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ENVIRONMENTAL CONSULTANTS INC.
A Member of the Associated Engineering Group of Companies

International Joint Commission
Osoyoos Lake Plan of Study: Studies 7 and 8

In partnership with: POLAR GEOSCIENCE LTD.

Osoyoos Lake Science Forum

September 2011

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International Joint Commission

Study 8 – Review of Methods to Monitor Channel Capacity in the Okanogan River downstream of Osoyoos Lake

In partnership with: POLAR GEOSCIENCE LTD.

Osoyoos Lake Science Forum

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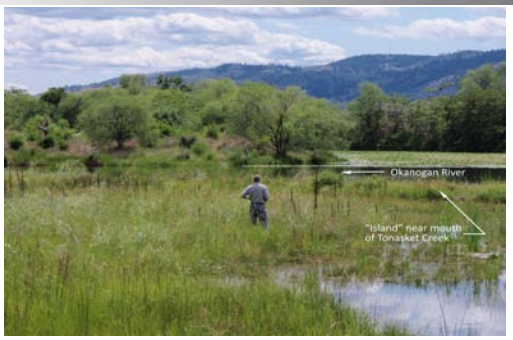
Obligations

Condition 4 (Suppl. Orders 1985:

- Ensure Okanogan River channel can pass 2,500 cfs when Osoyoos Lake is at 913 feet (and no backwater from Similkameen)

Okanogan River at the outlet of Osoyoos Lake

The Issue



Tonasket Creek fan – high sedimentation area

Objectives

- Part One: assess the current river monitoring program and other monitoring options. Determine whether changes are warranted.
- Part Two: Provide recommendations if necessary.

Okanogan River at the outlet of Osoyoos Lake

Current Monitoring System

- Compare river discharges and lake levels to confirm 2,500 cfs remains possible at 913 feet.
- Survey 4 river cross-sections if 5 consecutive years pass without verification from step 1; and conduct hydraulic modelling (eg HEC-RAS) to confirm measurements
- Survey cross-sections every 10 years regardless of conditions.

Recommendations

- Continue current program, with refinements to reduce risk of missing channel changes
- Refinements include:
  - Cross-section survey resolution should be standardized.
  - Add a comprehensive river survey between the Osoyoos Lake outlet and Zosel Dam every 20 years
  - Calibrate the hydraulic model during a high flow event.
  - Periodic site and aerial photo review of key channel features to monitor changes in morphology and vegetation.
  - Creation of capacity for real-time monitoring of Tonasket Creek and the Osoyoos Lake outflow during high flow events.

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Study 7 - An Investigation of Factors Controlling Osoyoos Lake Water Levels During High Water Periods

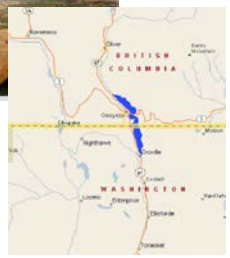
In partnership with: POLAR GEOSCIENCE LTD.

Osoyoos Lake Science Forum

September 2011

Outline

1. Background
2. Objectives
3. Factors causing high lake levels
4. Could the dam be operated better to reduce high levels
5. Recommendations



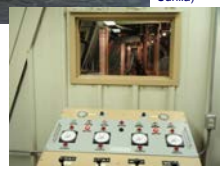
Zosel Dam – view north from downstream of the dam

Background

- Osoyoos Lake water levels are managed according to International Joint Commission (IJC) Orders of Approval
- Current Orders expire Feb 2013
- Osoyoos Lake level frequently exceeds the acceptable upper limit during the summer period.

Zosel Dam gates and control room

(Photo: L. Uunila)



Objectives

1. Review the factors causing high water levels on Osoyoos Lake

   Subtext: if there is a dam at the outlet, why does the lake get too high so often?

2. Could Zosel Dam have been operated any better since 1987 to reduce the frequency, magnitude, and duration of high lake levels?

What causes high lake levels?

Levels beyond approved levels only occur during "normal" years.

Why do they occur?

