

PROPOSED DROUGHT TRIGGER GUIDELINES FOR OKANAGAN MAINSTEM LAKES AND RIVER

Okanagan Basin Water Board Workshop

November 16, 2016

Presenter: Brian Symonds

PRESENTATION OUTLINE

- Hydrology of Okanagan mainstem lakes and river
- Regulation of the mainstem lakes
- Annual inflow forecasts and mainstem management forecasts
- British Columbia Drought Response Plan
- Recommended Okanagan Mainstem Drought Stage Triggers

OKANAGAN MAINSTEM LAKES & OKANAGAN RIVER

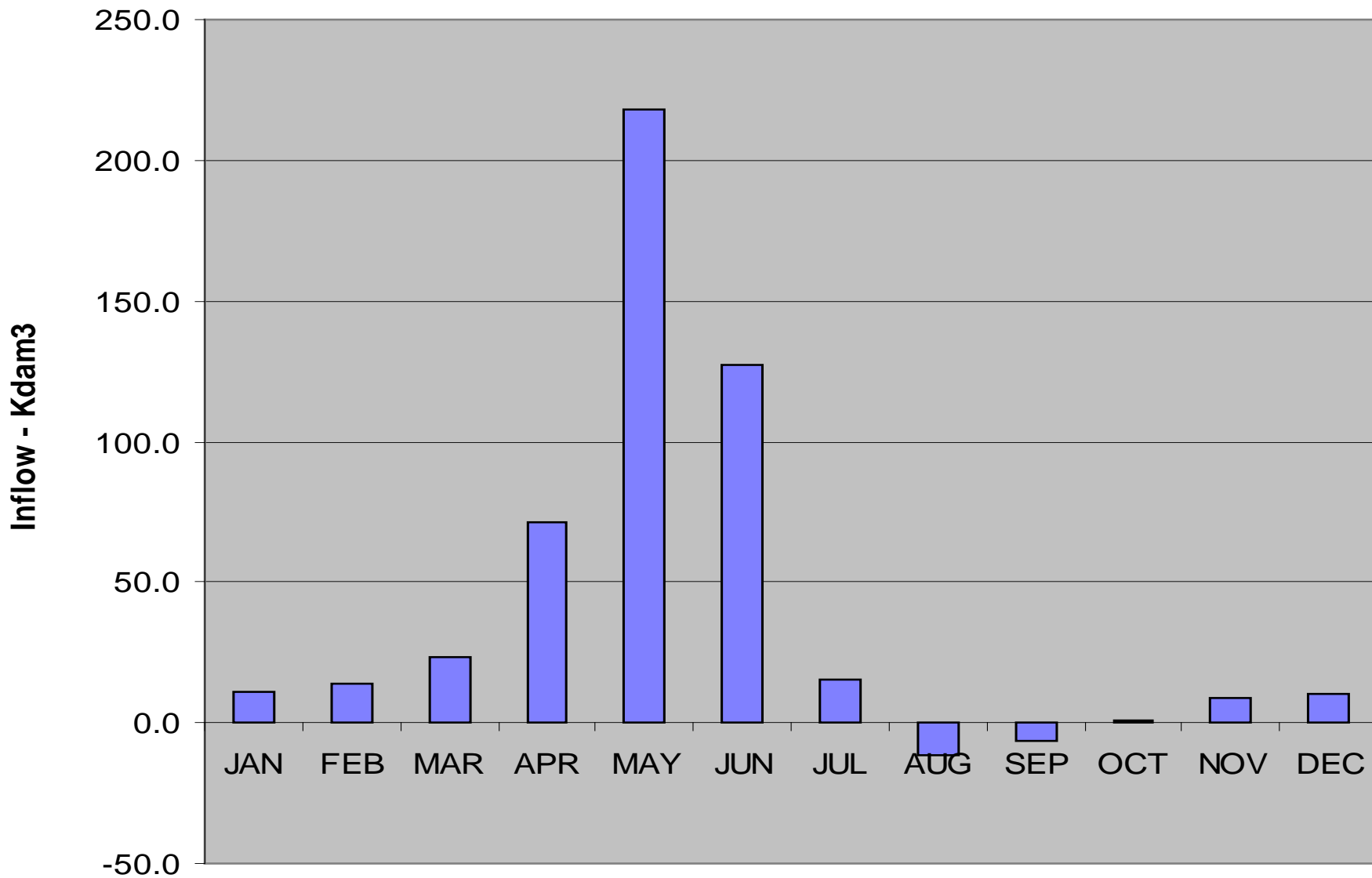


OKANAGAN HYDROLOGY

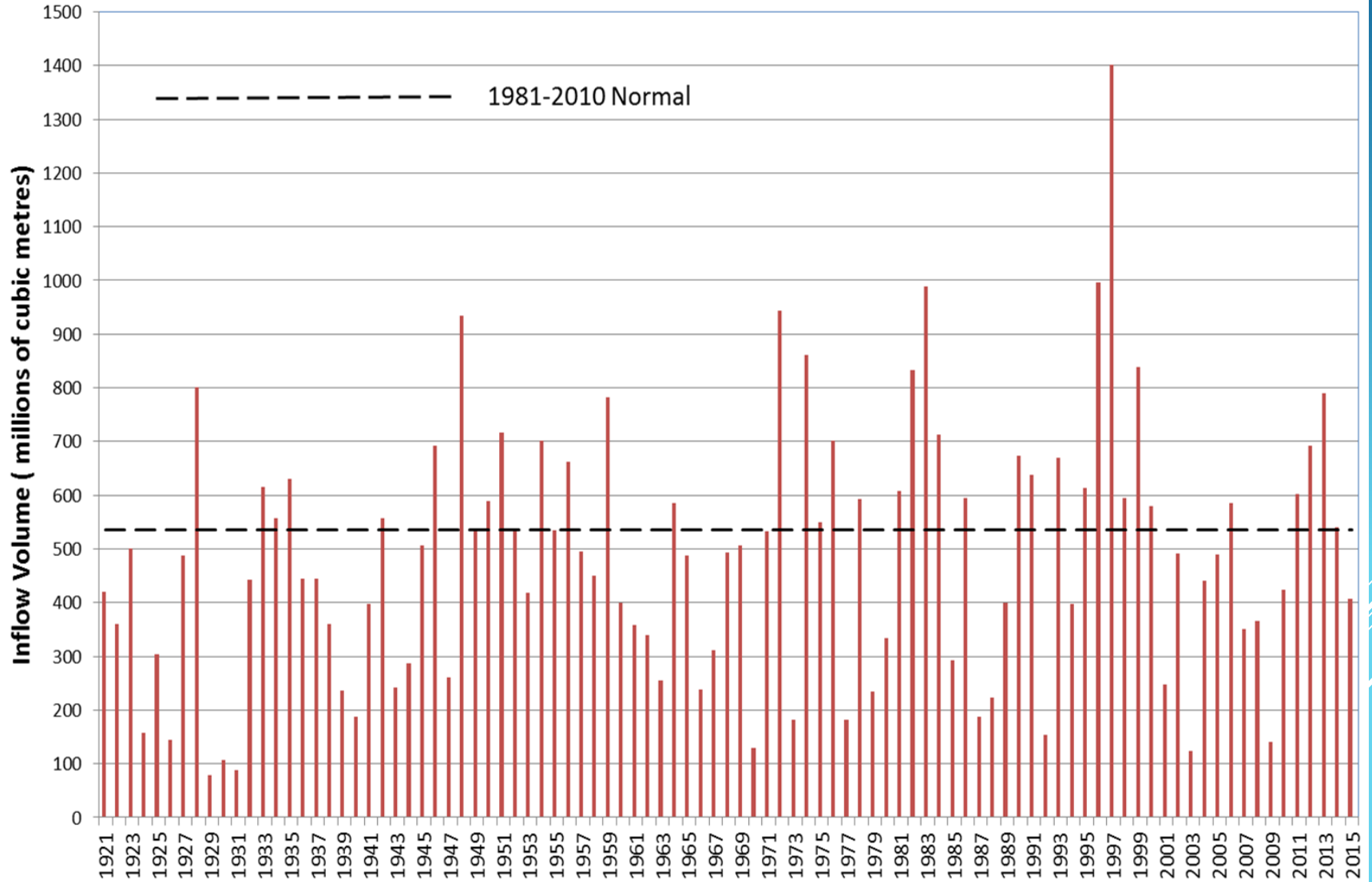


Annual hydrograph dominated by spring snowmelt

OKANAGAN LAKE - NET MONTHLY INFLOWS



Okanagan Lake - Annual Net Inflow Volume (1921 - 2015)



Source: BC River Forecast Centre, Ministry of Natural Resource Operations

REGULATION OF OKANAGAN MAINSTEM LAKES



OKANAGAN BASIN AGREEMENT

“The Comprehensive
Framework Plan”

Provides the general
rules for operating
the Okanagan Lake
Regulation System

MAIN REPORT

of the
CONSULTATIVE BOARD



“to everything there is a season
and a time for every purpose”

including
THE COMPREHENSIVE FRAMEWORK PLAN
prepared under the
CANADA-BRITISH COLUMBIA
OKANAGAN BASIN AGREEMENT
MARCH 1974

REGULATION OF MAINSTEM LAKES

