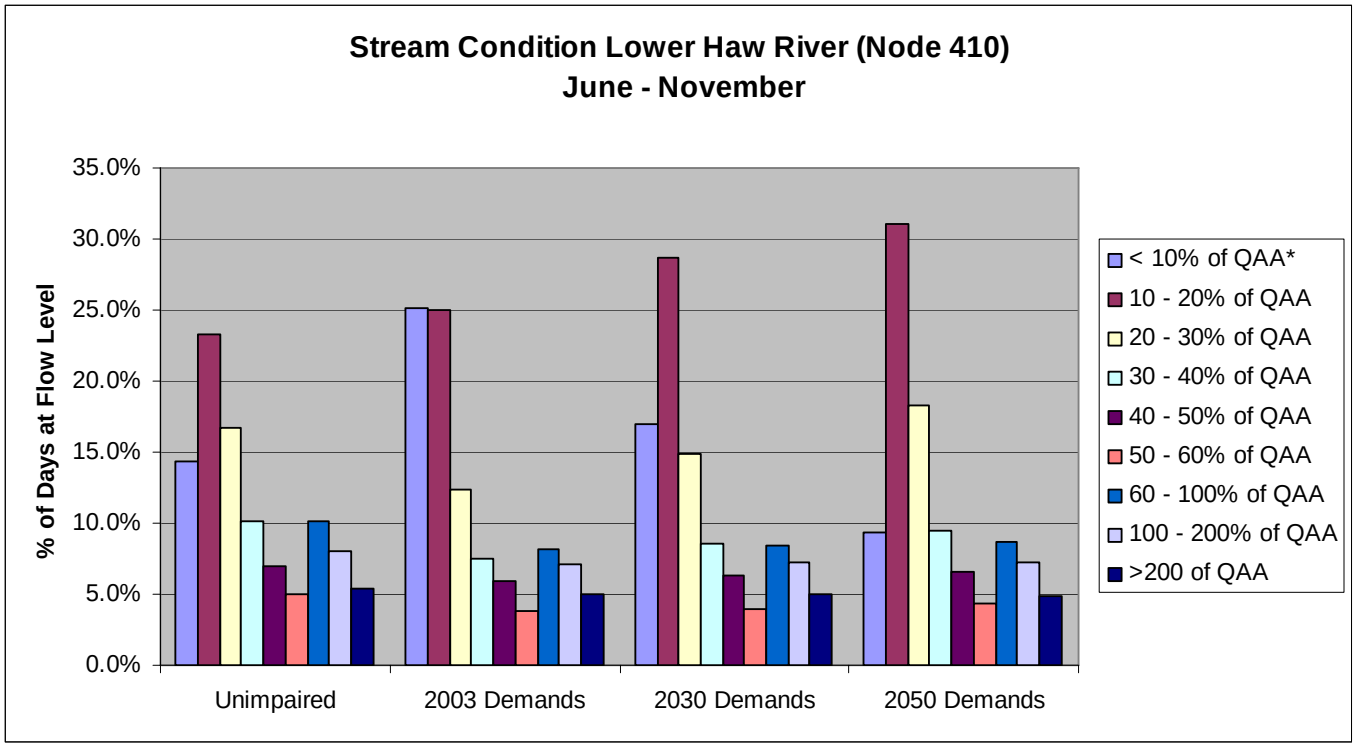
***QAA (average annual flow) at Node 410 = 1009 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.8%	0.2%	0.0%	0.0%
2	10 - 20% of QAA	5.1%	5.5%	3.6%	1.9%
3	20 - 30% of QAA	6.2%	6.2%	6.7%	7.5%
4	30 - 40% of QAA	6.1%	6.1%	6.0%	6.2%
5	40 - 50% of QAA	7.7%	7.5%	7.3%	7.2%
6	50 - 60% of QAA	7.5%	7.0%	7.0%	7.3%
7	60 - 100% of QAA	20.5%	20.8%	21.9%	22.3%
8	100 - 200% of QAA	25.8%	25.9%	26.2%	26.5%
9	>200 of QAA	20.4%	20.7%	21.2%	21.1%



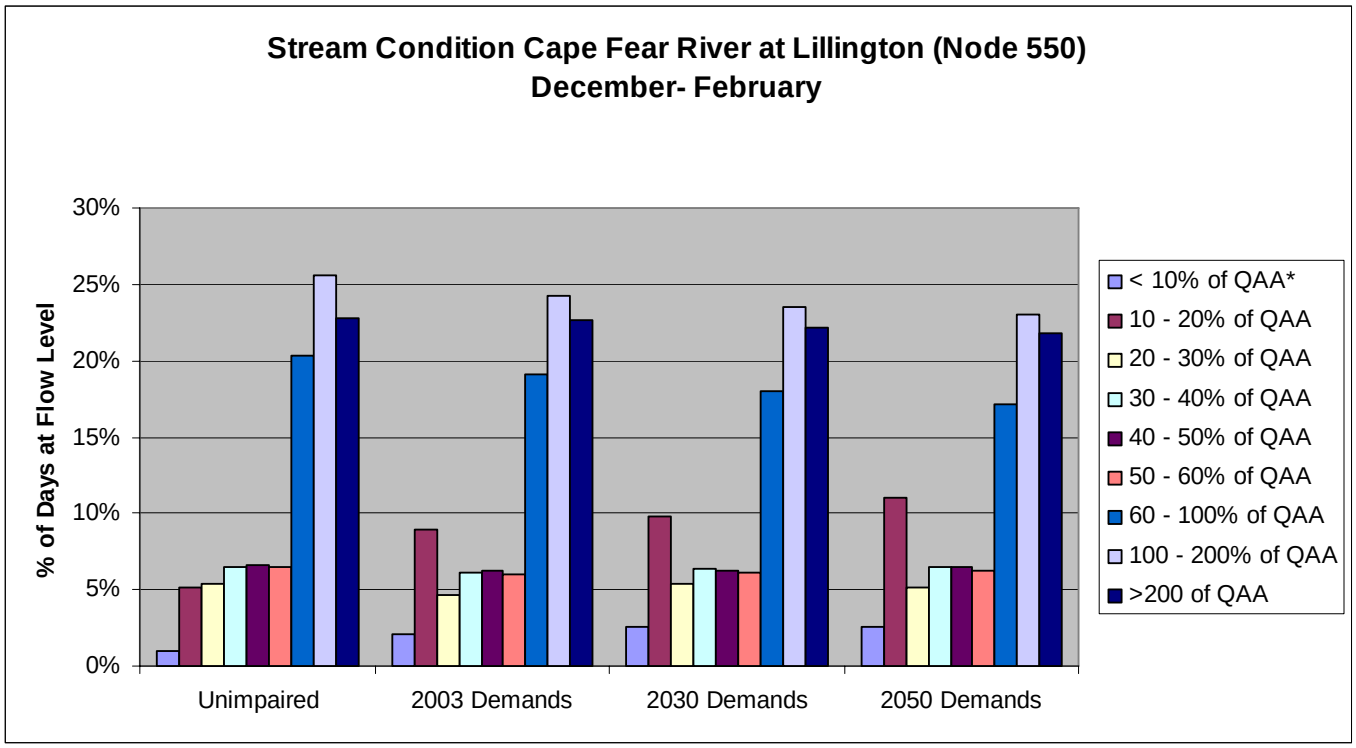
***QAA (average annual flow) at Node 410 = 1009 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.2%	0.9%	0.2%	0.0%
2	10 - 20% of QAA	3.6%	5.7%	4.4%	3.1%
3	20 - 30% of QAA	6.3%	7.0%	6.8%	6.7%
4	30 - 40% of QAA	8.3%	8.3%	8.1%	8.5%
5	40 - 50% of QAA	9.2%	7.9%	8.3%	8.3%
6	50 - 60% of QAA	8.0%	7.5%	7.4%	7.8%
7	60 - 100% of QAA	23.4%	22.4%	23.3%	23.8%
8	100 - 200% of QAA	23.0%	22.2%	23.0%	23.5%
9	>200 of QAA	18.1%	18.1%	18.4%	18.4%



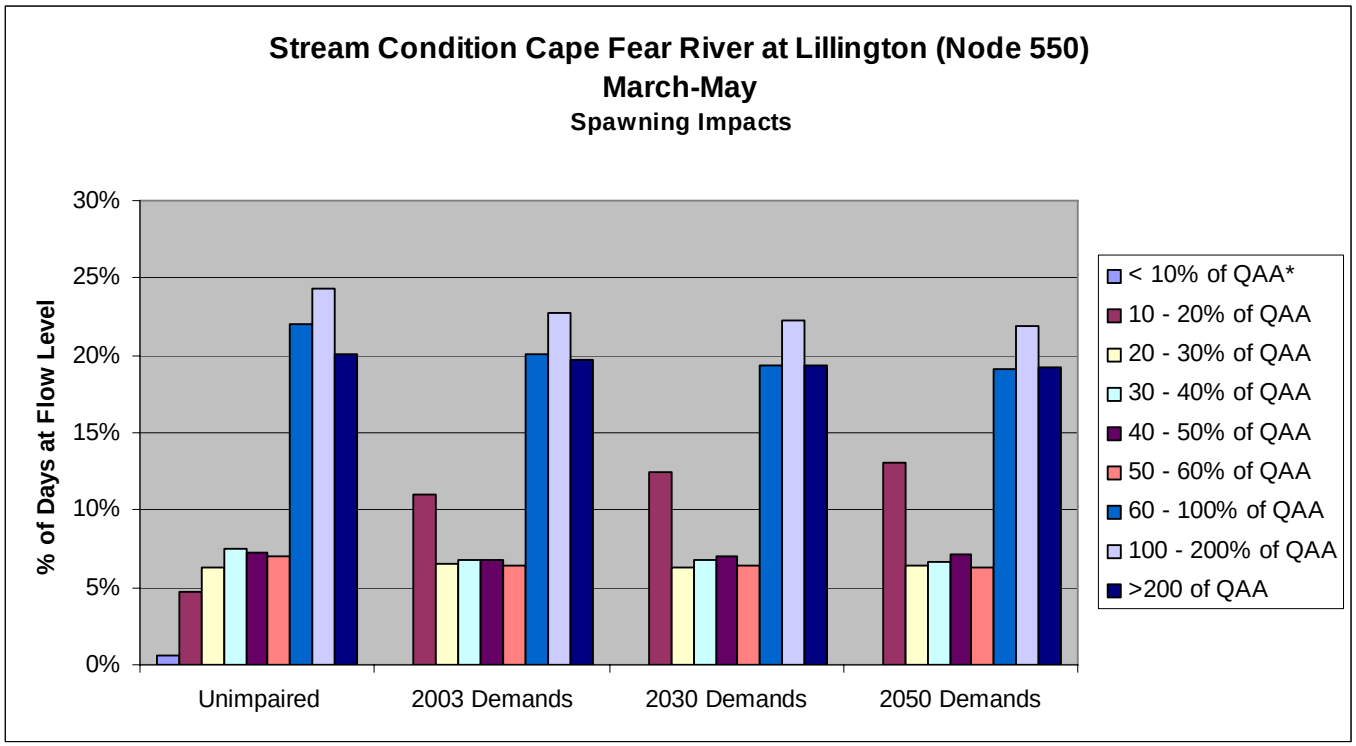
***QAA (average annual flow) at Node 410 = 1009 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	14.4%	25.1%	17.0%	9.4%
2	10 - 20% of QAA	23.3%	25.0%	28.6%	31.1%
3	20 - 30% of QAA	16.7%	12.4%	14.8%	18.3%
4	30 - 40% of QAA	10.2%	7.5%	8.5%	9.5%
5	40 - 50% of QAA	6.9%	5.9%	6.3%	6.6%
6	50 - 60% of QAA	5.0%	3.8%	4.0%	4.4%
7	60 - 100% of QAA	10.1%	8.1%	8.5%	8.6%
8	100 - 200% of QAA	8.0%	7.1%	7.2%	7.3%
9	>200 of QAA	5.4%	5.0%	5.0%	4.9%