1. Small storage volume within the allowed operating limits
2. High inflows from Okanagan River
3. Backwater from Similkameen River restricts lake outflow

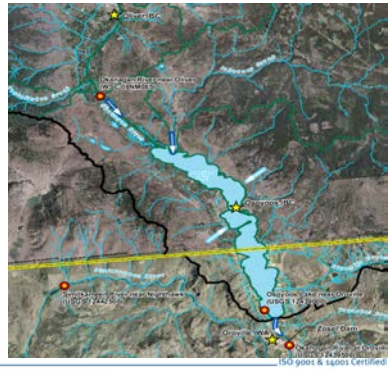
1. Small volume to work with, within the limits set by the Orders of Approval

1. Total lake volume: 272,000 AF

But, in "normal" years: only 3,200 AF within allowed spring/summer range – which is only 6 inches - very little room within the limits

2. High Okanagan River inflow

Okanagan River provides nearly all the inflow to the lake



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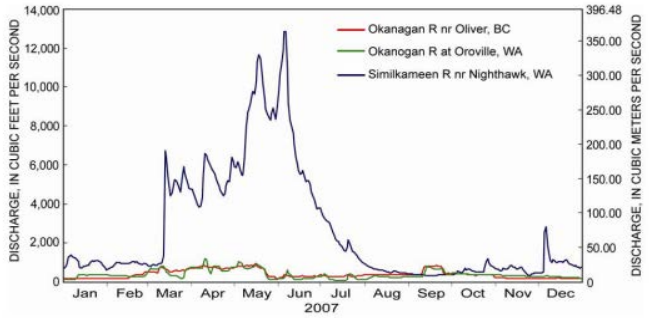
3. Similkameen: flow in spring can be 10 x Okanagan flow



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Similkameen

Flow above 10,000 cfs causes backwater and restricts outflow from the lake

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View upstream from east bank during high inflow and backwater

The small dam is powerless to prevent lake level rise with high inflow and backwater from Similkameen

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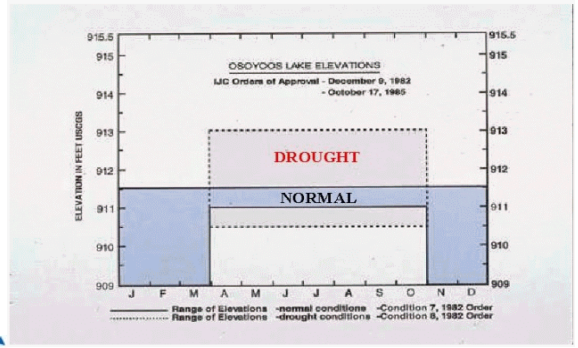
View downstream during high inflow and backwater

Another view upstream from west bank during backwater

Could the dam operators limit these high lake levels?

Lake levels above 912.5 ft cause concern for the shoreline environment and structures.



Could the dam operators limit these high lake levels?

Review of summer lake level ranges:

Average and high flow years = “normal”
Low flow years = “drought”

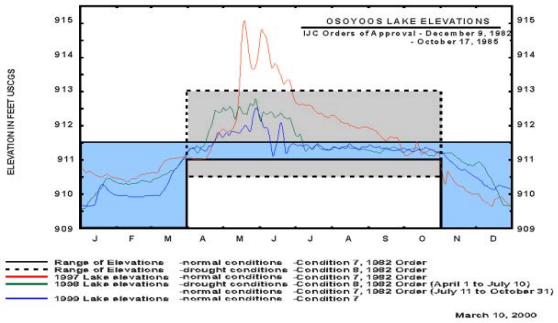
Drought declared if any one of three conditions met:

1. Similkameen spring (April – July) flow less than 1.0 million AF

2. Okanagan River spring (April – July) flow less than 195,000 AF

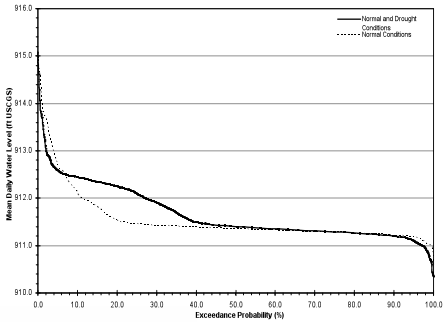
3. Okanagan Lake level (June – July) less than 1122.8 feet

Examples:
1997 (red), 1998 (green), 1999 (blue)



Reminder – very high levels (> 913 feet) occur infrequently

In normal summers; levels exceed allowable maximum 21% of the time, but exceed 913 feet only 4% of the time



When do these problems occur?

