Appendix F

Option Development Process
ARSP Modeling and Analysis
of Lake Levels and River Flows

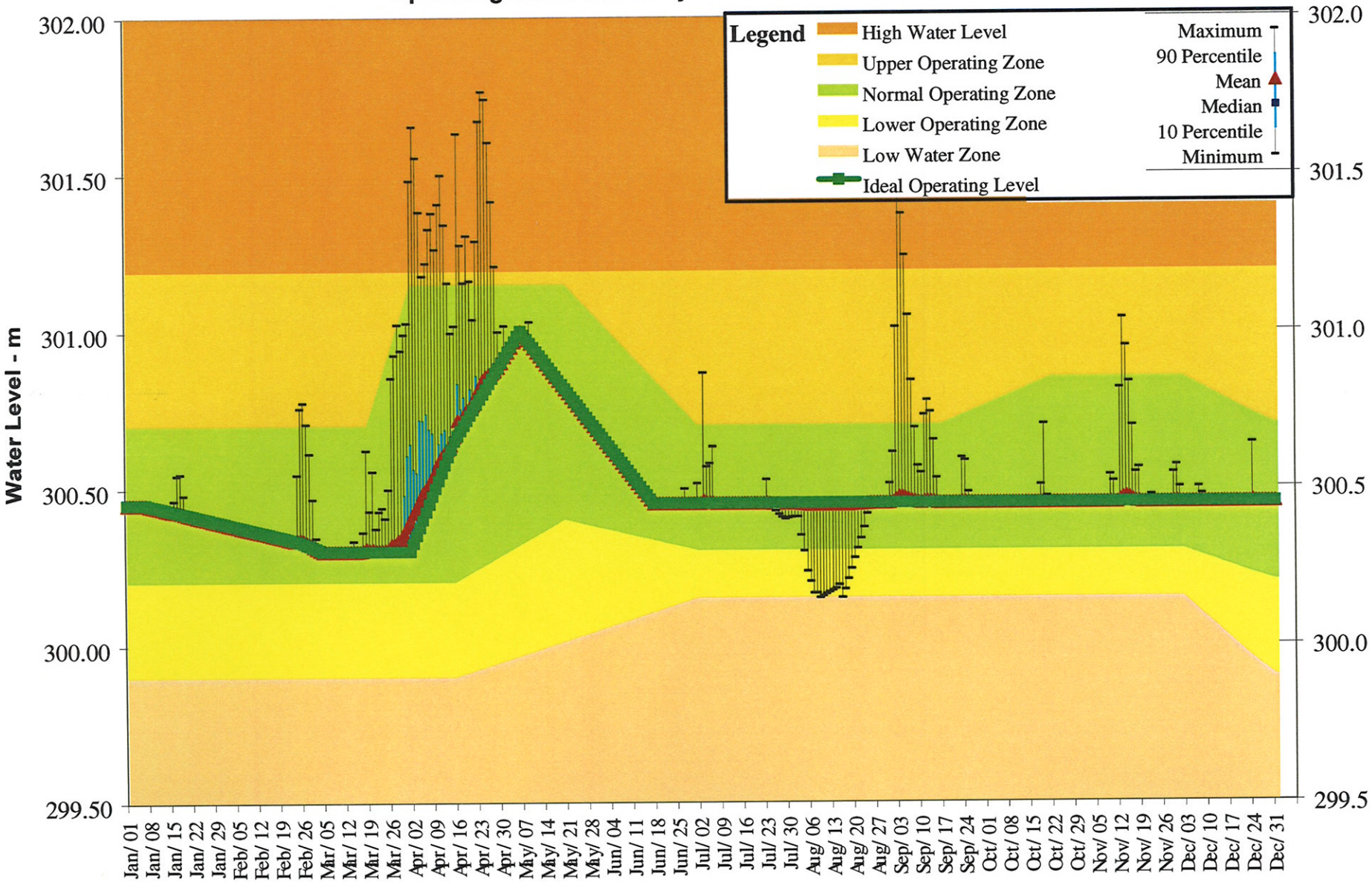
- **ARSP Base Case**
- **ARSP Case One**
- **ARSP Case Two**

Buck Lake

Buck Lake Water Levels

ARSP Simulation Base Case

Operating Rules and Daily Water Level Statistics



Buck Lake Water Levels
ARSP Simulation Base Case

Peak Water Levels	
HWZ	301.19
No of Days in Exceedance	35
No of Years Exceeded	12
Maximum WL	301.77