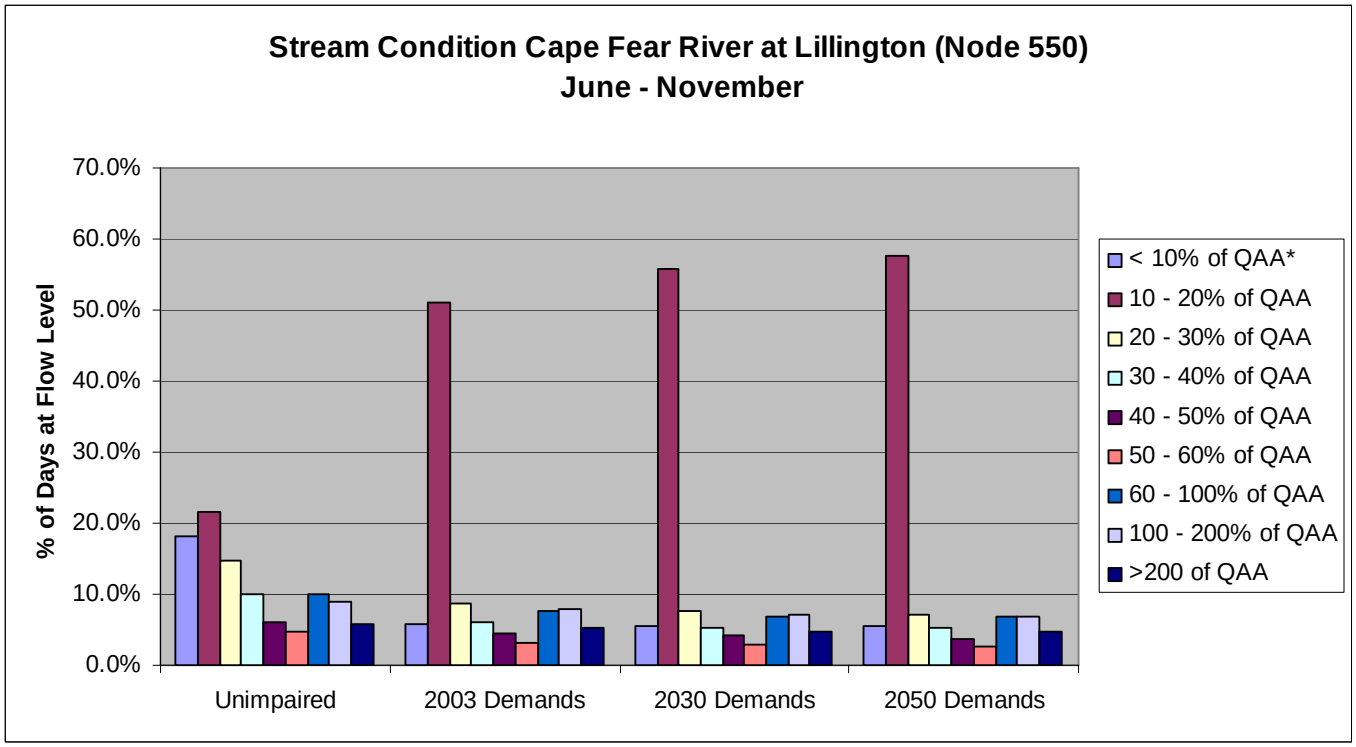
***QAA (average annual flow) at Node 550 = 2182 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	1.0%	2.1%	2.6%	2.6%
2	10 - 20% of QAA	5.2%	9.0%	9.7%	11.1%
3	20 - 30% of QAA	5.4%	4.7%	5.4%	5.2%
4	30 - 40% of QAA	6.5%	6.1%	6.3%	6.5%
5	40 - 50% of QAA	6.6%	6.2%	6.2%	6.5%
6	50 - 60% of QAA	6.5%	6.0%	6.2%	6.2%
7	60 - 100% of QAA	20.4%	19.1%	18.0%	17.2%
8	100 - 200% of QAA	25.6%	24.3%	23.5%	23.0%
9	>200 of QAA	22.8%	22.6%	22.2%	21.7%



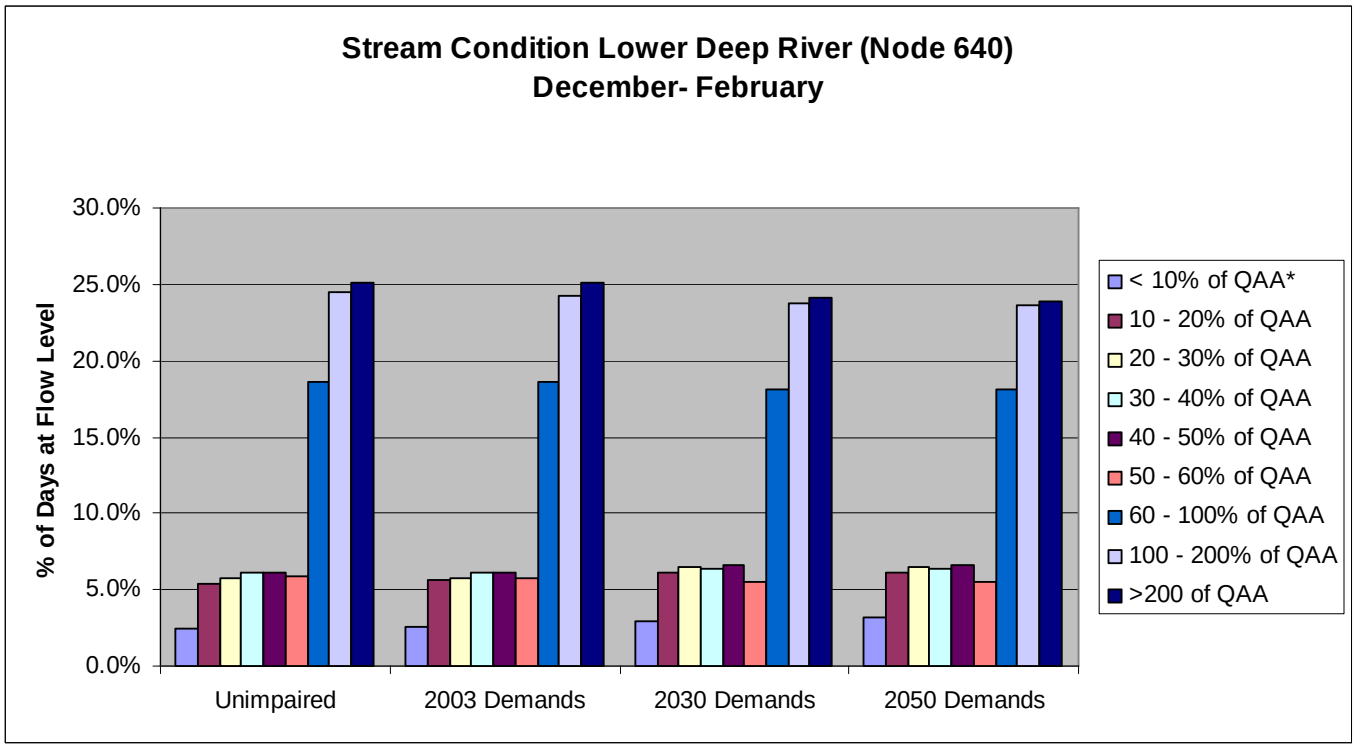
***QAA (average annual flow) at Node 550 = 2182 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.6%	0.0%	0.0%	0.0%
2	10 - 20% of QAA	4.7%	11.0%	12.4%	13.1%
3	20 - 30% of QAA	6.3%	6.5%	6.2%	6.4%
4	30 - 40% of QAA	7.5%	6.8%	6.8%	6.7%
5	40 - 50% of QAA	7.3%	6.7%	7.1%	7.1%
6	50 - 60% of QAA	7.0%	6.4%	6.4%	6.3%
7	60 - 100% of QAA	22.1%	20.0%	19.4%	19.2%
8	100 - 200% of QAA	24.4%	22.8%	22.3%	21.9%
9	>200 of QAA	20.0%	19.7%	19.4%	19.2%