- **Canada – BC Okanagan Basin Agreement** (1974) and the **Comprehensive Framework Plan** for the development & management of Okanagan water resources provides higher level guidance to the management and operation of regulatory works
- Contains specific operational target levels for each of the mainstem lakes and Okanagan River flows
- Framework plan balances competing goals of economic development, environmental quality & social betterment

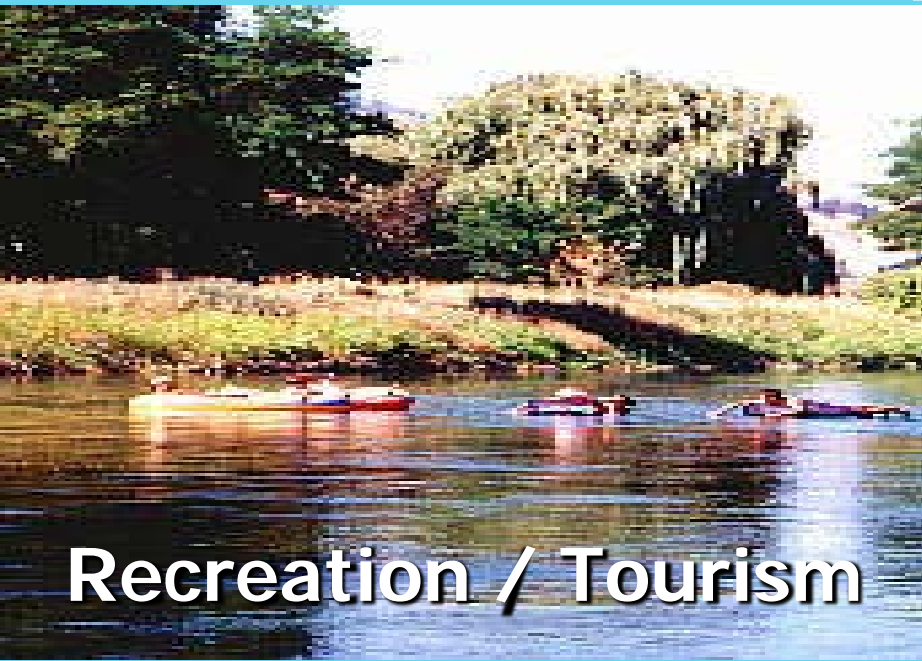


Flood Protection



Water Use Demands

Balance? competing interests



Recreation / Tourism



Environmental Values

OPERATIONAL GOALS INCLUDE:

- Economic Development: flood control, water supply, lakeshore development, tourism
 - Environmental Quality: instream flows for fish, lake levels for shore spawners, other ecosystem values
- 

DROUGHT YEAR SPECIFIC MAINSTEM OPERATING OBJECTIVES

- **Freshet:** Mainstem lakes regulated to maximize the capture and storage of freshet runoff for use later in the year.
- **Summer and fall:** Releases generally kept at or near minimum levels to conserve water supplies to meet environmental and human objectives.
- **Pre-winter:** Lake levels (particularly Okanagan Lake levels) and releases managed to reduce potential for any adverse impacts of current drought year to carry over into next year.

