FIDS Symposium 2014

The River Bender

Golder Associates

TransAlta

Bow River Simulation Model

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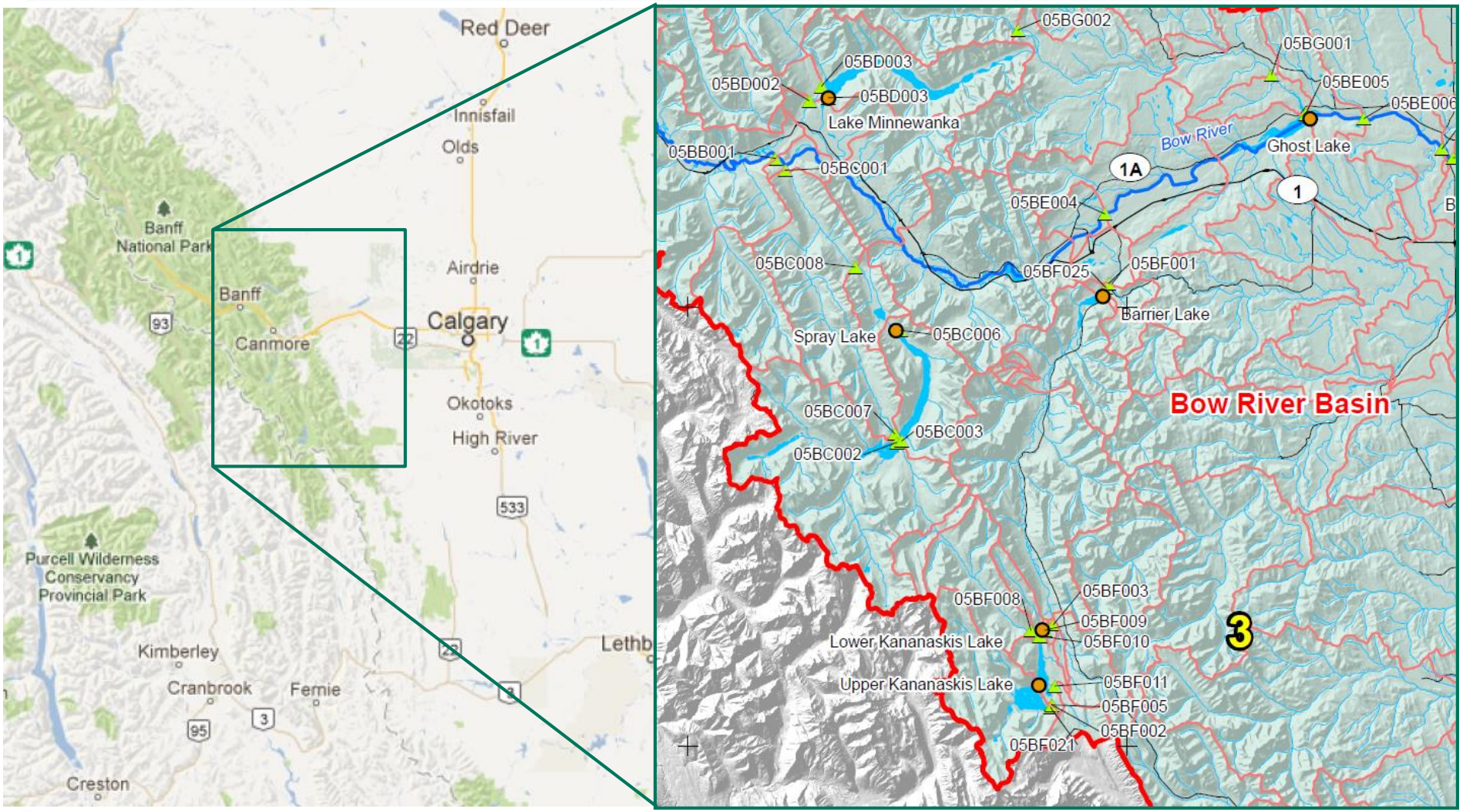
Location