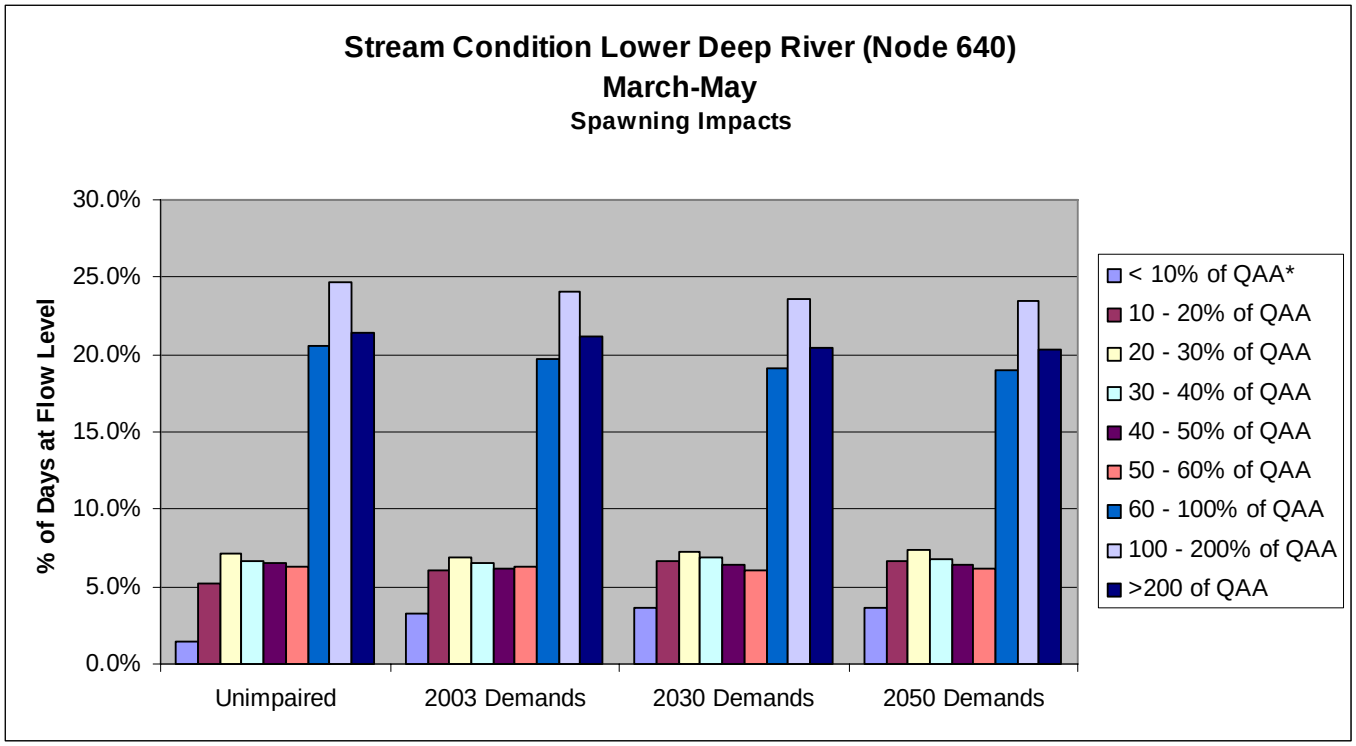
***QAA (average annual flow) at Node 550 = 2182 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	18.1%	5.7%	5.5%	5.4%
2	10 - 20% of QAA	21.5%	51.0%	55.8%	57.5%
3	20 - 30% of QAA	14.8%	8.8%	7.5%	7.2%
4	30 - 40% of QAA	9.9%	6.0%	5.4%	5.2%
5	40 - 50% of QAA	6.0%	4.5%	4.1%	3.8%
6	50 - 60% of QAA	4.8%	3.2%	2.9%	2.7%
7	60 - 100% of QAA	10.0%	7.6%	6.8%	6.7%
8	100 - 200% of QAA	8.9%	7.8%	7.1%	6.7%
9	>200 of QAA	5.9%	5.3%	4.8%	4.7%



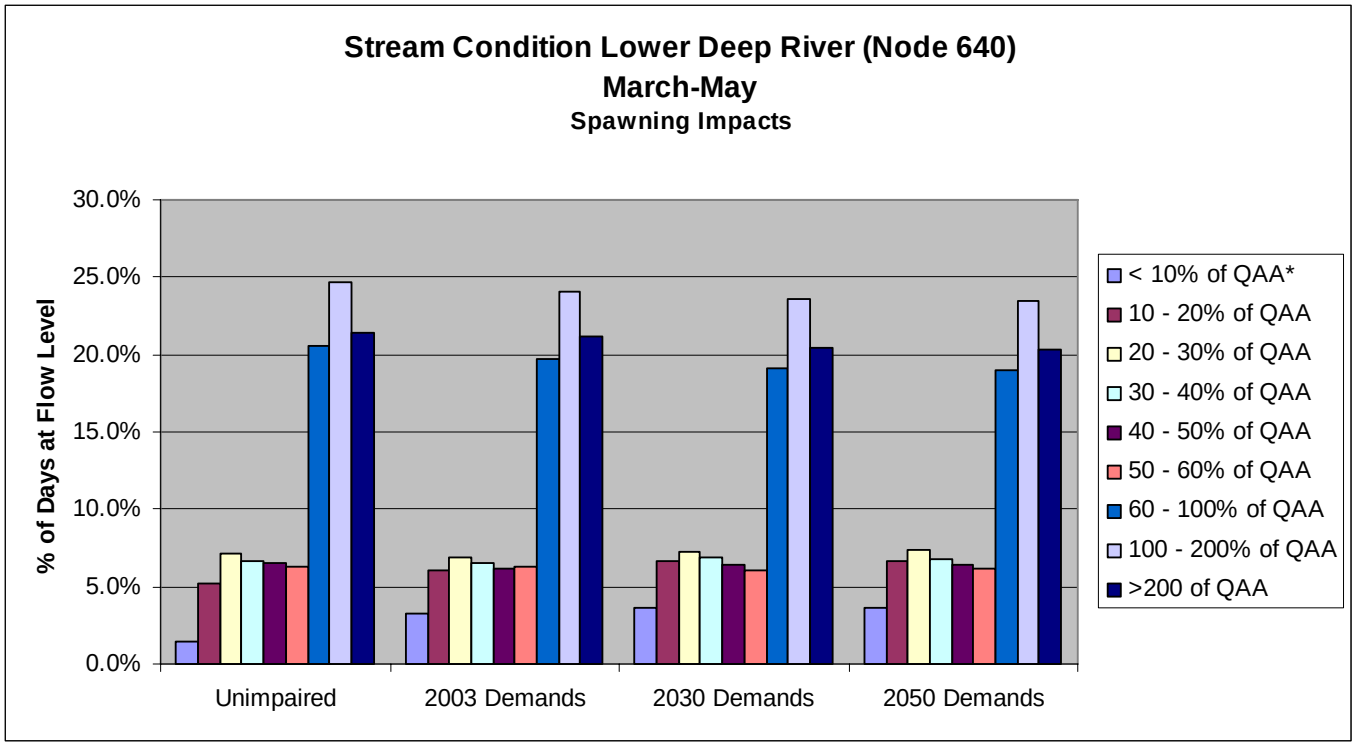
***QAA (average annual flow) at Node 640 = 930 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	2.4%	2.6%	3.0%	3.2%
2	10 - 20% of QAA	5.4%	5.6%	6.2%	6.1%
3	20 - 30% of QAA	5.7%	5.7%	6.5%	6.5%
4	30 - 40% of QAA	6.2%	6.1%	6.4%	6.4%
5	40 - 50% of QAA	6.1%	6.1%	6.6%	6.6%
6	50 - 60% of QAA	5.9%	5.8%	5.5%	5.5%
7	60 - 100% of QAA	18.6%	18.6%	18.2%	18.1%
8	100 - 200% of QAA	24.5%	24.3%	23.7%	23.7%
9	>200 of QAA	25.1%	25.2%	24.1%	23.8%



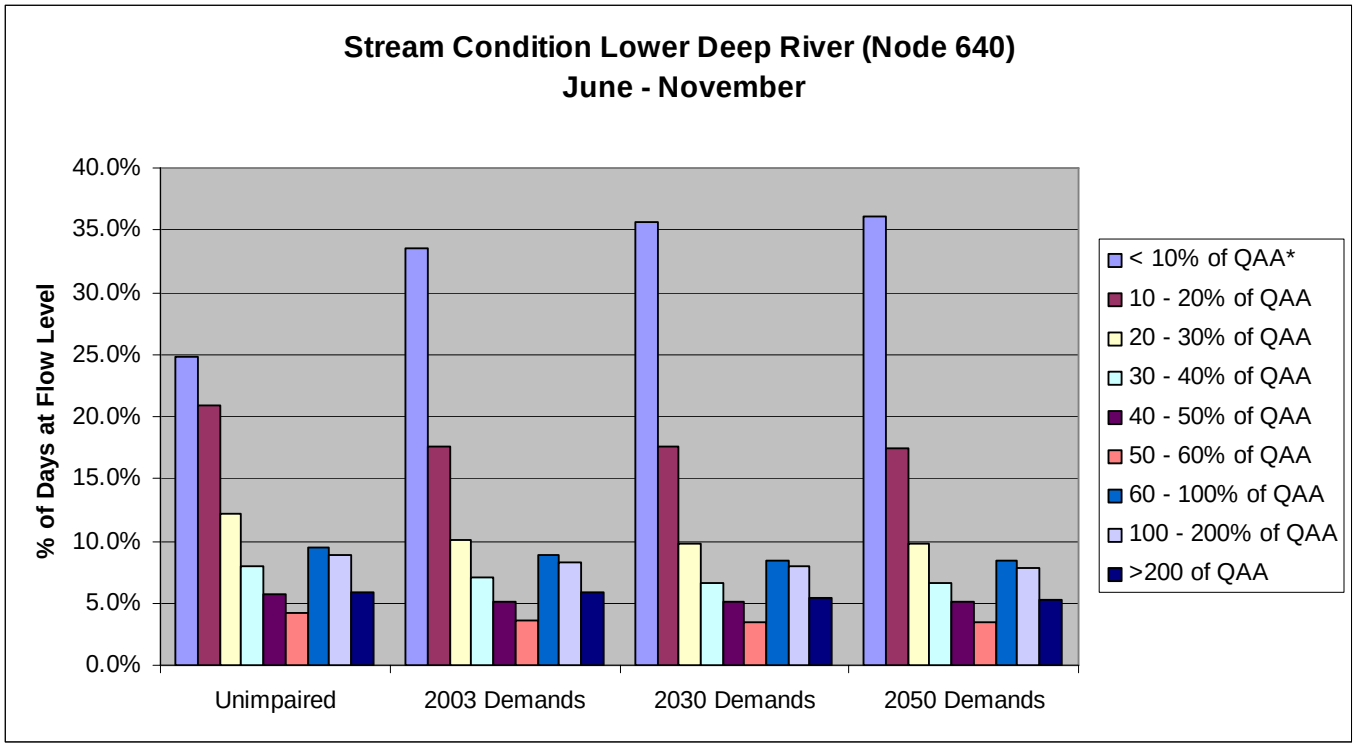
***QAA (average annual flow) at Node 640 = 930 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	1.5%	3.2%	3.6%	3.7%
2	10 - 20% of QAA	5.2%	6.1%	6.6%	6.7%
3	20 - 30% of QAA	7.1%	6.9%	7.2%	7.3%
4	30 - 40% of QAA	6.7%	6.5%	6.9%	6.8%
5	40 - 50% of QAA	6.5%	6.1%	6.4%	6.5%
6	50 - 60% of QAA	6.3%	6.3%	6.1%	6.2%
7	60 - 100% of QAA	20.6%	19.7%	19.2%	19.0%
8	100 - 200% of QAA	24.6%	24.1%	23.6%	23.5%
9	>200 of QAA	21.4%	21.1%	20.5%	20.4%