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	300.90
Date of peak	30-Apr
Tolerance	0
Tolerated WL	300.90
Date tolerated exceeded	30-Apr

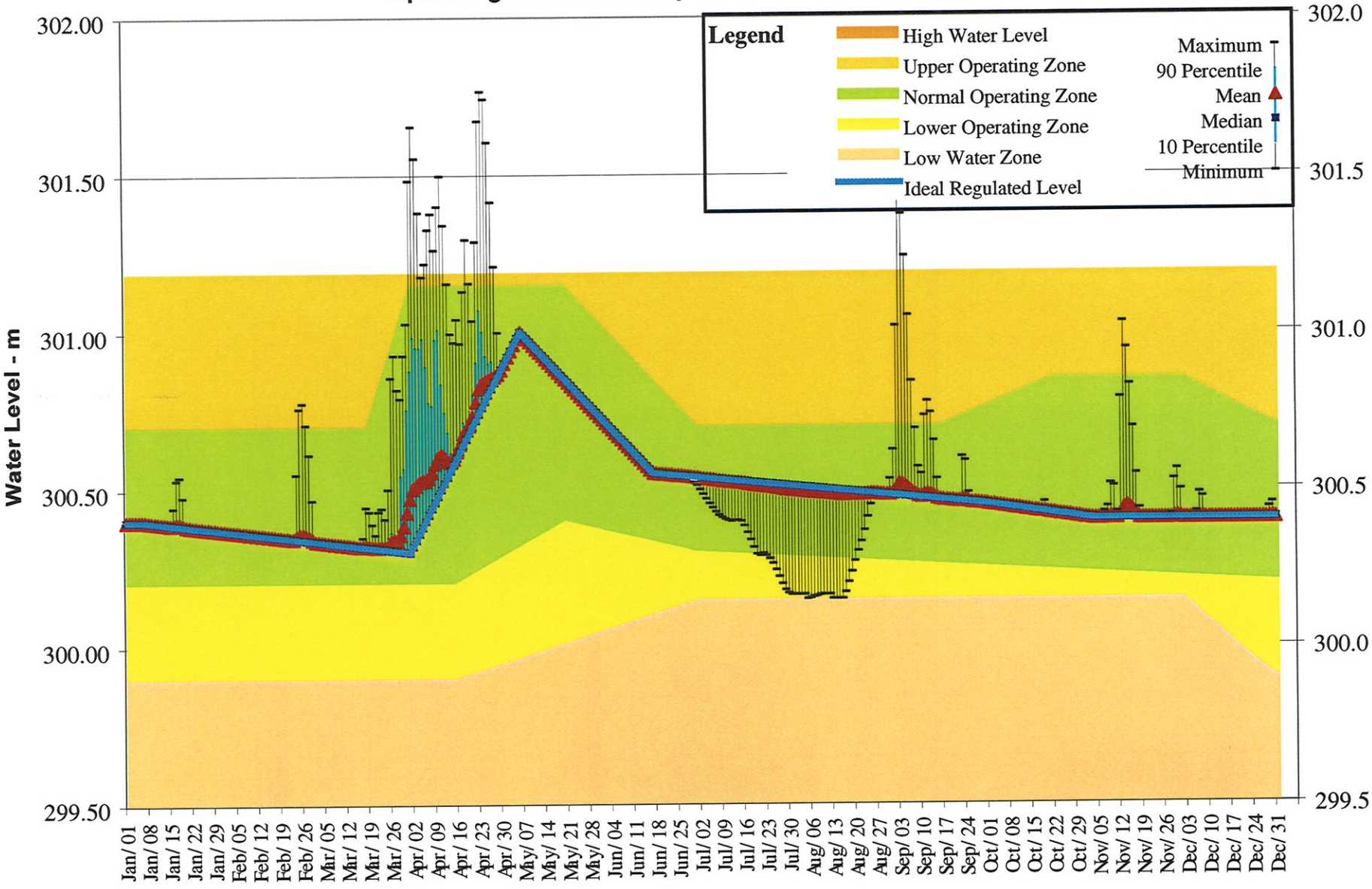
Summer recreation levels Jun-15 to Sep-30	
90 and 10 percentile range	
Max 90%	300.48
Min 10%	300.45
Range	0.03