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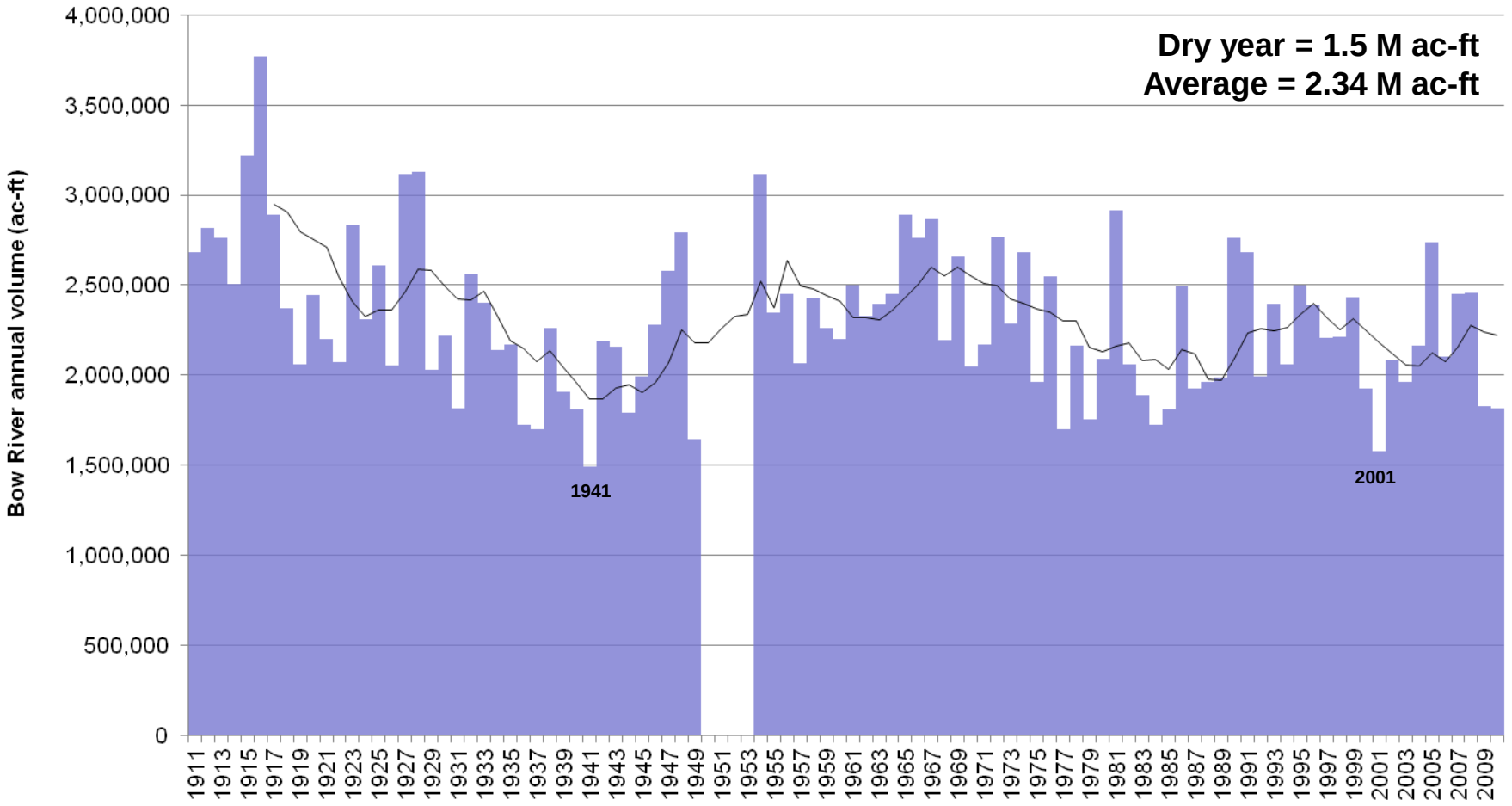
Cumulative Annual Volume - Bow River at Calgary



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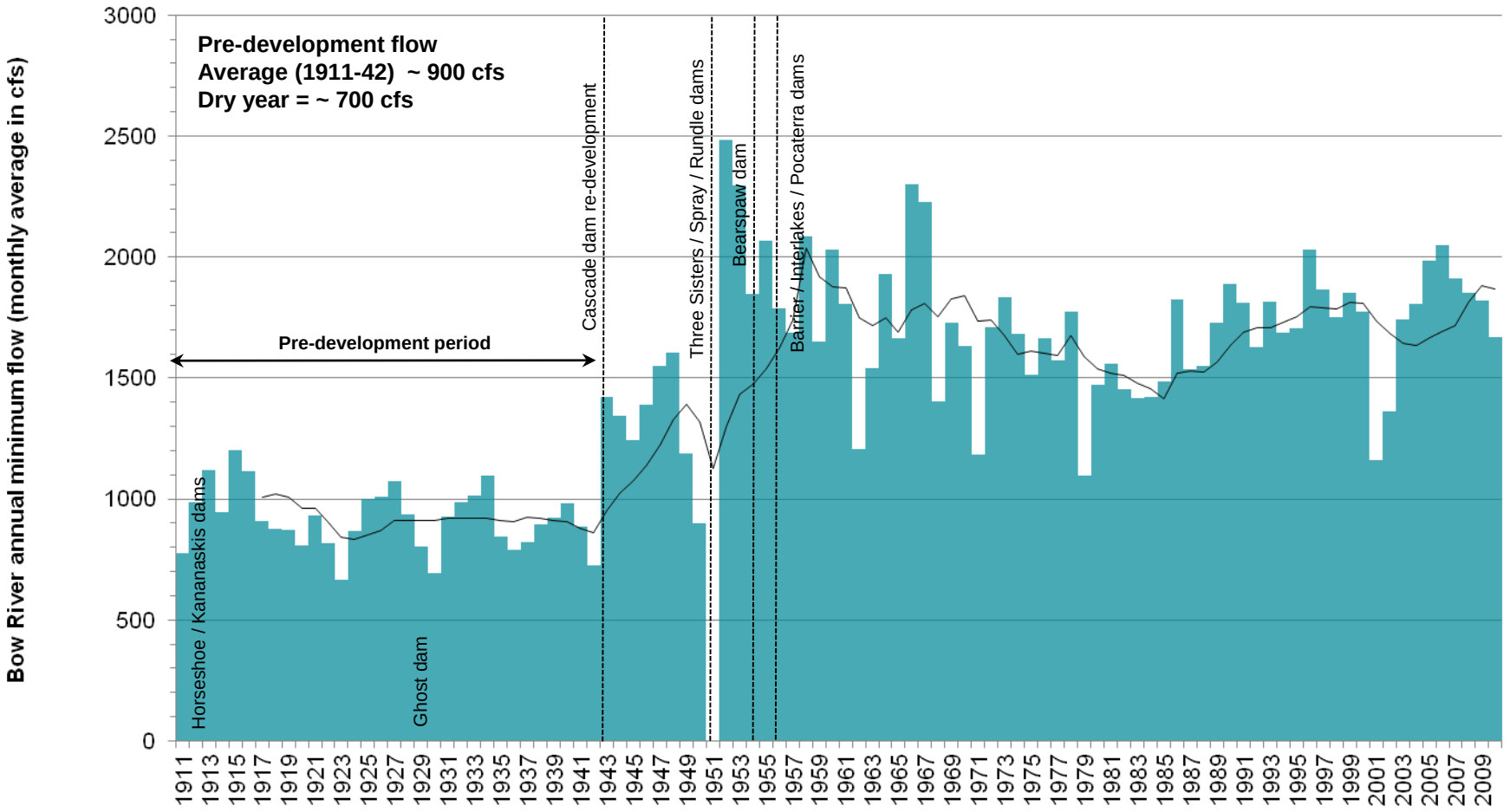
Annual minimum flow - Bow River at Calgary