From 1988 – 2008 (21 years):

- 12 out of 21 were “normal”

- 9 out of 21 - “drought” was declared (but in 2 years it was subsequently rescinded)

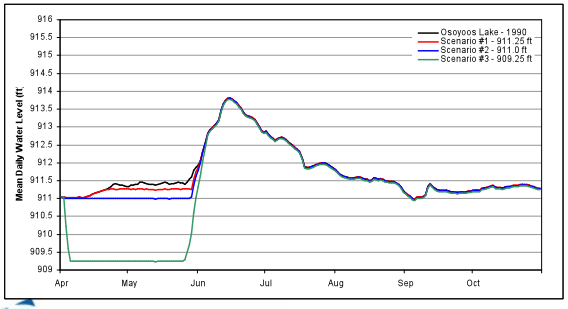
In the “normal” years, the lake went above the allowed range in 10 of those 12 years (83% of years had problems)

But in the drought years – no problems staying in range.

Back to the key question – could the dam operators limits high water levels?

- Created a water balance model to investigate the management of Zosel Dam (thanks to OBWB for data)
- Looked at 5 key high water years – when levels exceeded 912.5 feet – 1990, 1991, 1996, 1997, 1999.
- Ran model to see if spring/summer levels could be reduced ... and the answer is …
- Can delay the onset of high water levels by about a week, but can’t reduce the ultimate height of the high levels reached in these years.

1990: actual = black
modelled = green, blue, red



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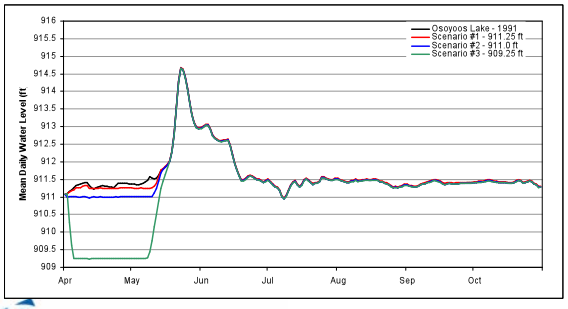
1991: actual = black
modelled = green, blue, red



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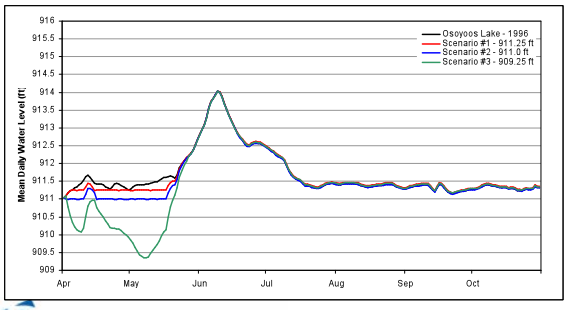
1996: actual = black
modelled = green, blue, red



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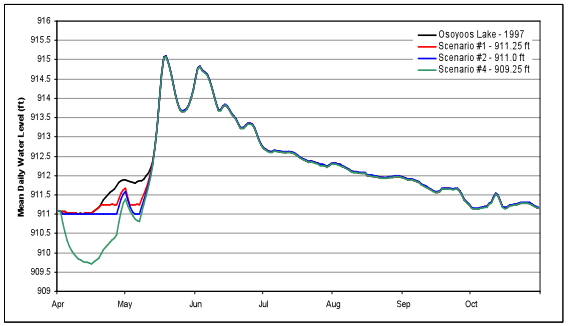
1997: actual = black
modelled = green, blue, red



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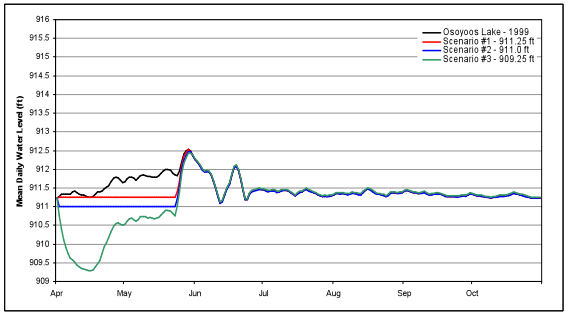
1999: actual = black modelled = green, blue, red



Recommendations

1. Washington State Department of Ecology and B.C. Ministry of Environment continue their informal agreement to keep Osoyoos Lake below 912.5 ft (278.1 m) in drought conditions.
2. Under normal conditions with little chance of drought, Osoyoos Lake should maintain water levels as low as possible – i.e. near 911.0 ft - prior to and during freshet.
3. Due to the major impact of high Similkameen River flows, investigate potential storage options on the Similkameen River.
4. Investigate the potential for managing storage upstream in the Okanagan watershed (eg Okanagan Lake).