Median range	
Max Median	300.48
Min Median	300.45
Range	0.03

Buck Lake Water Levels

ARSP Simulation Proposed Case 1

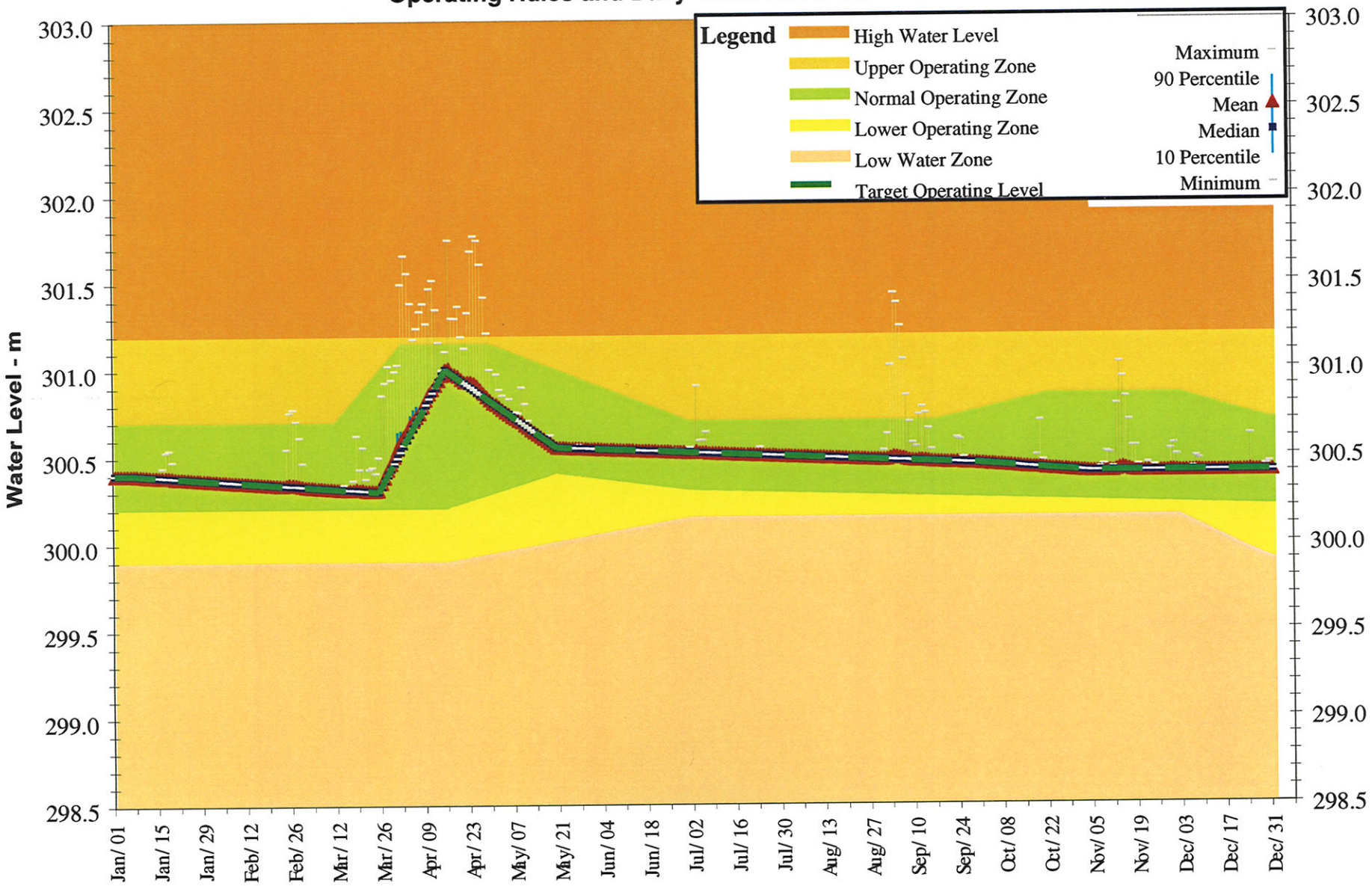
Operating Rules and Daily Water Level Statistics



Buck Lake Water Levels

ARSP Simulation Case 2

Operating Rules and Daily Water Level Statistics



Buck Lake Water Levels
ARSP Simulation Case 2

Peak Water Levels	
HWZ	301.19
No of Days in Exceedance	38
No of Years Exceeded	13
Maximum WL	301.77