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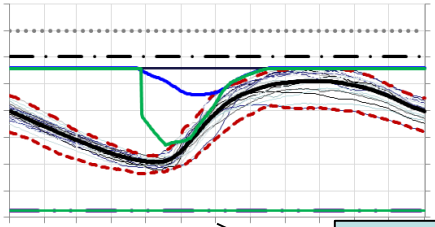
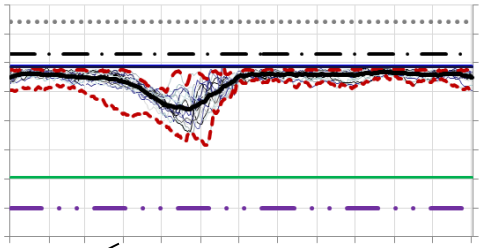
Bow River Reservoirs – Existing Operations

Total active storage = 0.56 M ac-ft
Normal storage variability = 0.30 M ac-ft
Minimum carry-over storage = 0.10 M ac-ft





Cascade
28 MW
180k ac-ft
1400 cfs max

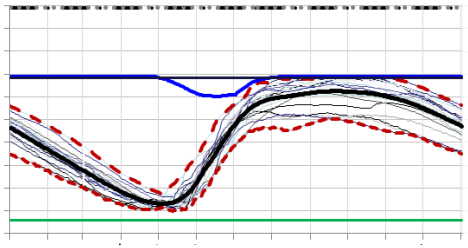
19 MW
0.5k ac-ft
3700 cfs max

15 MW
0.4k ac-ft
3400 cfs max

Bow River → Kananaskis → Horseshoe → Ghost → Bearspaw & Calgary

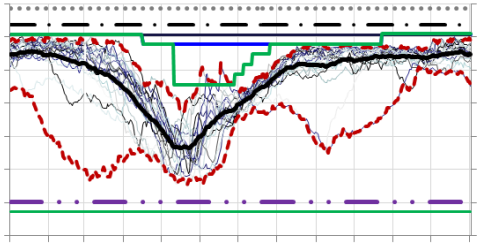
54 MW
57k ac-ft
8600 cfs max

Spray
149 MW
147k ac-ft
1400 cfs max



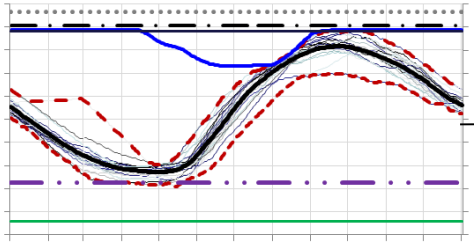
Barrier

11 MW
20k ac-ft
1300 cfs winter
1150 cfs summer



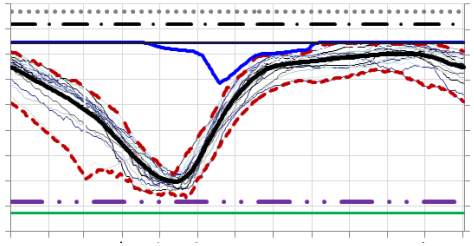
13 MW
51k ac-ft
1100 cfs max

Pocaterra



Interlakes

4 MW
101k ac-ft
680 cfs max



Reported numbers:
1. **MW generation capacity**
2. **ac-ft active storage between LSL and FSL**
3. **cfs max flowby through the power plant**

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Model Interface

Find | Run | Restore Defaults | Golder Associates | TRANSALTA BOW RIVER FLOW AUGMENTATION FEASIBILITY STUDY | TransAlta | Graphs / Outputs | Model Units | Acronyms

INITIAL WATER LEVELS

HELP

Initial comfort: 0.5

ML Initial WL: 1,471.43 — 1473.22

SL Initial WL: 1,691.04 — 1692.49

UK Initial WL: 1,694.70 — 1694.35

LK Initial WL: 1,661.19 — 1666.26

BF Initial WL: 1,370.56 — 1375.61

KF Initial WL: 1279.28

HS Initial WL: 1255.71

GF Initial WL: 1,188.05 — 1191.18

NOTE:
Cick on the HELP or ? buttons for further information about the various interface controls.