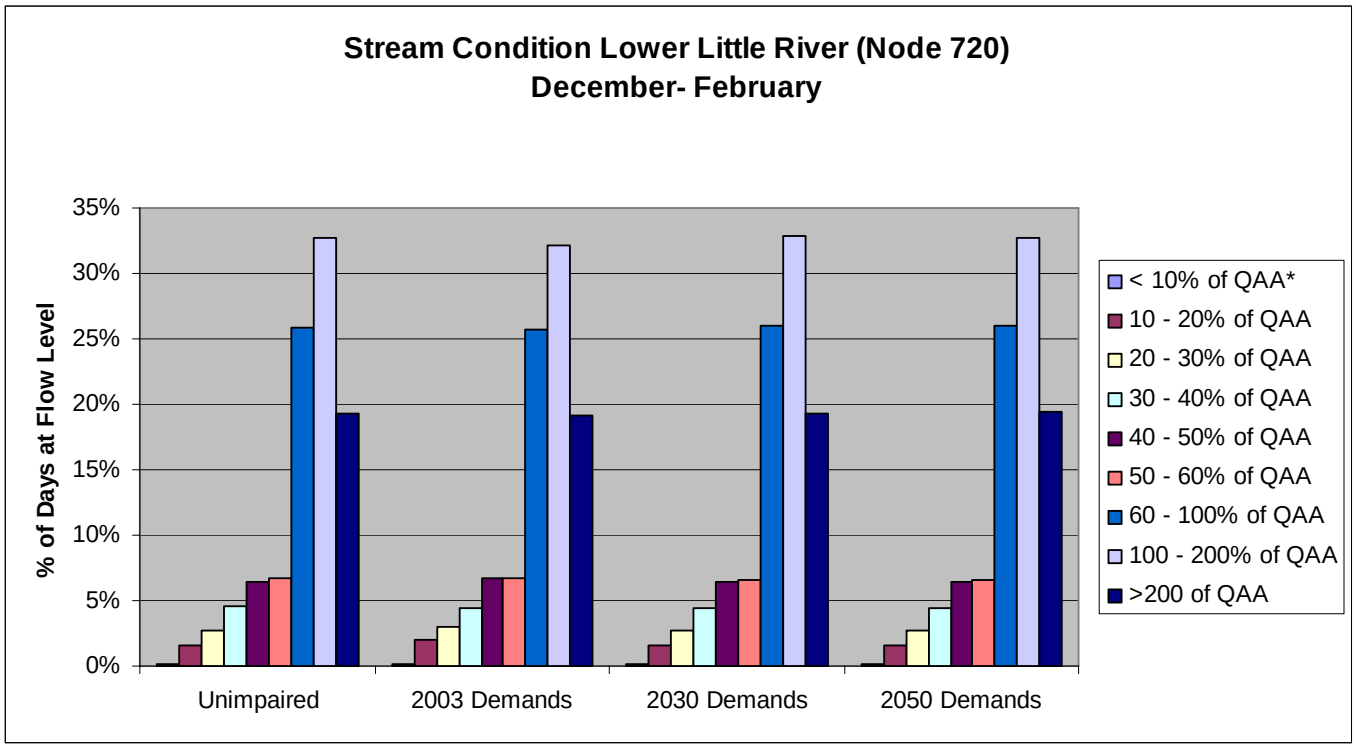
***QAA (average annual flow) at Node 640 = 930 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	1.5%	3.2%	3.6%	3.7%
2	10 - 20% of QAA	5.2%	6.1%	6.6%	6.7%
3	20 - 30% of QAA	7.1%	6.9%	7.2%	7.3%
4	30 - 40% of QAA	6.7%	6.5%	6.9%	6.8%
5	40 - 50% of QAA	6.5%	6.1%	6.4%	6.5%
6	50 - 60% of QAA	6.3%	6.3%	6.1%	6.2%
7	60 - 100% of QAA	20.6%	19.7%	19.2%	19.0%
8	100 - 200% of QAA	24.6%	24.1%	23.6%	23.5%
9	>200 of QAA	21.4%	21.1%	20.5%	20.4%



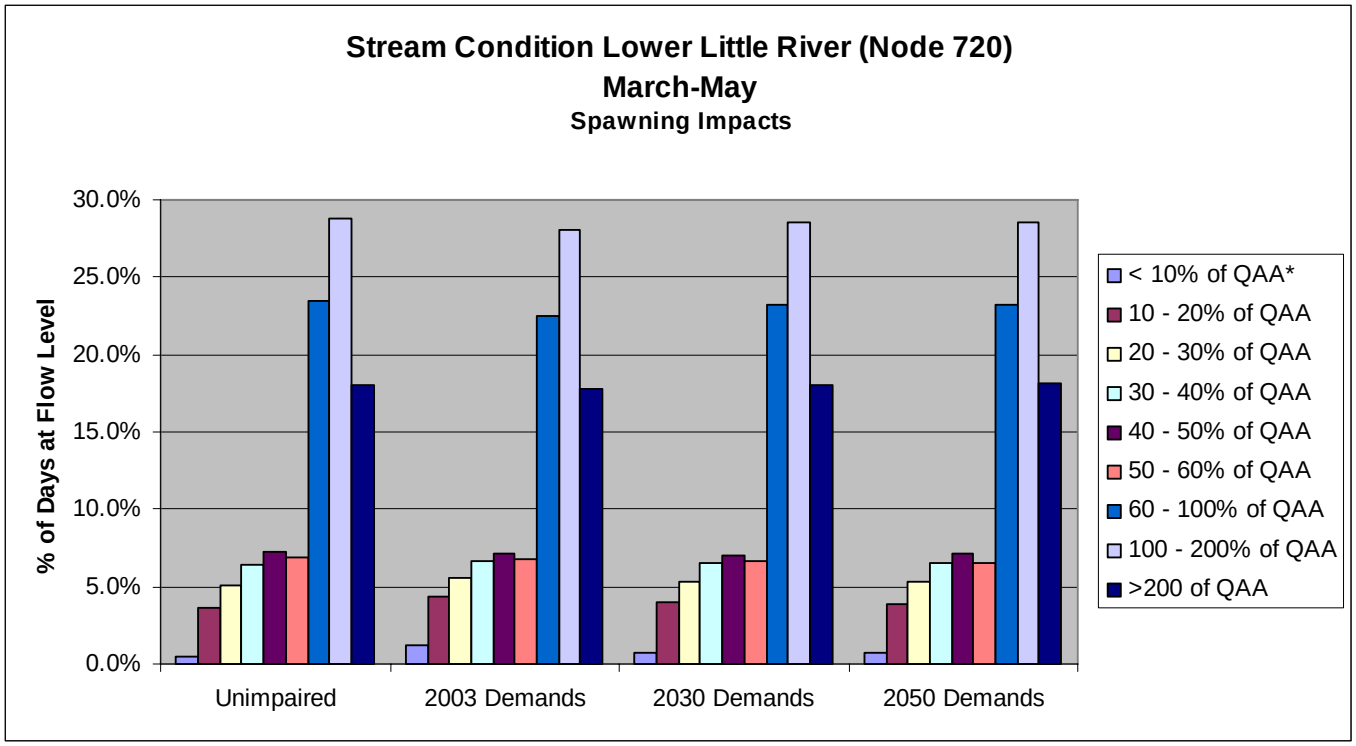
***QAA (average annual flow) at Node 640 = 930 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	24.8%	33.6%	35.7%	36.1%
2	10 - 20% of QAA	20.9%	17.6%	17.6%	17.4%
3	20 - 30% of QAA	12.1%	10.0%	9.8%	9.8%
4	30 - 40% of QAA	8.0%	7.0%	6.6%	6.6%
5	40 - 50% of QAA	5.7%	5.2%	5.2%	5.2%
6	50 - 60% of QAA	4.1%	3.6%	3.4%	3.4%
7	60 - 100% of QAA	9.4%	8.9%	8.4%	8.4%
8	100 - 200% of QAA	8.9%	8.3%	7.9%	7.9%
9	>200 of QAA	5.9%	5.8%	5.4%	5.3%