Time of spring peak levels before April 30	
Percentile	0.90
Peak percentile WL	301.01
Date of peak	16-Apr
Tolerance	0
Tolerated WL	301.01
Date tolerated exceeded	16-Apr

Summer recreation levels Jun-15 to Sep-30

90 and 10 percentile range

Max 90%	300.53
Min 10%	300.45
Range	0.08

Median range

Max Median	300.53
Min Median	300.45
Range	0.08

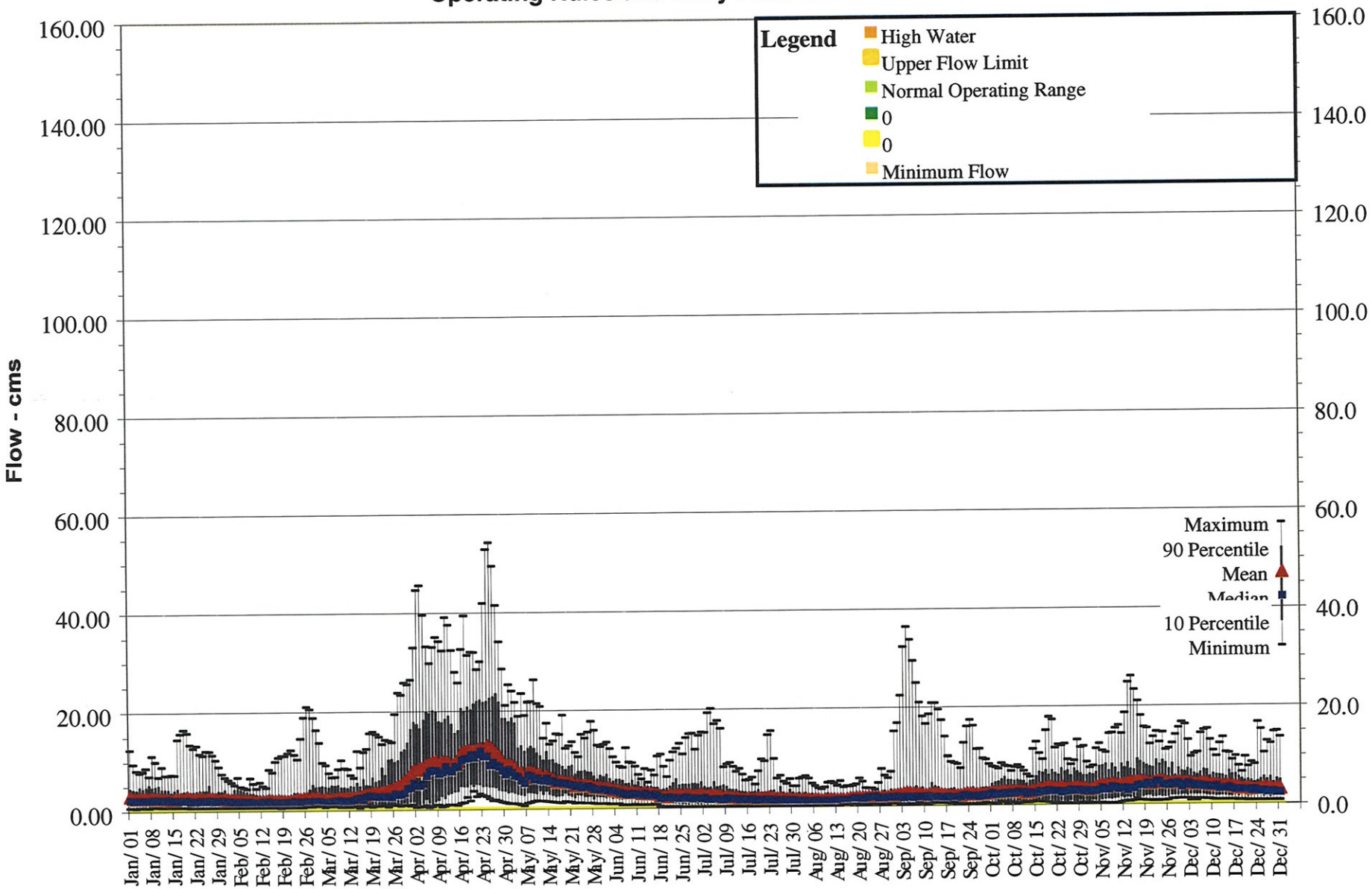
Spring Peak Water Level

Maximum - 50 yr Average	301.11
Date - 50 yr Average	15/Apr
Summer Average Level	300.50