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Apurva_Gollamudi@Golder.com

LOWER COMFORT ZONE CURVES

HELP

ML Lower CZ | SL Lower CZ | GF Lower CZ

UK Lower CZ | LK Lower CZ | BF Lower CZ

GATE CONTROLS

Master SG Control — HELP — Master Sluice Gate Control

UK SG Control | BF SS Control

KF RG Control | BF SG Control

KF SS Control | HS GS Control

HS OFS Control | HS SG Control

GF OFS Control | GF SG Control

SLUICE GATE OPERATION RULES

HELP

UK SG Rule | BF SG Rule

GF SG3 Rule | GF SG Rule

FLOOD / DROUGHT RESPONSE RULE

HELP

Ghost Water Level Rule: 0

Bow flood response rule

Normal operation

Emergency release rule

Banff Flow Response Rule | Inflow Response Rule

GRAPHICAL RULES FOR POWERPLANT OPERATIONS

HELP

Casc Emerg Release Rule | Casc Augment Rule | Casc Normal Op Rule | Casc Bow Flood Rule

Qmin Casc Summer cfs: 35

Qmin Poca cfs: 35

Qmin Ghost Summer cfs: 1250

Qmin Casc Winter cfs: 300

Qmin Barr cfs: 35

Qmin Ghost Winter cfs: 1250

Spray Emerg Release Rule | Spray Augment Rule | Spray Normal Op Rule | Spray Bow Flood Rule

Barr Emerg Release Rule | Barr Augment Rule | Barr Normal Op Rule | Barr Bow Flood Rule | Ghost normal rule

Inter Emerg Release Rule | Inter Augment Rule | Inter Normal Op Rule | Inter Bow Flood Rule

Poca Emerg Release Rule | Poca Augment Rule | Poca Normal Op Rule | Poca Bow Flood Rule | Ghost Augment rule

AUGMENTATION RULE CHOICE

HELP

Augmentation Switch

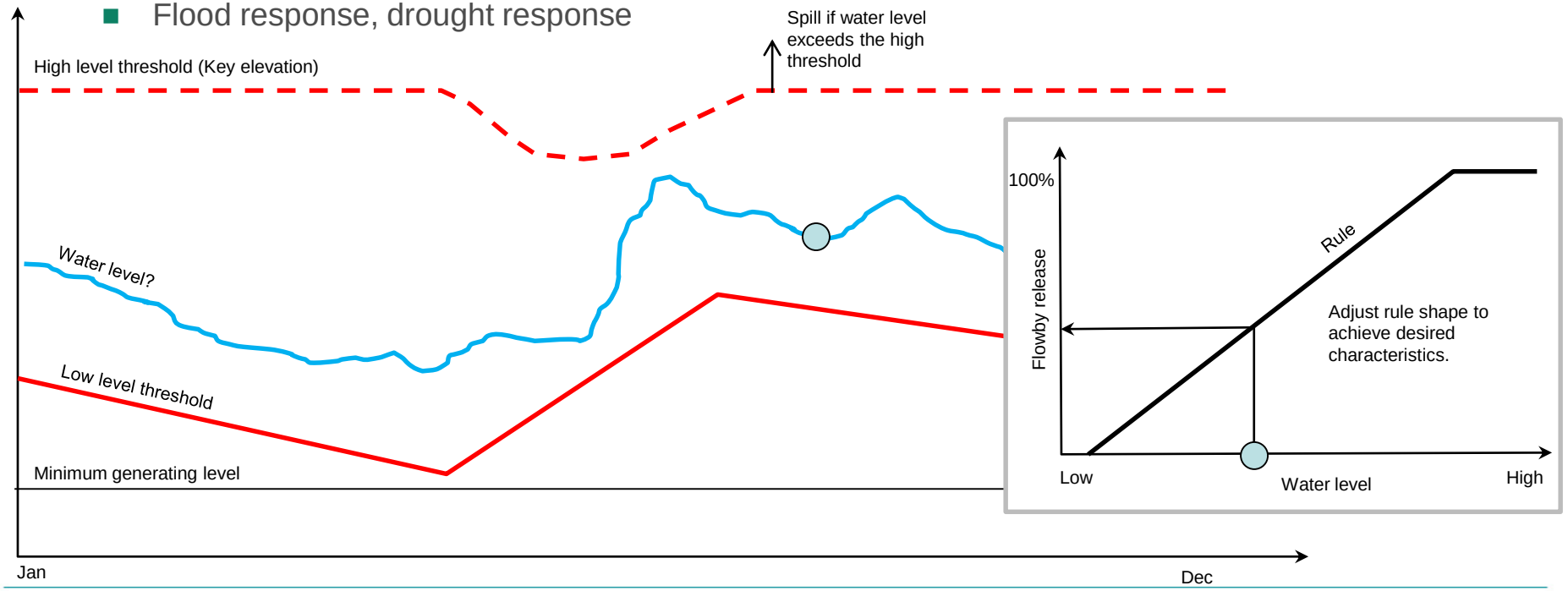
Bassano Flow Trigger cfs: 800 / 750 / 300 / 1200

Augment Start: 4.0 / 6.5 / 1.0 / 12.0

Augment End: 11 / 7 / 1 / 13

Operating Rules

- **iThink (Stella) Simulation Model**
  - Daily inflows (1990-2010), no intra-day peaking.
- **Dynamic rules determine daily release as a function of:**
  - Current reservoir levels (no forecast)
  - Power plant flowby capacity (normal operations and augmentation periods)
  - Spill gates, spillways, stop log operations
  - Flood response, drought response