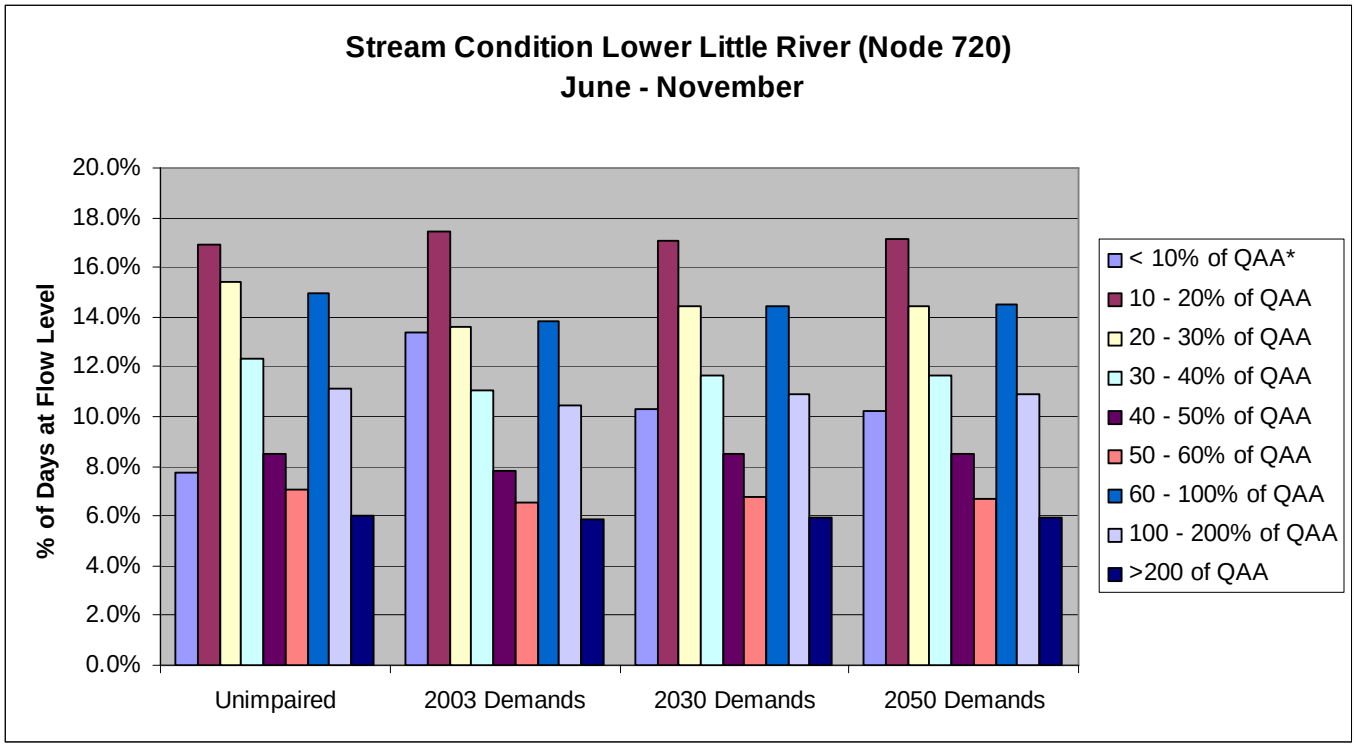
***QAA (average annual flow) at Node 720 = 379 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.1%	0.2%	0.1%	0.1%
2	10 - 20% of QAA	1.6%	1.9%	1.6%	1.6%
3	20 - 30% of QAA	2.7%	3.0%	2.8%	2.7%
4	30 - 40% of QAA	4.5%	4.5%	4.4%	4.4%
5	40 - 50% of QAA	6.4%	6.7%	6.5%	6.5%
6	50 - 60% of QAA	6.6%	6.6%	6.6%	6.6%
7	60 - 100% of QAA	25.9%	25.7%	25.9%	26.0%
8	100 - 200% of QAA	32.7%	32.2%	32.8%	32.7%
9	>200 of QAA	19.3%	19.1%	19.3%	19.4%



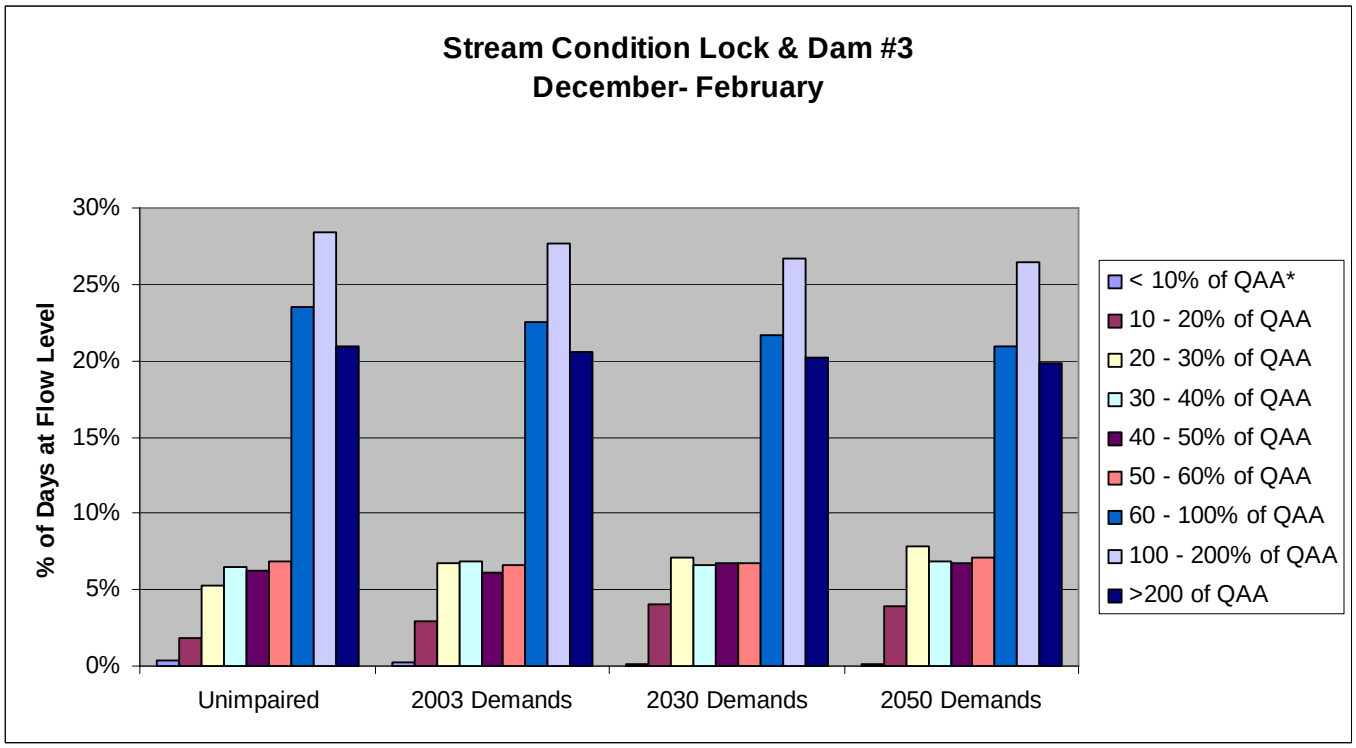
***QAA (average annual flow) at Node 720 = 379 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.5%	1.2%	0.7%	0.7%
2	10 - 20% of QAA	3.6%	4.4%	3.9%	3.9%
3	20 - 30% of QAA	5.1%	5.5%	5.4%	5.3%
4	30 - 40% of QAA	6.5%	6.7%	6.5%	6.5%
5	40 - 50% of QAA	7.2%	7.1%	7.0%	7.1%
6	50 - 60% of QAA	6.8%	6.7%	6.7%	6.6%
7	60 - 100% of QAA	23.4%	22.5%	23.2%	23.3%
8	100 - 200% of QAA	28.7%	28.1%	28.5%	28.5%
9	>200 of QAA	18.1%	17.8%	18.0%	18.1%



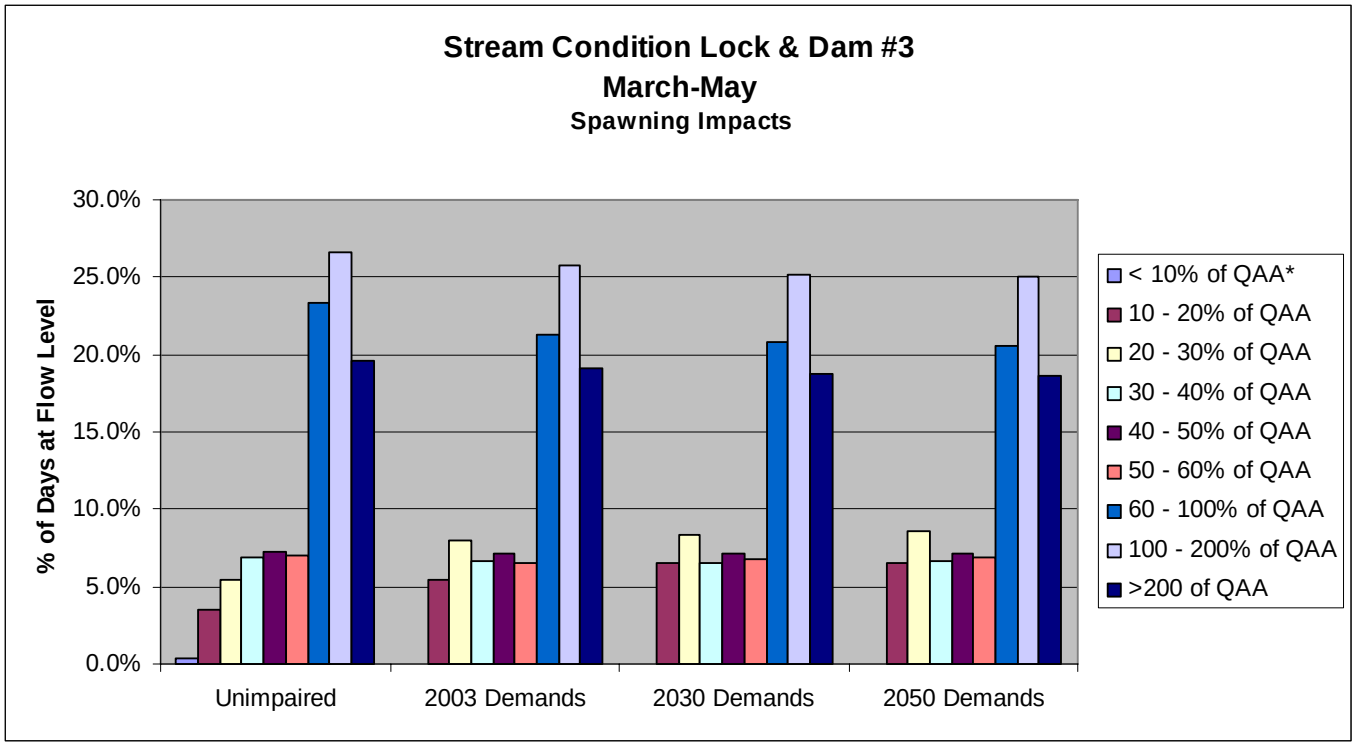
***QAA (average annual flow) at Node 720 = 379 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	7.7%	13.4%	10.3%	10.2%
2	10 - 20% of QAA	16.9%	17.4%	17.1%	17.1%
3	20 - 30% of QAA	15.4%	13.6%	14.4%	14.4%
4	30 - 40% of QAA	12.4%	11.0%	11.6%	11.7%
5	40 - 50% of QAA	8.5%	7.8%	8.5%	8.5%
6	50 - 60% of QAA	7.0%	6.5%	6.8%	6.7%
7	60 - 100% of QAA	14.9%	13.9%	14.4%	14.5%
8	100 - 200% of QAA	11.1%	10.5%	10.9%	10.9%
9	>200 of QAA	6.0%	5.8%	5.9%	5.9%