Buck River below Buck Lake

ARSP Simulation Base Case

Operating Rules and Daily Flow Statistics



Flow Evaluation

Yellow cells indicate values that can be changed for analysis

Buck River below Buck Lake
ARSP Simulation Base Case
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow 0 m³/s Achieved #N/A of time

No of days above minumum flow

First half of season

Min	25	days
Avg	25	days
Years Provided	100%	

Last half of season

Min	24	days
Avg	24	days
Years Provided	100%	

For whole season

Min	49	days
Avg	49	days
Years Provided	100%	

From flow duration curve

%	Flow		*No of days*			
99%	1.28	m³/s	*min flow is achievd*		90%	*percentile peak flow*
95%	2.17	m³/s	49	days	15	m3/s

Summer Minimum 7-day Flow

	Maximum	1.58	m³/s
	Minimum	0.20	m³/s
90%	Percentile	1.27	m³/s
10%	Percentile	0.41	m³/s
	Median	0.81	m³/s
	Mean	0.83	m³/s

Maximum Flows

Regulatory Flood Outflow		No of years exceeded
25	m³/s	21

Minumum Flows

Min Daily flow		*7-day minimums*			
		2	10	20	return period
		-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.19	m³/s	0.75	0.41	0.36	m³/s

Summer Fluctuations

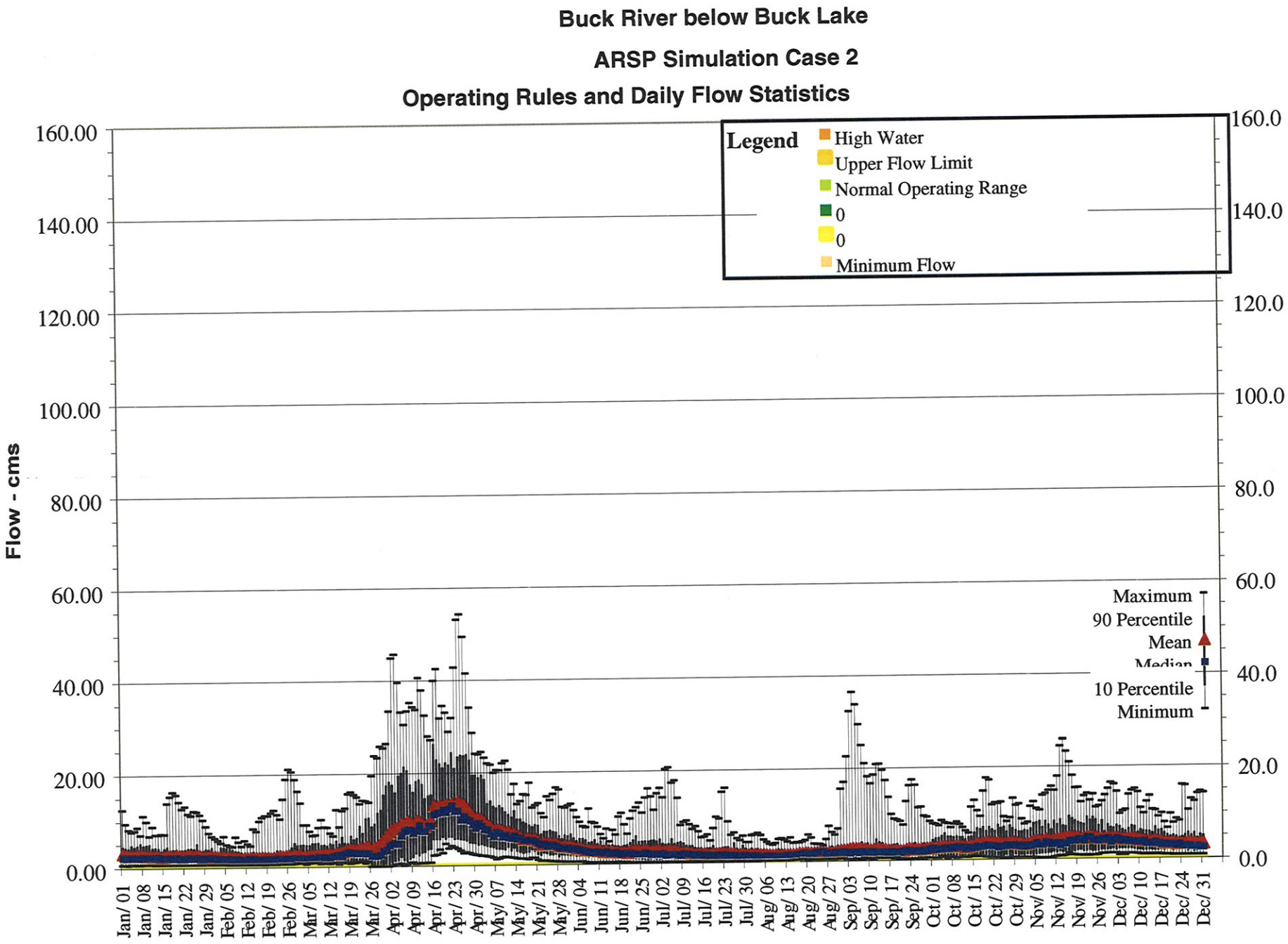
Delta Flow	Average number of daily flow fluctuations per year		
1	10.80		
3	1.32		
5	0.34		
>0.794	14.94	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer	winter	summer	winter
m³/s	m³/s	m³/s	m³/s
2.14	2.73	0.78	0.29