Bow River Simulation Model

Summer Flow Augmentation

May 30, 2014

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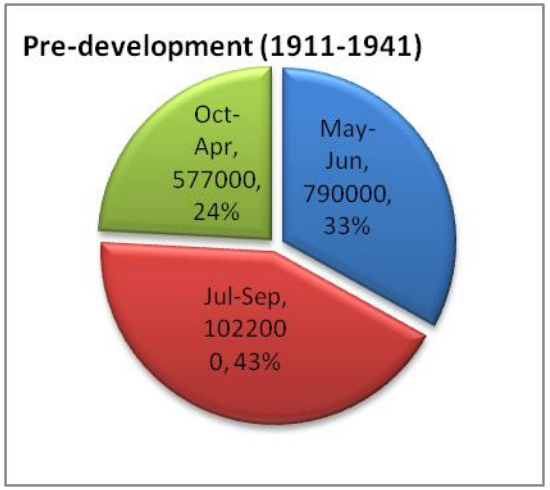
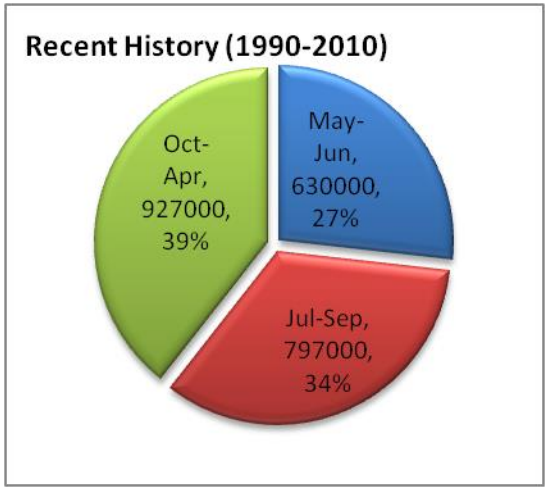
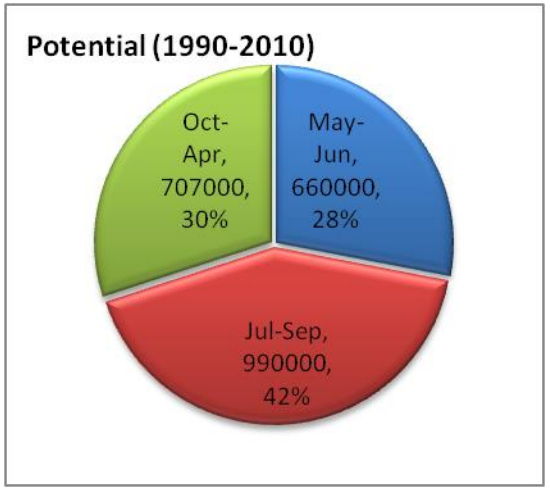
Bow River System Summary

Seasonal release volumes from Ghost Reservoir (ac-ft)







Bow River Storage Characteristics

Average annual cumulative flow volume

- Bow at Calgary	=	2,350,000 acre-ft
- Bow at Banff	=	940,000 acre-ft
- Tributaries upstream of Ghost	=	1,390,000 acre-ft
Total active storage	=	560,000 acre-ft
Typical storage variability in a year	=	300,000 acre-ft

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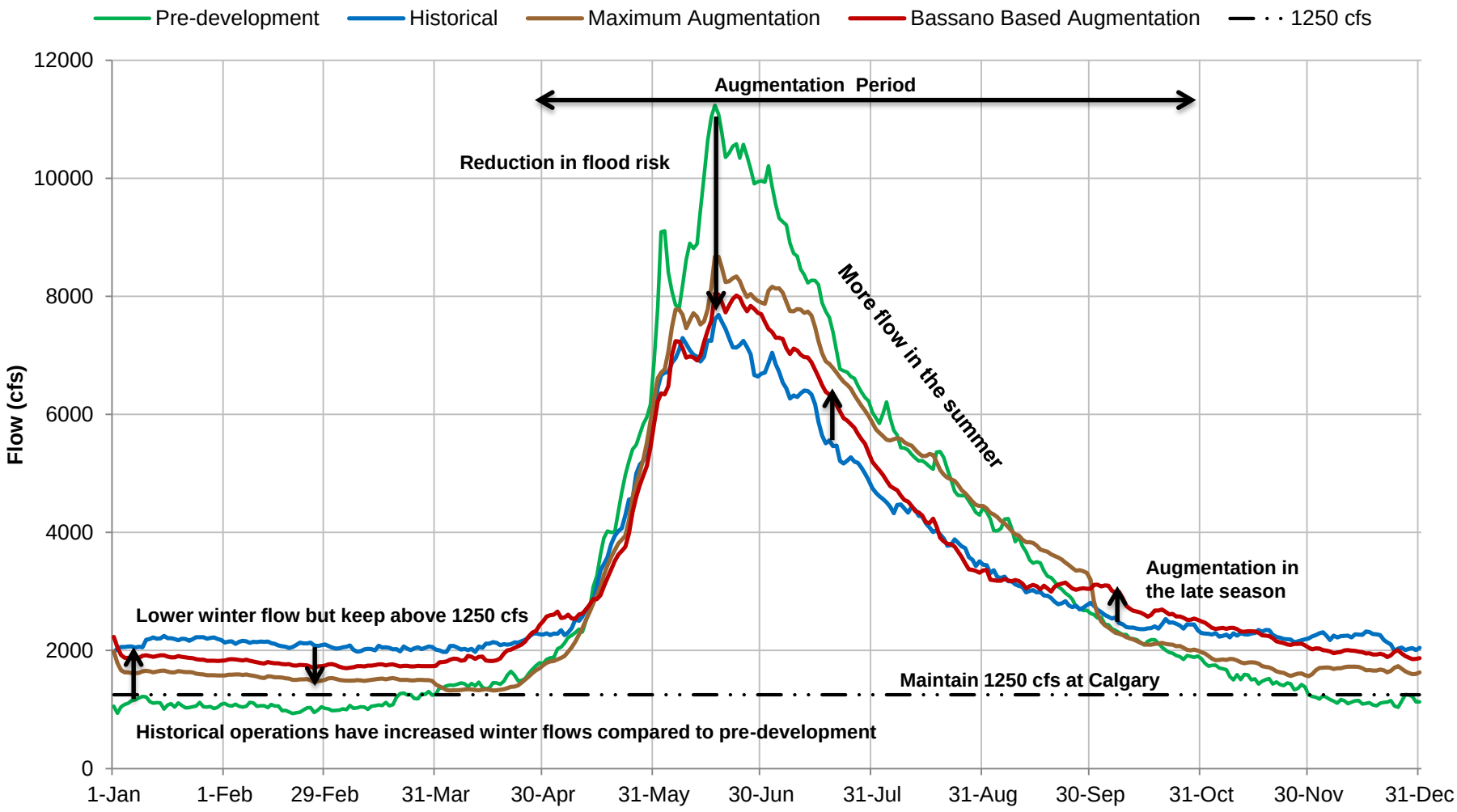
Potential for Augmentation