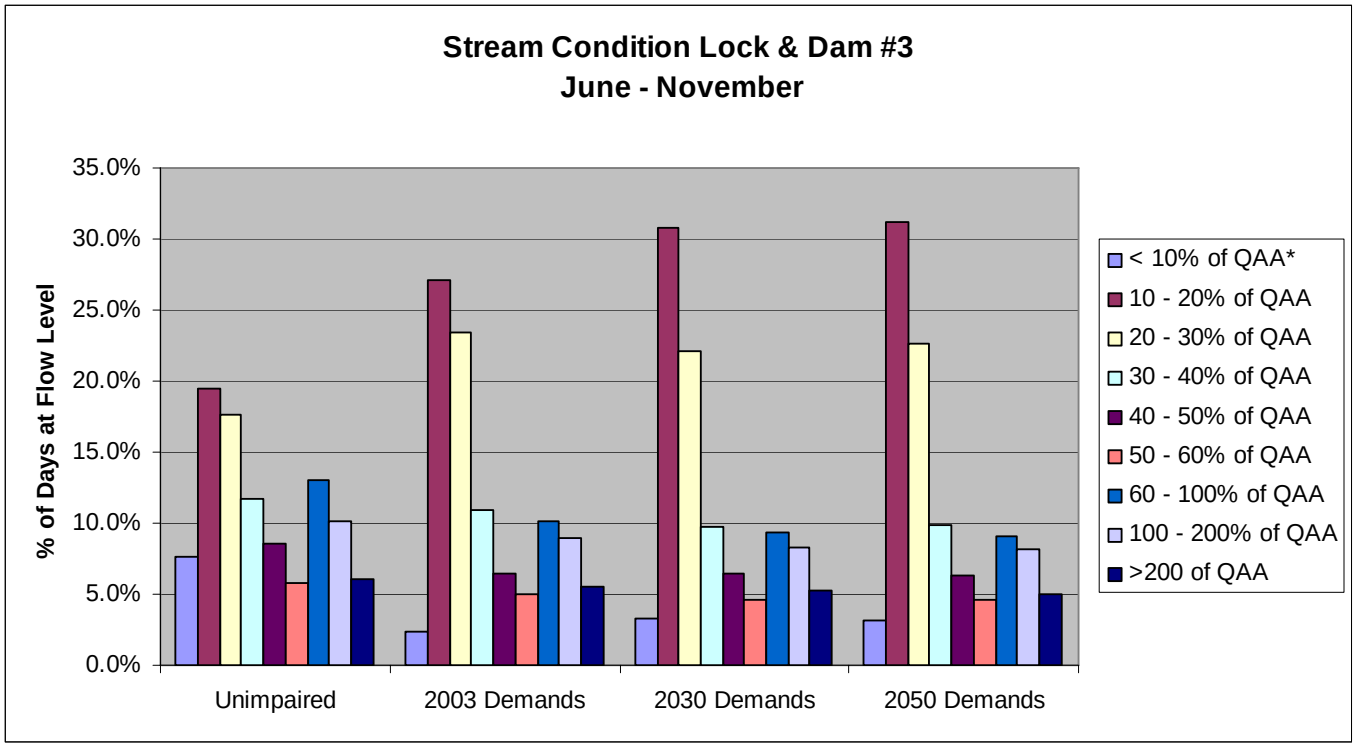
***QAA (average annual flow) at Lock & Dam #1 (Node 780) = 3196 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.3%	0.2%	0.1%	0.1%
2	10 - 20% of QAA	1.9%	2.9%	4.1%	4.0%
3	20 - 30% of QAA	5.3%	6.7%	7.1%	7.8%
4	30 - 40% of QAA	6.5%	6.8%	6.6%	6.8%
5	40 - 50% of QAA	6.2%	6.1%	6.8%	6.8%
6	50 - 60% of QAA	6.8%	6.6%	6.8%	7.1%
7	60 - 100% of QAA	23.6%	22.5%	21.6%	21.0%
8	100 - 200% of QAA	28.4%	27.6%	26.7%	26.5%
9	>200 of QAA	20.9%	20.5%	20.2%	19.9%



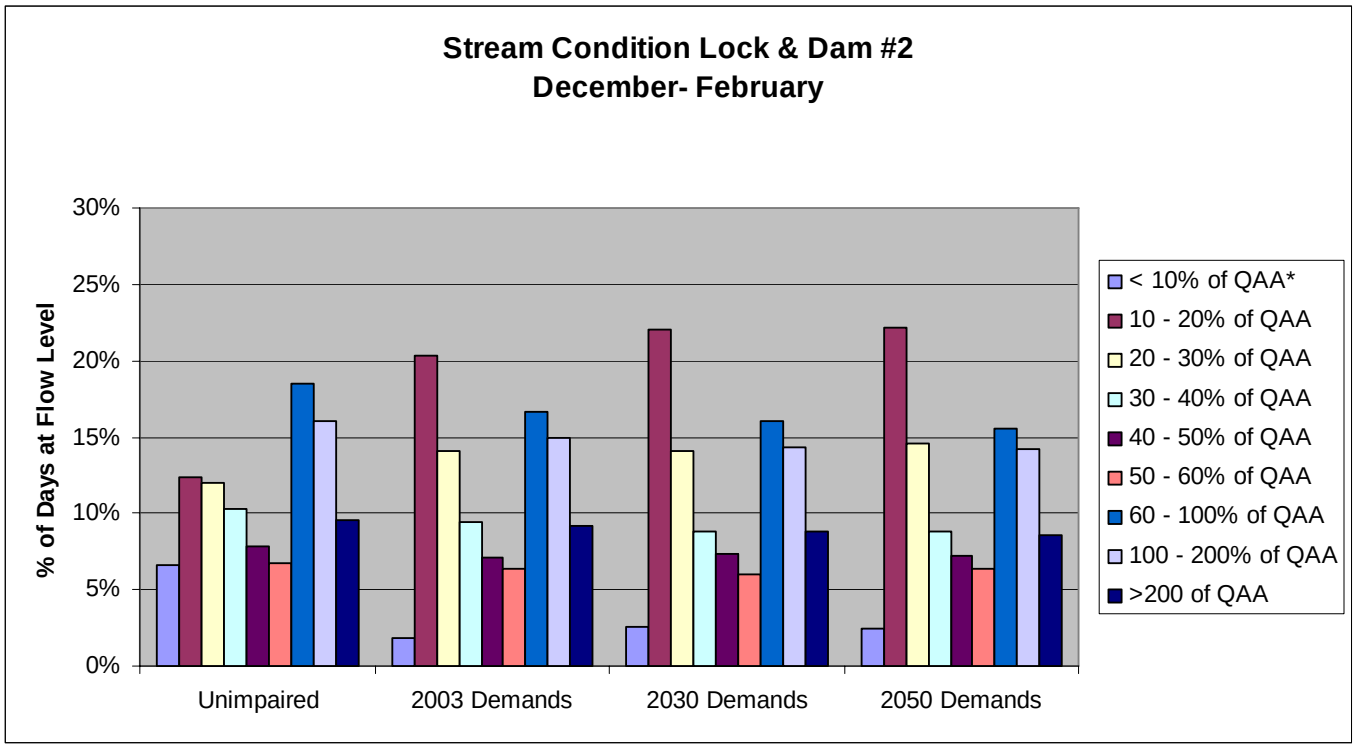
***QAA (average annual flow) at Lock & Dam #1 (Node 780) = 3196 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.3%	0.0%	0.0%	0.0%
2	10 - 20% of QAA	3.5%	5.5%	6.5%	6.5%
3	20 - 30% of QAA	5.4%	8.0%	8.3%	8.6%
4	30 - 40% of QAA	6.9%	6.7%	6.6%	6.7%
5	40 - 50% of QAA	7.3%	7.1%	7.1%	7.1%
6	50 - 60% of QAA	7.1%	6.5%	6.8%	6.9%
7	60 - 100% of QAA	23.3%	21.3%	20.8%	20.5%
8	100 - 200% of QAA	26.6%	25.8%	25.2%	25.0%
9	>200 of QAA	19.5%	19.1%	18.8%	18.7%