Power Generation

	Quarter					
	1	2	3	4	Annual	
Flow	2.80	6.49	1.95	3.62	3.71	m³/s


Buck River below Buck Lake
ARSP Simulation Case 2
Operating Rules and Daily Flow Statistics
Legend
High Water
Upper Flow Limit
Normal Operating Range
0
0
Minimum Flow
Maximum
90 Percentile
Mean
Median
10 Percentile
Minimum
Flow - cms
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Jan/ 01
Jan/ 08
Jan/ 15
Jan/ 22
Jan/ 29
Feb/ 05
Feb/ 12
Feb/ 19
Feb/ 26
Mar/ 05
Mar/ 12
Mar/ 19
Mar/ 26
Apr/ 02
Apr/ 09
Apr/ 16
Apr/ 23
Apr/ 30
May/ 07
May/ 14
May/ 21
May/ 28
Jun/ 04
Jun/ 11
Jun/ 18
Jun/ 25
Jul/ 02
Jul/ 09
Jul/ 16
Jul/ 23
Jul/ 30
Aug/ 06
Aug/ 13
Aug/ 20
Aug/ 27
Sep/ 03
Sep/ 10
Sep/ 17
Sep/ 24
Oct/ 01
Oct/ 08
Oct/ 15
Oct/ 22
Oct/ 29
Nov/ 05
Nov/ 12
Nov/ 19
Nov/ 26
Dec/ 03
Dec/ 10
Dec/ 17
Dec/ 24
Dec/ 31

Flow Evaluation

Yellow cells indicate values that can be changed for analysis

Buck River below Buck Lake
ARSP Simulation Case
2
Daily Flows Model Results 1951 to 2000

Walleye Spawning

Min Flow 0 m³/s Achieved #N/A of time

No of days above minumum flow

First half of season

Min	25	days
Avg	25	days
Years Provided	100%	

Last half of season

Min	24	days
Avg	24	days
Years Provided	100%	

For whole season

Min	49	days
Avg	49	days
Years Provided	100%	

From flow duration curve

%	Flow		*No of days*			
99%	1.08	m³/s	*min flow is achievd*		90%	*percentile peak flow*
95%	2.06	m³/s	49	days	15	m3/s

Summer Minimum 7-day Flow

	Maximum	1.61	m³/s
	Minimum	0.23	m³/s
90%	Percentile	1.29	m³/s
10%	Percentile	0.43	m³/s
	Median	0.83	m³/s
	Mean	0.85	m³/s

Maximum Flows

Regulatory Flood Outflow

25 m³/s

No of years exceeded

24

Minumum Flows

Min Daily flow

0.00 m³/s

7-day minimums

2	10	20	return period
-yr 7Q2	-yr 7Q10	-yr 7Q20	
0.68	0.38	0.26	m³/s

Summer Fluctuations

Delta Flow	Average number of daily flow fluctuations per year		
1	10.82		
3	1.30		
5	0.36		
>0.80275	14.74	0.5	ratio of summer median

Water Usage

Median Flow		*10% Percentile*	
summer m³/s	winter m³/s	summer m³/s	winter m³/s
2.11	2.70	0.80	0.00

Power Generation

	Quarter				Annual	
	1	2	3	4		
Flow	2.72	6.52	1.97	3.64	3.71	m³/s