Conversion: 1000 cfs = ~ 1983 ac-ft/day

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Flow Augmentation Target at Bassano
(April to October, acre-ft)

Year	Historical Release from Ghost	Modelled Release (Bassano Augmentation)	Augmentation Compared to Historical	Augmentation Target to Maintain 800 cfs at Bassano	Number of Days that Augmentation Rule is Triggered
1991	2,191,100	2,244,000	52,900	34,711	35
1992	1,479,100	1,523,000	43,900	68,430	69
1993	1,792,900	1,886,700	93,800	0	0
1994	1,440,500	1,518,100	77,600	95,207	96
1995	1,916,900	2,019,800	102,900	28,760	29
1996	1,862,400	1,942,900	80,500	30,744	31
1997	1,676,600	1,771,200	94,600	39,670	40
1998	1,714,900	1,810,500	95,600	55,537	56
1999	1,851,800	1,896,300	44,500	16,860	17
2000	1,410,300	1,489,700	79,400	120,992	122
2001	1,204,900	1,269,500	64,600	163,637	165
2002	1,700,000	1,771,700	71,700	35,703	36
2003	1,489,800	1,573,400	83,600	105,125	106
2004	1,681,000	1,777,800	96,800	30,744	31
2005	2,064,300	2,148,000	83,700	13,884	14
2006	1,508,900	1,536,700	27,800	27,769	28
2007	1,922,400	2,004,000	81,600	3,967	4
2008	1,873,900	1,950,500	76,600	0	0
2009	1,379,300	1,415,700	36,400	4,959	5
2010	1,360,300	1,450,600	90,300	8,926	9
AVG.	**1,676,065**	**1,750,005**	**73,940**	**44,281**	**45**

Note: 70,000 ac-ft (12%) modelled active storage remaining at end of winter 2002.

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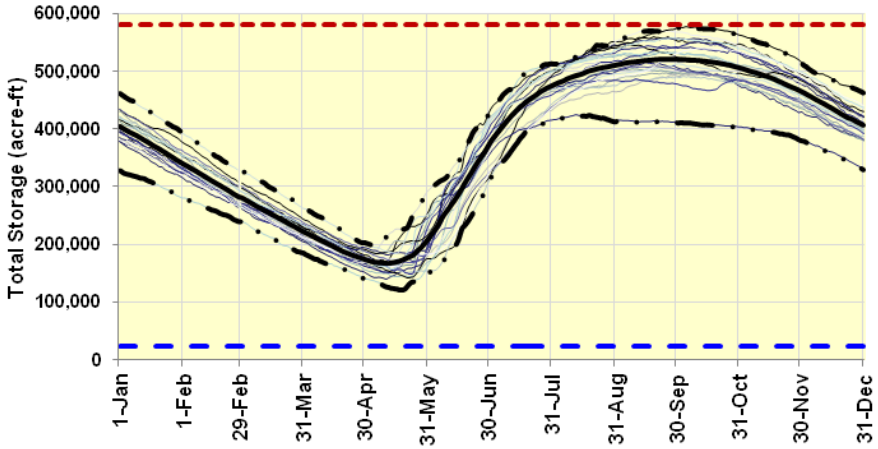
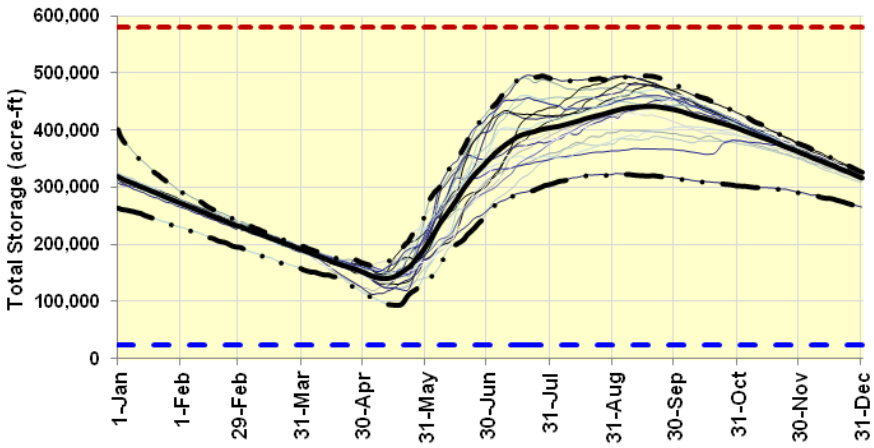
Model Output: Total Storage