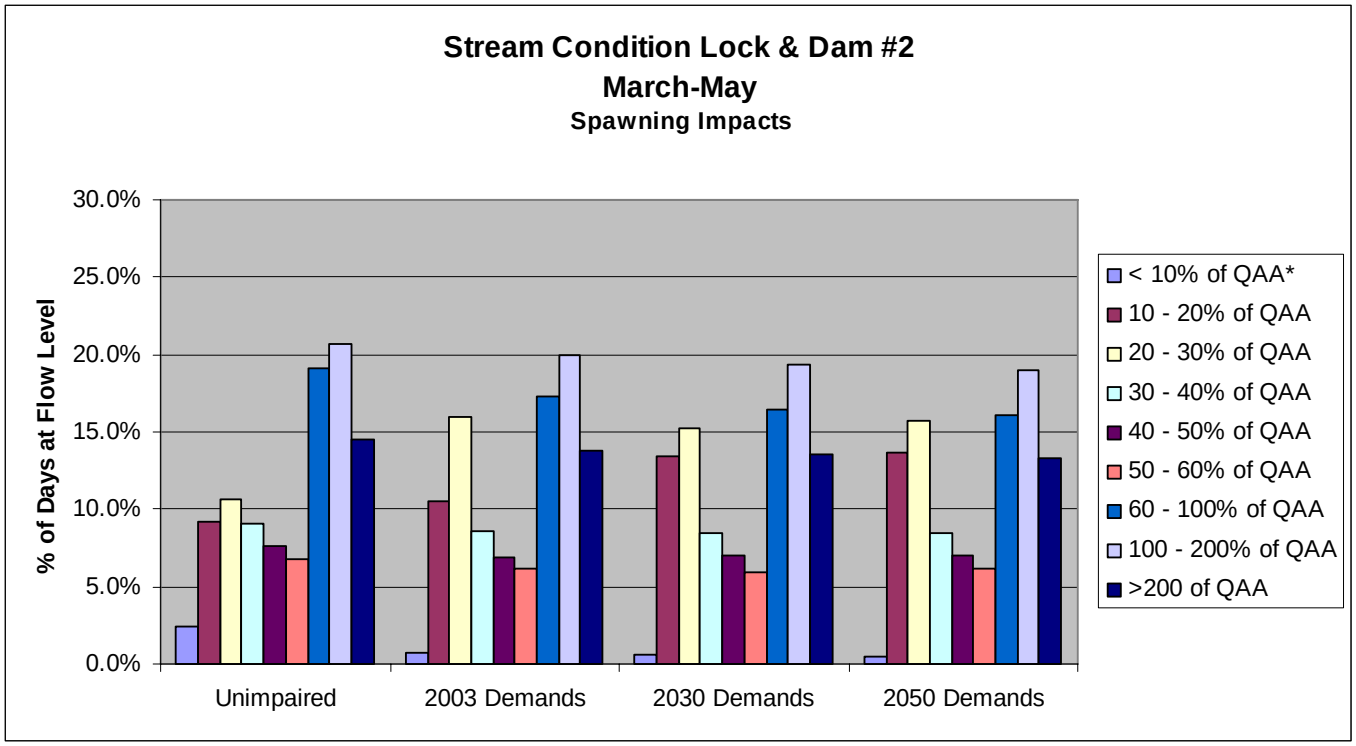
***QAA (average annual flow) at Lock & Dam #1 (Node 780) = 3196 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	7.7%	2.4%	3.3%	3.2%
2	10 - 20% of QAA	19.5%	27.1%	30.8%	31.1%
3	20 - 30% of QAA	17.6%	23.4%	22.1%	22.6%
4	30 - 40% of QAA	11.8%	10.9%	9.8%	9.9%
5	40 - 50% of QAA	8.6%	6.5%	6.4%	6.3%
6	50 - 60% of QAA	5.8%	5.0%	4.6%	4.6%
7	60 - 100% of QAA	13.0%	10.2%	9.4%	9.0%
8	100 - 200% of QAA	10.1%	8.9%	8.3%	8.1%
9	>200 of QAA	6.0%	5.6%	5.2%	5.0%



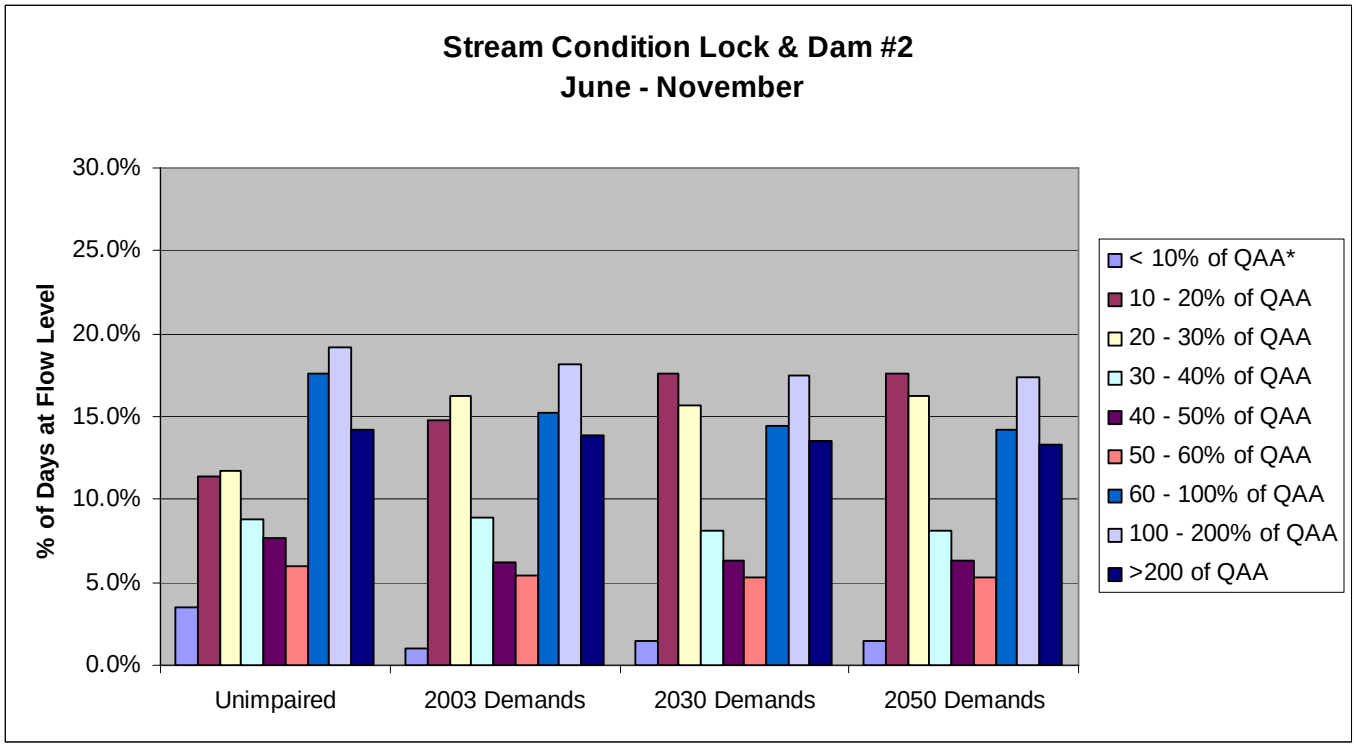
***QAA (average annual flow) at Lock & Dam #2 (Node 790) = 3196 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	6.7%	1.8%	2.5%	2.5%
2	10 - 20% of QAA	12.4%	20.3%	22.0%	22.2%
3	20 - 30% of QAA	12.0%	14.1%	14.1%	14.6%
4	30 - 40% of QAA	10.3%	9.4%	8.8%	8.8%
5	40 - 50% of QAA	7.8%	7.1%	7.3%	7.2%
6	50 - 60% of QAA	6.7%	6.4%	6.0%	6.4%
7	60 - 100% of QAA	18.4%	16.7%	16.1%	15.5%
8	100 - 200% of QAA	16.1%	14.9%	14.3%	14.2%
9	>200 of QAA	9.5%	9.2%	8.8%	8.6%



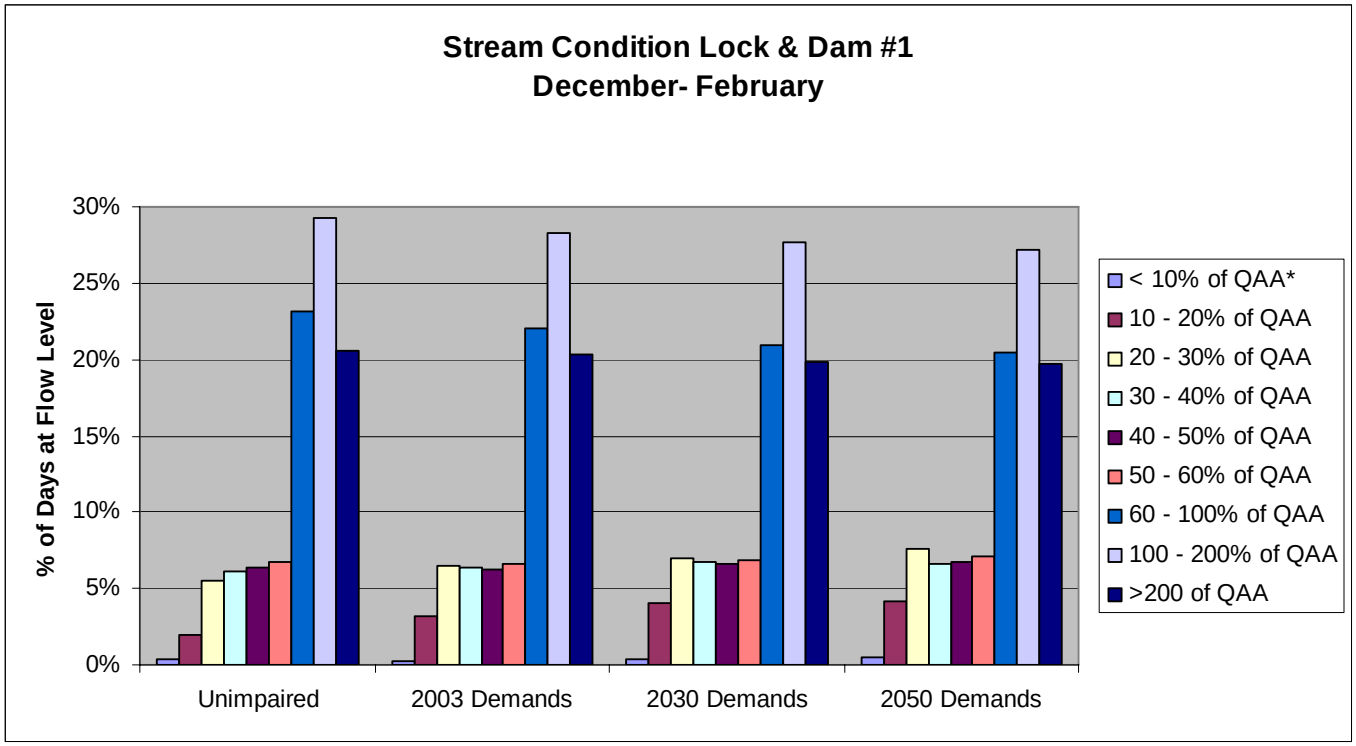
***QAA (average annual flow) at Lock & Dam #2 (Node 790) = 3196 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	2.4%	0.7%	0.6%	0.5%
2	10 - 20% of QAA	9.2%	10.5%	13.4%	13.7%
3	20 - 30% of QAA	10.6%	16.0%	15.3%	15.8%
4	30 - 40% of QAA	9.1%	8.6%	8.4%	8.5%
5	40 - 50% of QAA	7.6%	6.9%	7.0%	7.0%
6	50 - 60% of QAA	6.8%	6.1%	6.0%	6.1%
7	60 - 100% of QAA	19.1%	17.3%	16.5%	16.1%
8	100 - 200% of QAA	20.7%	20.0%	19.3%	19.0%
9	>200 of QAA	14.5%	13.8%	13.5%	13.4%