KEY REGULATED OKANAGAN MAINSTEM LAKES

- Kalamalka/Wood Lake
- Okanagan Lake
- Skaha Lake
- Vaseux Lake
- Osoyoos Lake



ANNUAL INFLOW FORECASTS

- BCRFC forecasts net freshet inflow volumes for Kalamalka/Wood & Okanagan Lakes
- Net inflow volumes are forecast for the period from the forecast date to end of July
- Forecast dates : Feb 1, Mar 1, **Apr 1**, May 1 & May 15 (optional)
- Forecasts are updated in-season in response to realtime changing conditions (i.e., snowpacks, streamflows and lake levels, weather, etc.)
- Forecasts inform operational decisions by province and others regarding the use and management of stored water and stream flows

BC DROUGHT RESPONSE PLAN

(Page 7)

- Provides guidance on how to prepare for and respond to hydrologic droughts in BC to assist in ensuring that the water needs of people and aquatic ecosystems are met
- Based on **four drought response levels**:
 - **Level 1:** Conditions normal, sufficient water
 - **Level 2:** Conditions dry, first signs of potential water shortages
 - **Level 3:** Conditions becoming very dry, impacts possible or imminent and may already be occurring
 - **Level 4:** Conditions extremely dry, insufficient water to meet community or ecosystem needs

DROUGHT LEVEL SUMMARY TABLE

Level	Conditions	Significance	Objective	Target
1 (Green)	Normal Conditions	There is sufficient water to meet human and ecosystem needs	Preparedness	Ongoing reductions in community water use
2 (Yellow)	Dry Conditions	First indications of a potential water supply problem	Voluntary conservation	Minimum 10% reduction
3 (Orange)	Very Dry Conditions	Potentially serious ecosystem or socioeconomic impacts are possible	Voluntary conservation and restrictions	Minimum additional 20% reduction to a minimum total of 30%
4 (Red)	Extremely Dry Conditions	Water supply insufficient to meet socio-economic and ecosystem needs	Voluntary conservation, restrictions and regulatory action as necessary.	Maximum reduction
Loss of Supply		Potential loss of a community's potable or fire fighting supply	Emergency response	Ensure health and safety

(Source: "The British Columbia Drought Response Plan" (updated July 2015))

ESTABLISHING DROUGHT STAGES AND TRIGGERS FOR MAINSTEM LAKES



RECOMMENDED MAINSTEM DROUGHT STAGES & TRIGGERS

Given the importance of water stored in the mainstem lakes to the Okanagan water supply outlook, it is **recommended that the triggers for determining drought stages for the mainstem lakes and river be based on the elevation of key lakes** during the critical period of the year.

FACTORS CONSIDERED IN DEVELOPMENT OF PRELIMINARY MAINSTEM DROUGHT STAGE RECOMMENDATIONS

- Drought stages need to be technically defensible
- Triggers should consider historic lake levels
- Information used to determine the stage triggers needs to be readily accessible to and easily understood by all users
- Need to consider both short term objectives and potential impacts of any response actions on the water supply outlook over the longer term
- Stage triggers need to be supported by all users in each applicable area along the mainstem

DRAINAGE AND SURFACE AREAS OF MAINSTEM LAKES

(Page 3)

LAKE	GROSS DRAINAGE AREA (in square kilometres)	SURFACE AREA (in square kilometres)	DAILY CHANGE IN LAKE LEVEL RESULTING FROM 1 m ³ /s CHANGE IN DISCHARGE (in cm/day)
Kalamalka/ Wood	569	35.20	0.245
Okanagan	5980	340.75	0.025
Skaha	6720	20.23	0.427
Vaseux	7150	2.43	3.556
Osoyoos	8275	23.18	0.372

INDICATOR LAKE LEVELS USED TO DETERMINE DROUGHT STAGES FOR DIFFERENT AREAS

Kalamalka/Wood Lake Levels:

Lower Vernon Creek and areas tributary to Kalamalka and Wood Lakes

Okanagan Lake Levels:

Okanagan, Skaha, Vaseux and Osoyoos Lakes, and Okanagan River between Okanagan and Osoyoos Lakes.

OKANAGAN LAKE DROUGHT STAGES



Okanagan Lake Elevations at Month End (in metres GSC)

(Page 10)

Month	Target Elevation	Median	Lower Quartile	Minimum
June	342.44	342.39	342.24	341.83
July	342.24	342.22	342.12	341.75
August	342.04	342.01	341.96	341.62
September	341.89	341.88	341.81	341.46
October	341.84	341.82	341.71	341.39
November	341.84	341.74	341.67	341.34

(Source: WSC Stn 08NM083, Okanagan Lake at Kelowna, Period of Record - 1943-2015, Geodetic datum 340.236 m)

OKANAGAN LAKE PROPOSED DROUGHT TRIGGERS

(Page 10)

Non-drought – Water suppliers would remain at their Normal stage (or no stage if they do not have a Normal stage in their bylaw) year round unless one of the triggers listed below was met.

Stage 1 (green)– The forecast or actual month end elevations of Okanagan Lake at Kelowna for the months June through November are **less than** the month end **target elevations** and **equal to or greater than** the **historic median** month end elevations .

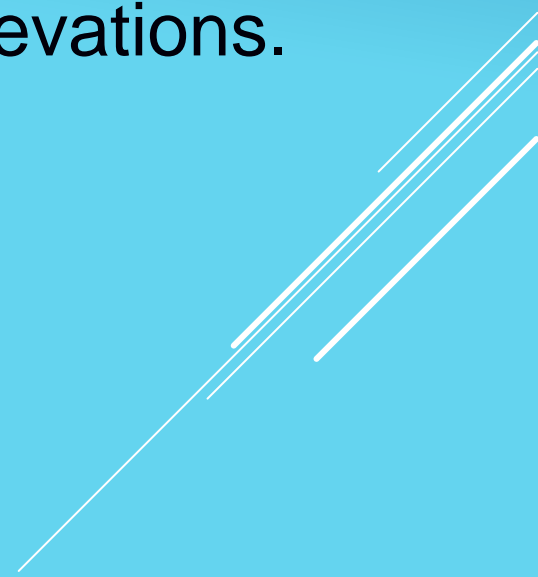
OKANAGAN LAKE PROPOSED DROUGHT STAGES

Stage 2 (yellow) – The forecast or actual month end elevations of Okanagan Lake at Kelowna for the months June through November are **less than the historic median** month end elevations and **greater than or equal to the lower quartile** month end elevations.