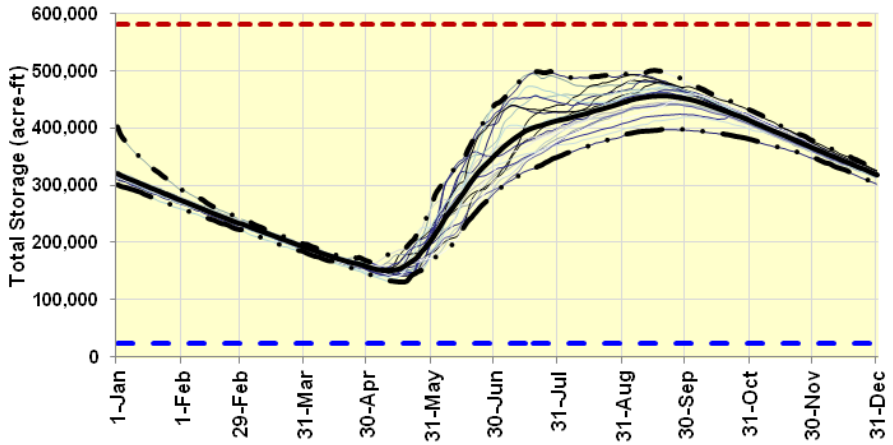
Historical Actual



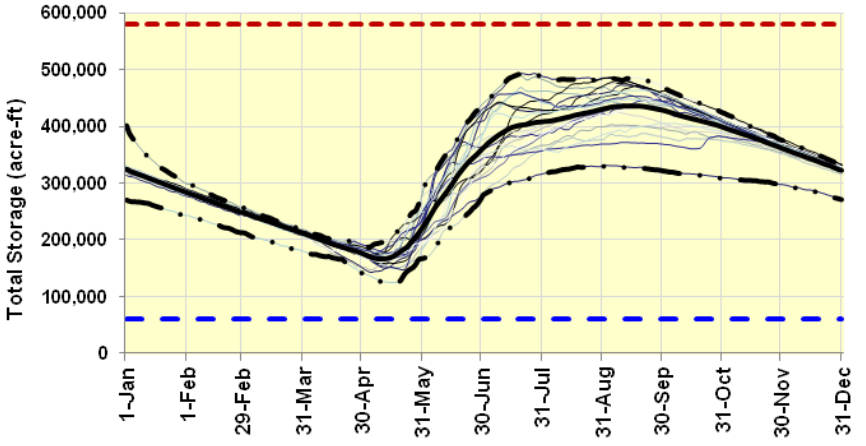
Bassano Augmentation Scenario



Model – Normal Ops (approximate historical)



Bassano Augmentation + LK Stabilized



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Summary of Findings

- Augmentation of about 80,000 ac-ft can be achieved, on average.
  - Average increase in summer flow at Ghost ~ 225 cfs
  - Winter flows through Calgary can be maintained at ~ 1250 cfs
  - Total storage will only be utilized in a flood year
- Downstream licensees' demands cannot be met in dry years (~1 in 10).
  - In 2001, the augmentation requirement was >160,000 ac-ft
  - Realistically, about 60,000 ac-ft could have been guaranteed
- Requires TransAlta to change the way their reservoirs are operated.
  - Potential impacts to recreational users (Kananaskis River, Ghost Lake)

Bow River Simulation Model

Additional Flood Control

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FIDS

Memories


HEAD


29 5 '92


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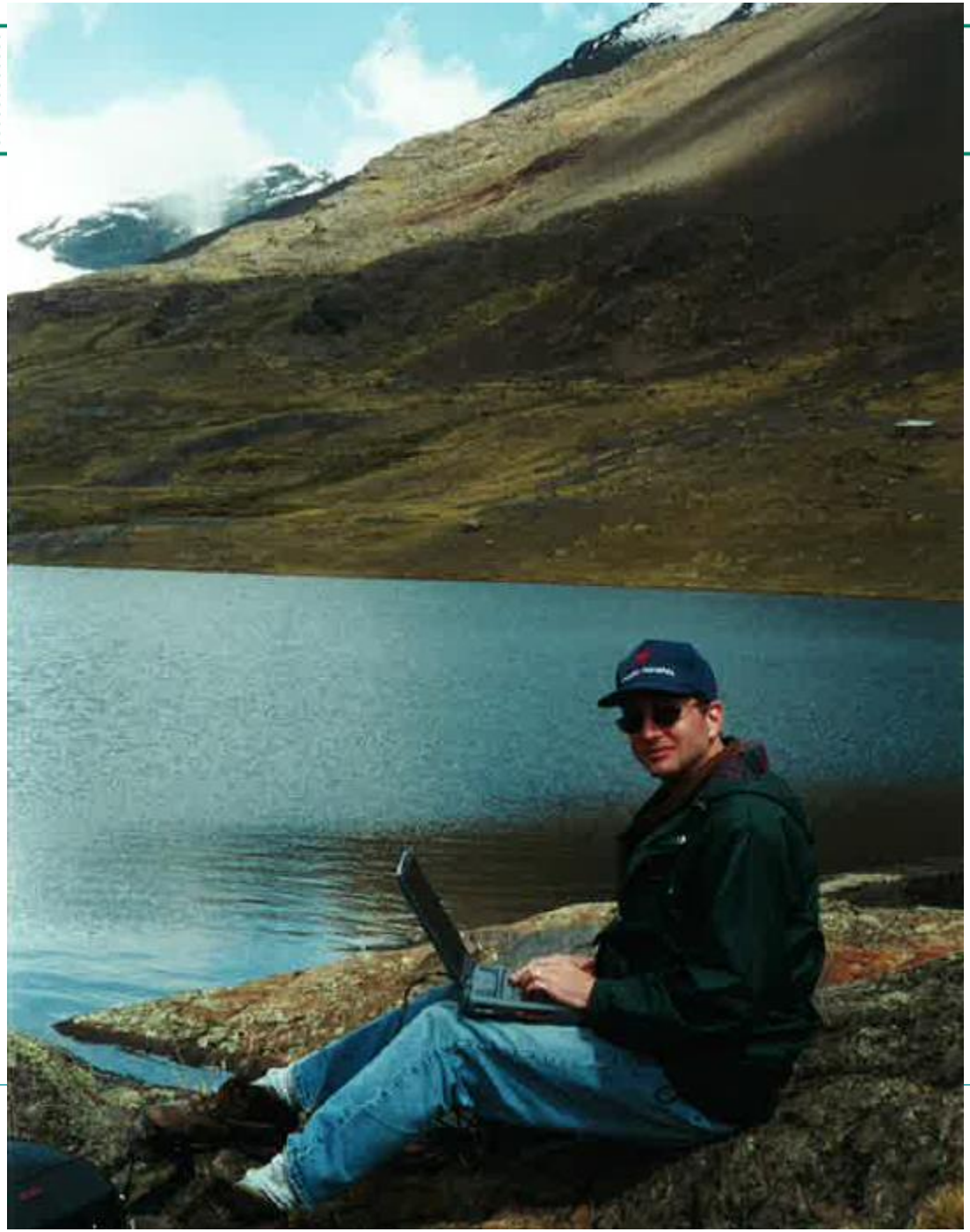