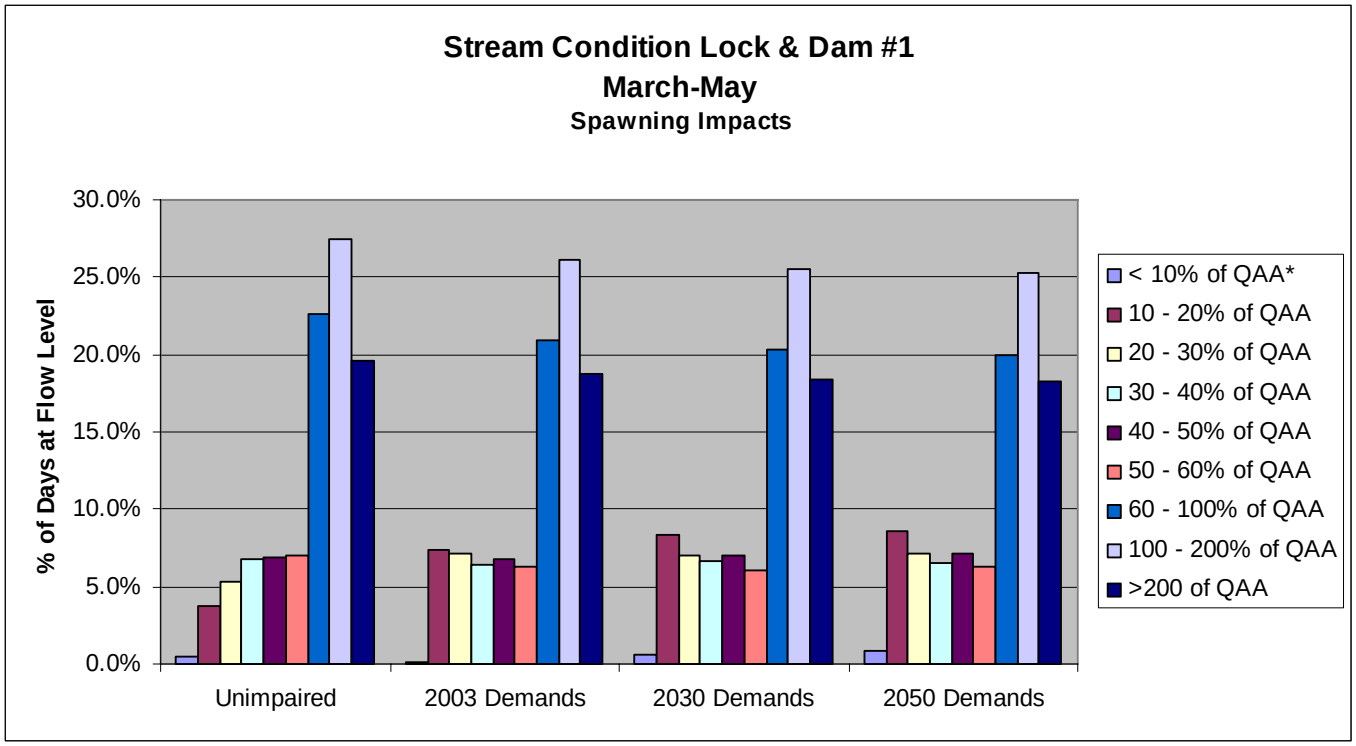
***QAA (average annual flow) at Lock & Dam #2 (Node 790) = 3196 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	3.5%	1.0%	1.4%	1.4%
2	10 - 20% of QAA	11.4%	14.8%	17.6%	17.6%
3	20 - 30% of QAA	11.7%	16.2%	15.6%	16.2%
4	30 - 40% of QAA	8.8%	9.0%	8.1%	8.2%
5	40 - 50% of QAA	7.6%	6.2%	6.3%	6.3%
6	50 - 60% of QAA	6.0%	5.4%	5.4%	5.3%
7	60 - 100% of QAA	17.6%	15.3%	14.5%	14.2%
8	100 - 200% of QAA	19.2%	18.1%	17.5%	17.3%
9	>200 of QAA	14.2%	13.9%	13.6%	13.3%



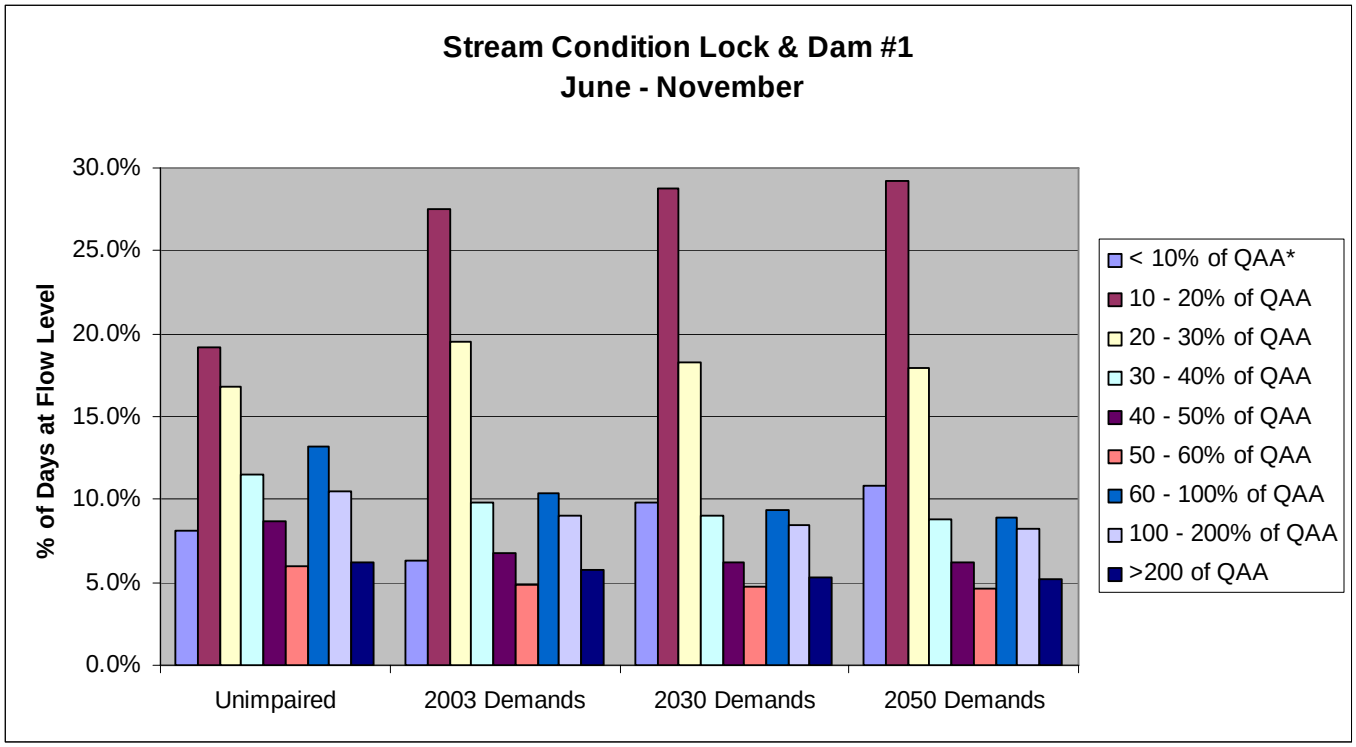
***QAA (average annual flow) at Lock & Dam #1 (Node 820) = 3654 mgd**

Level	Dec-Feb	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.3%	0.3%	0.4%	0.5%
2	10 - 20% of QAA	1.9%	3.2%	4.0%	4.1%
3	20 - 30% of QAA	5.5%	6.5%	6.9%	7.6%
4	30 - 40% of QAA	6.1%	6.4%	6.7%	6.6%
5	40 - 50% of QAA	6.3%	6.3%	6.6%	6.8%
6	50 - 60% of QAA	6.8%	6.6%	6.8%	7.1%
7	60 - 100% of QAA	23.2%	22.1%	21.0%	20.5%
8	100 - 200% of QAA	29.3%	28.3%	27.7%	27.2%
9	>200 of QAA	20.6%	20.3%	19.9%	19.7%



***QAA (average annual flow) at Lock & Dam #1 (Node 820) = 3654 mgd**

Level	Mar-May	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	0.5%	0.1%	0.6%	0.8%
2	10 - 20% of QAA	3.7%	7.4%	8.3%	8.6%
3	20 - 30% of QAA	5.4%	7.2%	7.0%	7.1%
4	30 - 40% of QAA	6.8%	6.4%	6.6%	6.6%
5	40 - 50% of QAA	6.9%	6.8%	7.0%	7.1%
6	50 - 60% of QAA	7.0%	6.3%	6.1%	6.3%
7	60 - 100% of QAA	22.7%	20.9%	20.3%	20.0%
8	100 - 200% of QAA	27.5%	26.2%	25.5%	25.3%
9	>200 of QAA	19.6%	18.7%	18.4%	18.3%



***QAA (average annual flow) at Lock & Dam #1 (Node 820) = 3654 mgd**

Level	June-Nov	Unimpaired	2003 Demands	2030 Demands	2050 Demands
1	< 10% of QAA*	8.1%	6.4%	9.8%	10.8%
2	10 - 20% of QAA	19.1%	27.6%	28.7%	29.2%
3	20 - 30% of QAA	16.8%	19.5%	18.3%	17.9%
4	30 - 40% of QAA	11.5%	9.8%	9.0%	8.8%
5	40 - 50% of QAA	8.6%	6.7%	6.1%	6.2%
6	50 - 60% of QAA	6.0%	4.8%	4.8%	4.6%
7	60 - 100% of QAA	13.2%	10.4%	9.4%	8.9%
8	100 - 200% of QAA	10.5%	9.0%	8.5%	8.3%
9	>200 of QAA	6.2%	5.8%	5.3%	5.2%