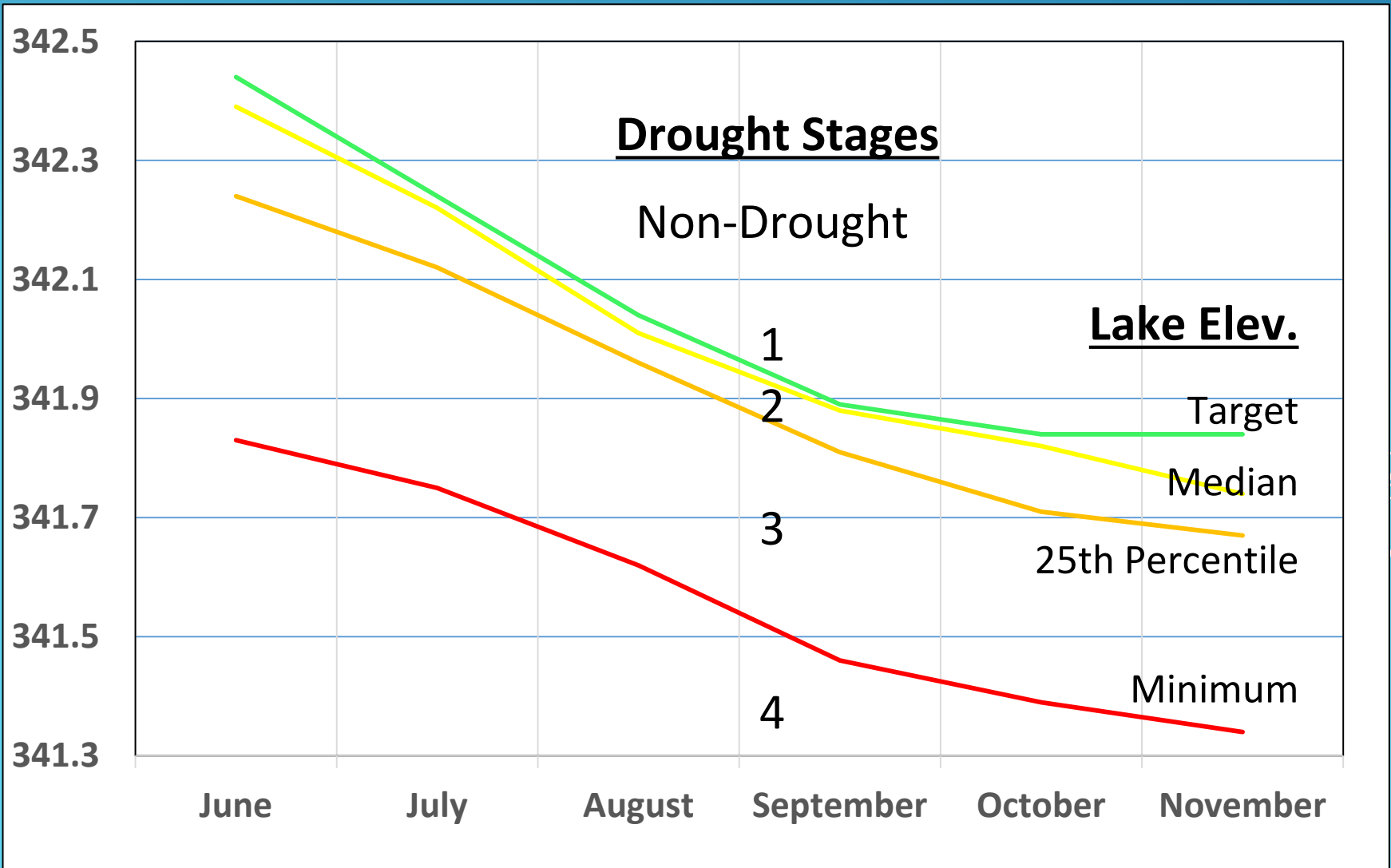
Stage 3 (orange) – The forecast or actual month end elevations of Okanagan Lake at Kelowna for the months June through November are **less than the lower quartile** month end elevations and **equal to or greater than the historic minimum** month end elevations.

OKANAGAN LAKE PROPOSED DROUGHT STAGES

Stage 4 (red) – The forecast or actual month end elevations of Okanagan Lake at Kelowna for the months June through November are **lower than the historic minimum** month end elevations.

A decorative graphic consisting of several parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, located in the lower right quadrant of the slide.

OKANAGAN LAKE PRELIMINARY DROUGHT STAGES



HYPOTHETICAL OKANAGAN LAKE DROUGHT STAGES

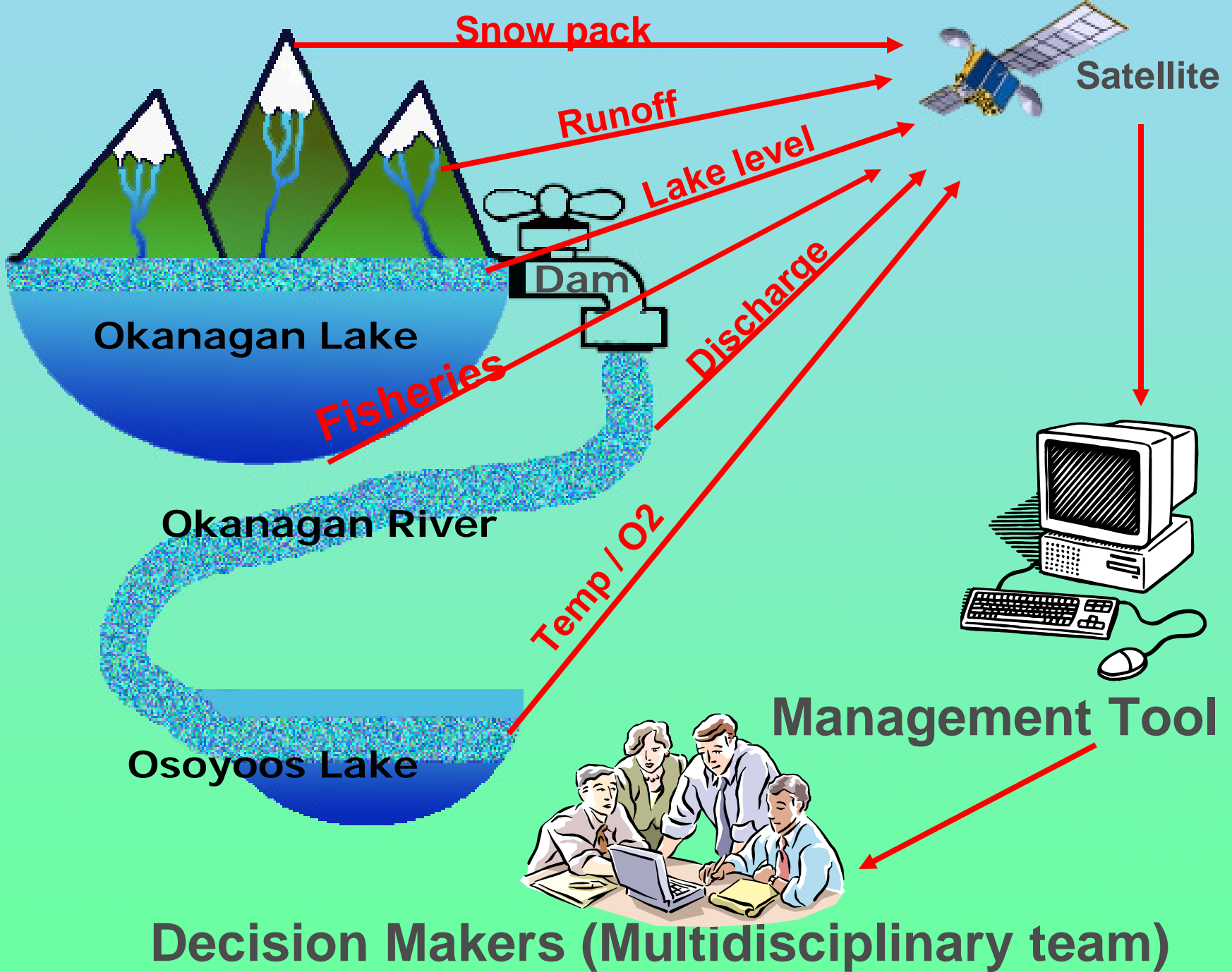
(Above targets = white, Stage 1 = green, Stage 2 = yellow, Stage 3 = orange and Stage 4 = red)