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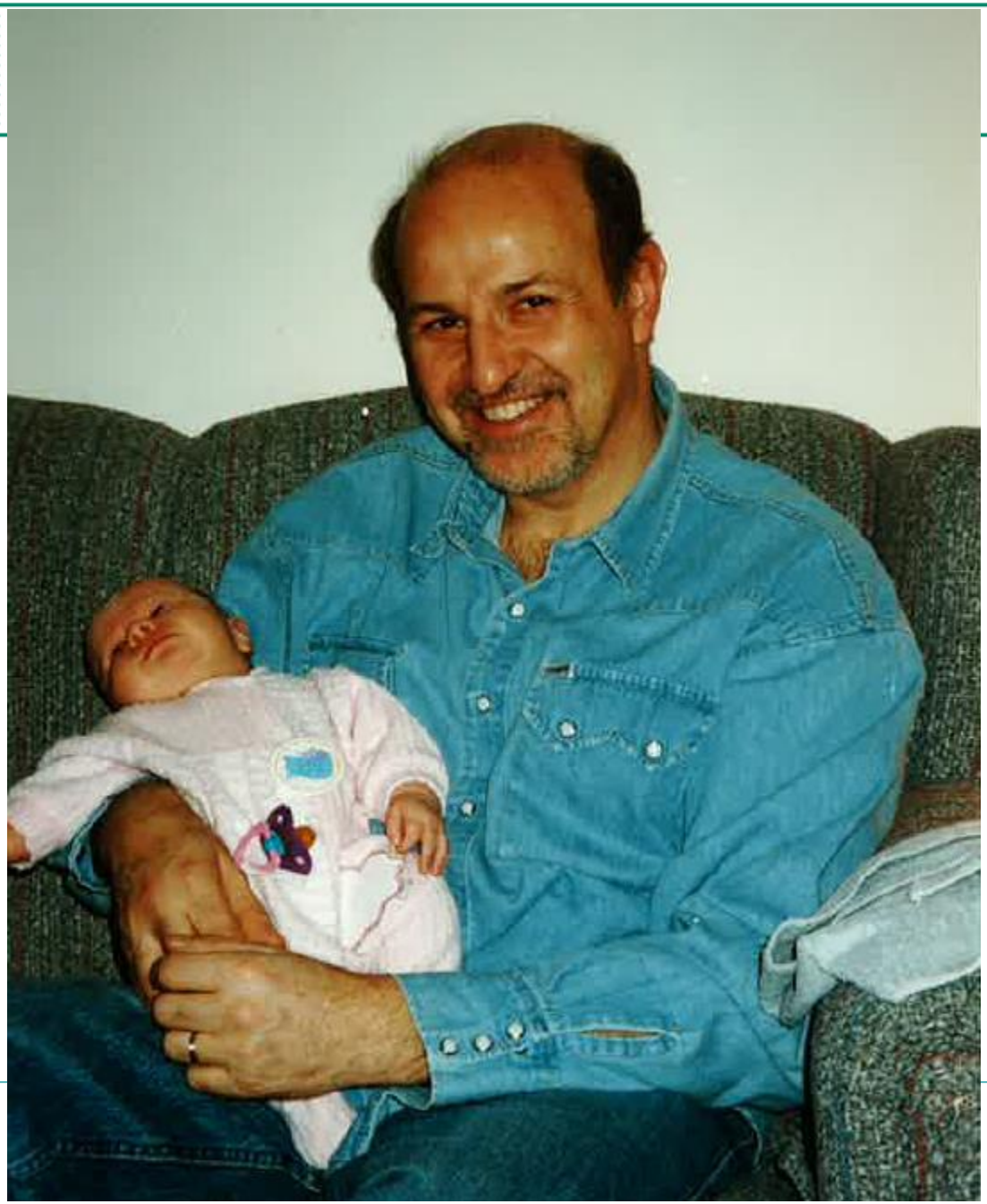


SKOKI