(Page 11)

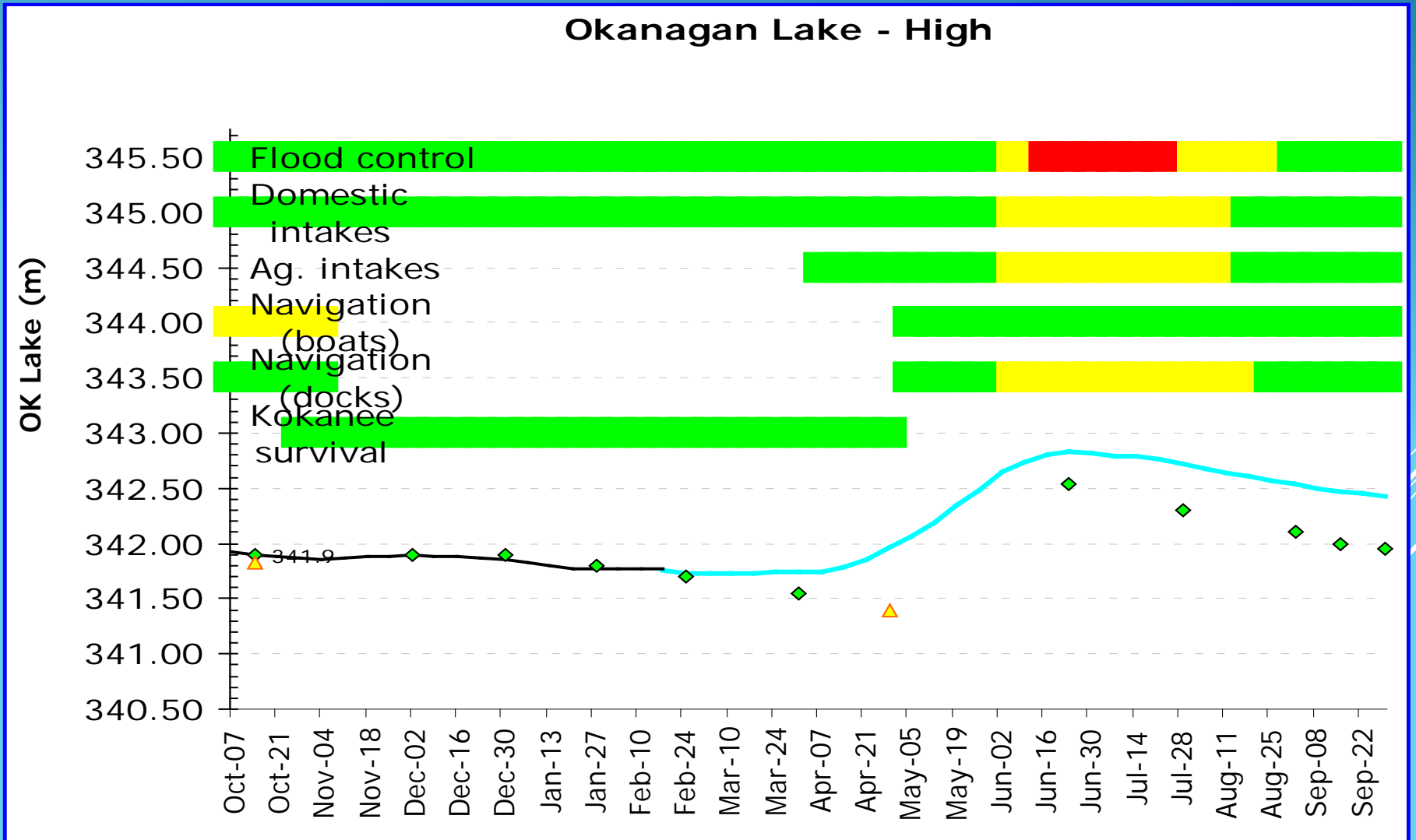
	YEAR / MONTH END ELEVATION (m)									
MONTH	2001	2003	2004	2009	2010	2011	2012	2013	2015	2016
Jun	342.21	342.05	342.23	342.03	342.43	342.56	342.61	342.57	342.25	342.49
Jul	342.12	341.85	342.10	341.92	342.28	342.22	342.33	342.21	342.01	342.29
Aug	341.98	341.62	341.99	341.80	342.04	341.99	342.03	342.02	341.88	342.08
Sept	341.82	341.46	341.87	341.65	341.94	341.83	341.86	341.91	341.74	342.93
Oct	341.71	341.39	341.80	341.55	341.84	341.76	341.78	341.76	341.69	341.93
Nov	341.71	341.34	341.89	341.50	341.77	341.69	341.81	341.83	341.66	

FORECASTING LAKE LEVELS: OKANAGAN FISH/WATER MANAGEMENT TOOL

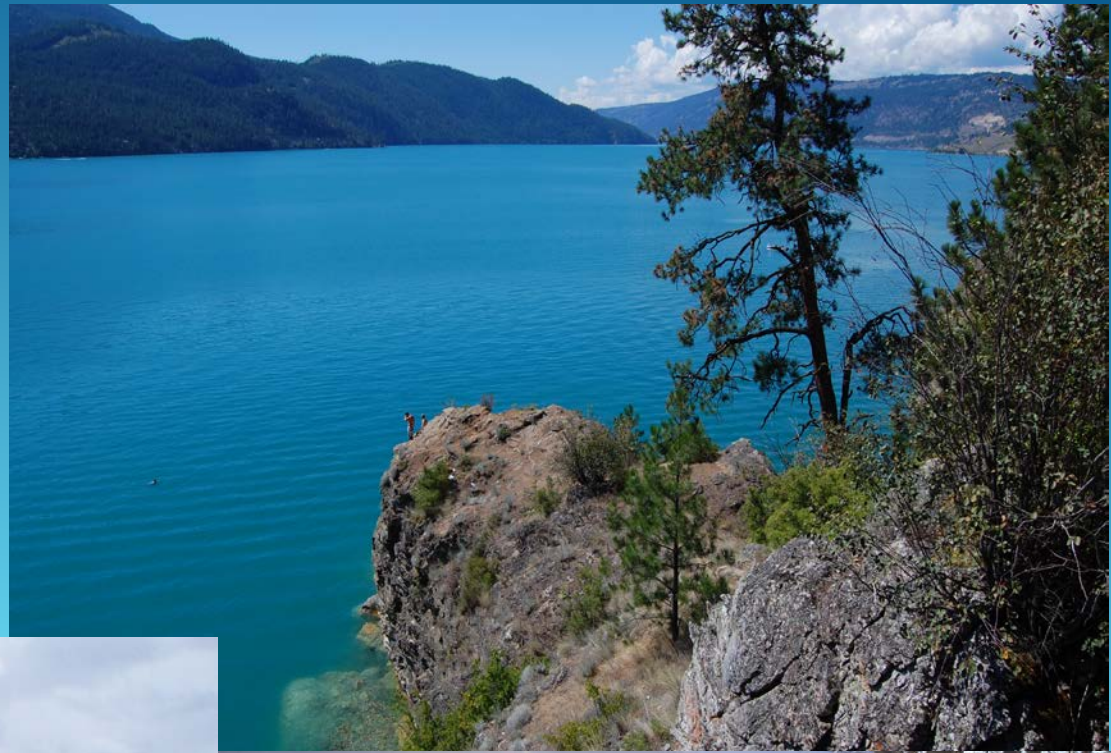
- A web based model developed by a partnership of fishery and water managers to inform and improve the in-season management of water on the mainstem for fishery and other management goals and objectives
- Tool facilitates the sharing of expert knowledge and expertise using real time data to examine the implications of a variety of water release scenarios on the potential to attain the different OLRs management goals and objectives



SAMPLE OUTPUT FROM FWMT:



KALAMALKA/ WOOD LAKE DROUGHT STAGES



Kalamalka Lake Elevations at Month End (in metres GSC)


Month	Target Elevation	Median	Lower Quartile	Minimum
June	391.7	391.68	391.60	391.33
July	391.6	391.60	391.52	391.23
August	391.5	391.50	391.40	391.16
September	391.4	391.43	391.34	391.09
October	391.35	391.39	391.30	391.05
November	391.3	391.38	391.28	391.04

(Source: WSC Stn 08NM143 - Kalamalka Lake at Vernon, Period of Record – 1967-2015 ¹, Geodetic datum 386.122 m)

KALAMALKA/WOOD LAKES PROPOSED DROUGHT STAGES

(PAGE 12)

Non-drought – Water suppliers would remain at their Normal stage (or no stage if they do not have a Normal stage in their bylaw) year round unless one of the triggers listed below was met.

A decorative graphic consisting of several parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, set against a light blue background.

KALAMALKA/WOOD LAKES PROPOSED DROUGHT STAGES

Stage 1 (green) – The forecast or actual month end elevations of Kalamalka Lake at Vernon **for the months June through August** are **less than** the month end target elevations and **equal to or greater than the historic median** month end elevations.

(Note: Stage 1 does not apply during the months **September through November** when the historic median month end elevations exceed the month end target elevations. During these months **whenever** the forecast or actual month end **elevation exceeds the month end target elevation** Kalamalka Lake shall be considered to be at a Non-drought stage.

KALAMALKA/WOOD LAKES PROPOSED DROUGHT STAGES

Stage 2 (yellow) – The forecast or actual month end elevations of Kalamalka Lake at Vernon for the months **June through August** are **less than the historic median** month end elevations and **greater than or equal to the lower quartile** month end elevations,

AND

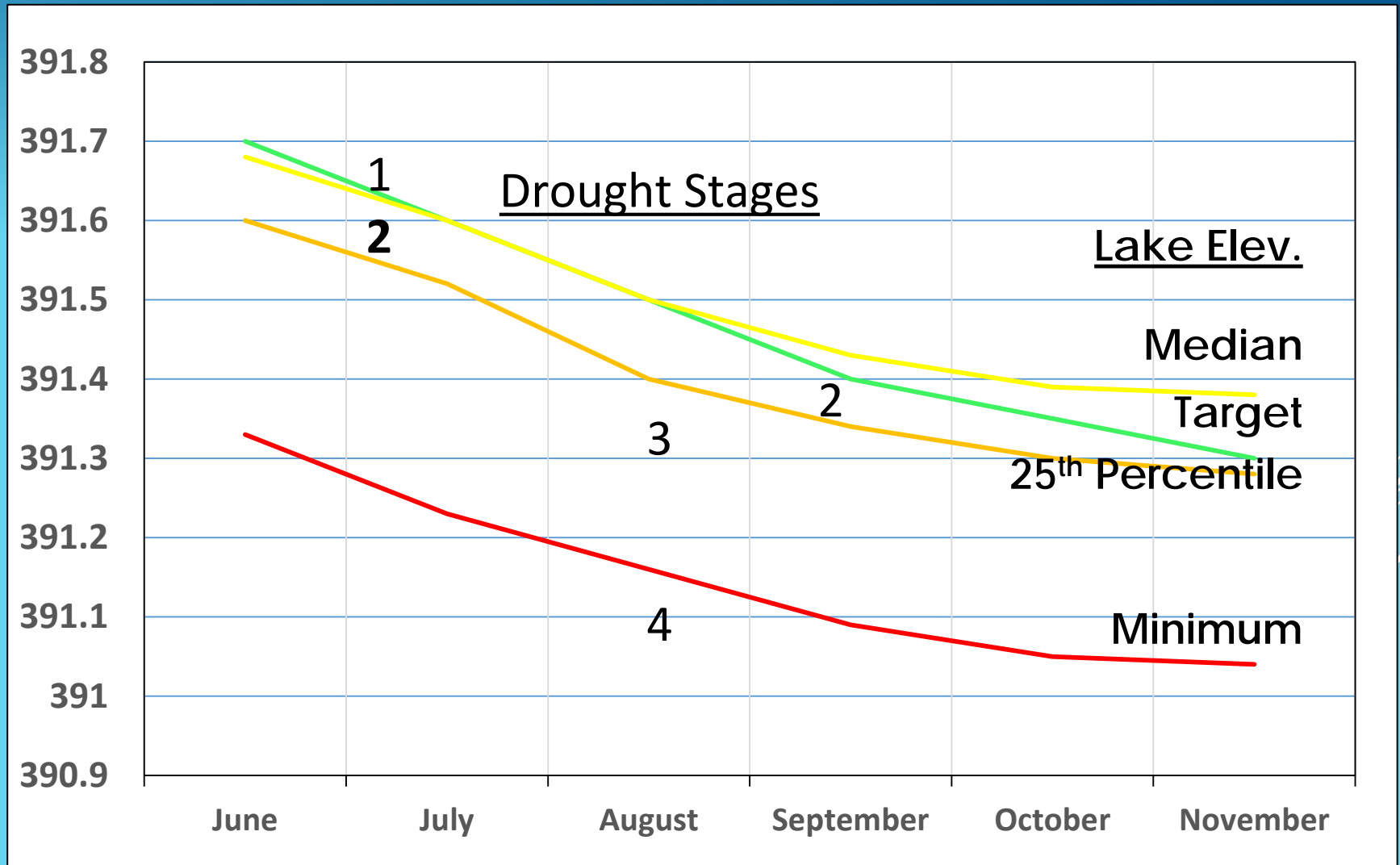
when the forecast or actual month end elevations for the months **September through November** are **less than** the month end **target** elevations and **greater than or equal to the lower quartile** month end elevation.

KALAMALKA/WOOD LAKES PROPOSED DROUGHT STAGES

Stage 3 (orange) – The forecast or actual month end elevations of Kalamalka Lake at Vernon for the months June through November are **less than the lower quartile** month end elevations **and equal to or greater than or equal to the historic minimum** month end elevations.

Stage 4 (red) – The forecast or actual month end elevations of Kalamalka Lake at Vernon for the months June through November are **lower than the historic minimum** month end elevations.

KALAMALKA/WOOD LAKE PRELIMINARY DROUGHT STAGES



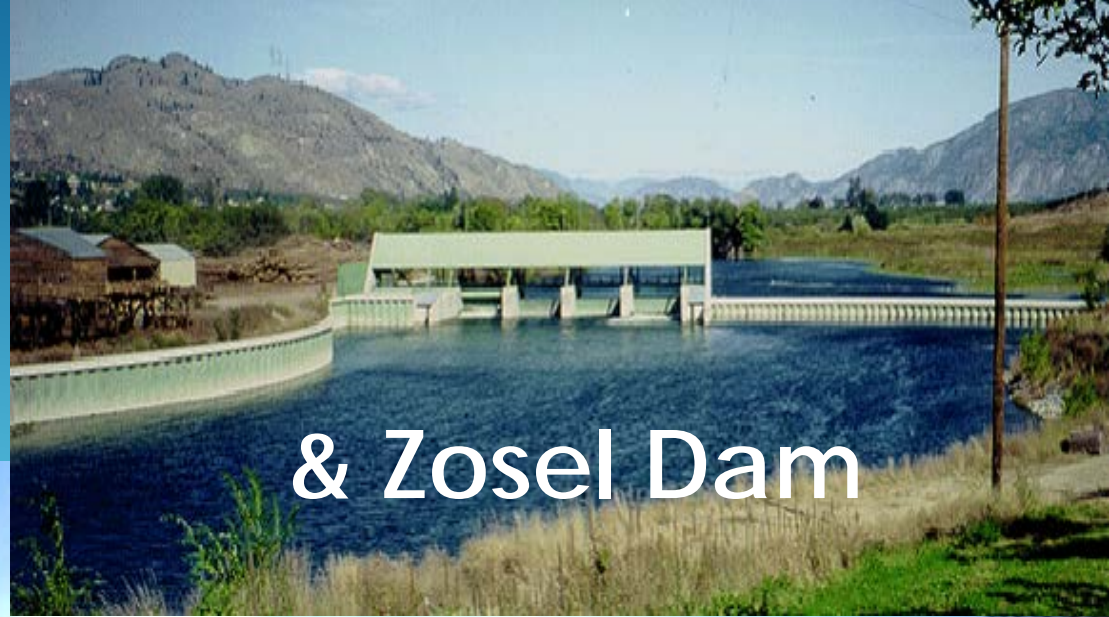
KALAMALKA/WOOD LAKE

HYPOTHETICAL DROUGHT STAGES

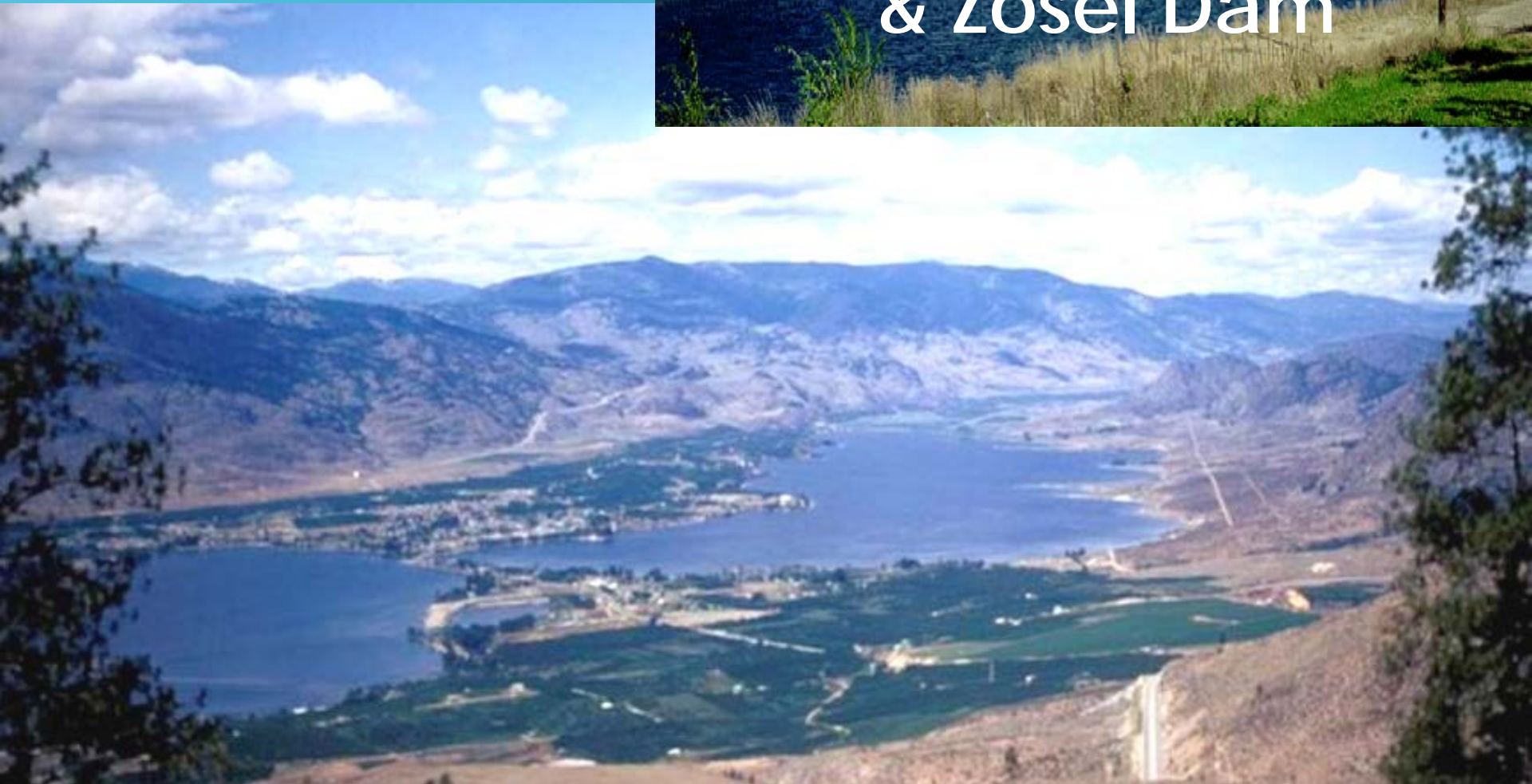
(ABOVE TARGETS = WHITE, STAGE 1= GREEN, STAGE 2 = YELLOW, STAGE 3 = ORANGE AND STAGE 4 = RED)

	YEAR / MONTH END ELEVATION (m GSC)									
MONTH	2001	2003	2004	2009	2010	2011	2012	2013	2015	2016
Jun	391.68	391.49	391.33	391.59	391.59	391.70	391.98	391.83	391.57	391.66
Jul	391.64	391.34	391.23	391.51	391.53	391.64	391.81	391.63	391.43	391.65
Aug	391.56	391.18	391.16	391.41	391.41	391.54	391.52	391.53	391.30	391.50
Sept	391.48	391.09	391.12	391.32	391.36	391.43	391.43	391.47	391.22	391.37
Oct	391.45	391.05	391.10	391.32	391.29	391.41	391.38	391.38	391.21	391.35
Nov	391.43	391.04	391.13	391.30	391.25	391.38	391.37	391.37	391.22	

OSOYOOS LAKE



& Zosel Dam





QUESTIONS ?

**SUPPLEMENTARY
REFERENCE
INFORMATION**

(Appendix A)



Table A-1: Impact of Changes to the Release from Kalamalka Lake on the Levels of Kalamalka-Wood Lake and Okanagan Lake

Change in Release (m ³ /s)	Resulting Change in Lake Level (cm)							
	Kalamalka – Wood Lake Duration of Change (Days)				Okanagan Lake Duration of Change (Days)			
	30	60	90	120	30	60	90	120
0.1	0.7	1.5	2.2	2.9	0.1	0.1	0.2	0.3
0.2	1.5	2.9	4.4	5.9	0.1	0.3	0.4	0.6
0.3	2.2	4.4	6.6	8.8	0.2	0.4	0.7	0.9
0.4	2.3	5.9	8.8	11.8	0.3	0.6	0.9	1.2
0.5	3.7	7.4	11.0	14.7	0.4	0.7	1.1	1.5
0.6	4.4	8.8	13.3	17.7	0.5	0.9	1.3	1.8
0.7	5.2	10.3	15.5	20.6	0.5	1.0	1.6	2.1
0.8	5.9	11.8	17.7	23.6	0.6	1.2	1.8	2.4
0.9	6.6	13.3	19.9	26.5	0.7	1.3	2.0	2.7
1.0	7.4	14.7	22.1	29.5	0.7	1.5	2.2	3.0

Table A-2: Impacts of Changes to the Releases from Okanagan Lake on the Level of Okanagan Lake

Change in Release (m ³ /s)	Change in Lake Level (cm)							
	Duration of Change (days)							
	5	10	15	20	30	60	90	120
5	0.6	1.2	1.9	2.5	3.7	7.4	11.2	14.9
10	1.2	2.5	3.7	5.0	7.4	14.9	22.3	29.8
15	1.9	3.7	5.6	7.4	11.1	22.3	33.5	44.7
20	2.5	5.0	7.4	9.9	14.9	29.8	44.6	60.0
25	3.1	6.2	9.3	12.4	18.6	37.2	55.9	74.5
30	3.7	7.4	11.1	14.8	22.3	44.7	67.0	89.4
35	4.3	8.7	13.0	17.4	26.1	52.1	78.2	104.3
40	5.0	9.9	14.8	19.9	29.7	59.6	89.4	119.2
45	5.6	11.2	16.7	22.3	33.5	67.0	100.6	134.1
50	6.2	12.4	18.6	24.8	37.2	74.5	111.7	149.0

Table A-3: Licensed and Actual Use Volumes for the Okanagan Mainstem Lakes and Basin
Average Water Use During the Period 1996 – 2006

Point-of-Interest	Surface Area of Lake (sq. km)	Annual Offstream Licenced Volume (ML)	July 10 to September 30			August 1 to September 30		
			Actual Water Use (ML)	Water Conserved Under Level 3 Drought Declaration		Actual Water Use (ML)	Water Conserved Under Level 3 Drought Declaration	
				Volume (ML)	Depth on Lake (cm)		Volume (ML)	Depth on Lake (cm)
Kalamalka-Wood Lake	35.2	17,077	5,994	1,798	5.11	4,133	1,240	11.74
Okanagan Lake	348.0	118,353	15,313	4,594	1.32	10,490	3,147	0.90
Okanagan Lake Watershed	348.0	275,125	92,078	27,623	7.94	62,879	18,864	5.42
Okanagan Basin D/S of Okanagan Lake	348.0	48,244	25,424	7,627	2.19	17,282	5,185	1.49
Okanagan Basin Total	348.0	323,369	117,502	35,350	10.16	80,161	24,049	6.91

Table A-4: Licensed and Actual Use Volumes for the Okanagan Mainstem Lakes and Basin Water Use During Drought Year (2003)

Point-of-Interest	Surface Area of Lake (sq. km)	Annual Offstream Licenced Volume (ML)	July 10 to September 30			August 1 to September 30		
			Actual Water Use (ML)	Water Conserved Under Level 3 Drought Declaration		Actual Water Use (ML)	Water Conserved Under Level 3 Drought Declaration	
				Volume (ML)	Depth on Lake (cm)		Volume (ML)	Depth on Lake (cm)
Kalamalka-Wood Lake	35.2	17,077	5,994	2,049	5.82	4,656	1,397	4.00
Okanagan Lake	348.0	118,353	16,865	5,060	1.45	11,446	3,434	0.99
Okanagan Lake Watershed	348.0	275,125	105,159	31,548	9.07	71,090	21,327	6.13
Okanagan Basin D/S of Okanagan Lake	348.0	48,244	28,375	8,513	2.45	19,307	5,792	1.66
Okanagan Basin Total	348.0	323,369	133,834	40,061	11.51	90,397	27,119	7.79