Using a DSS to Analyze the Medium-term Planning and Operations of the Manitoba Hydro System

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Power Sales & Operations
Manitoba Hydro

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PRESENTATION OUTLINE

- Resource Management & Operations Planning
- DSS Planning Tools – HERMES
- HERMES applications
  - Operations Planning During DROUGHT
  - Other Applications
- Future Improvements
- Questions

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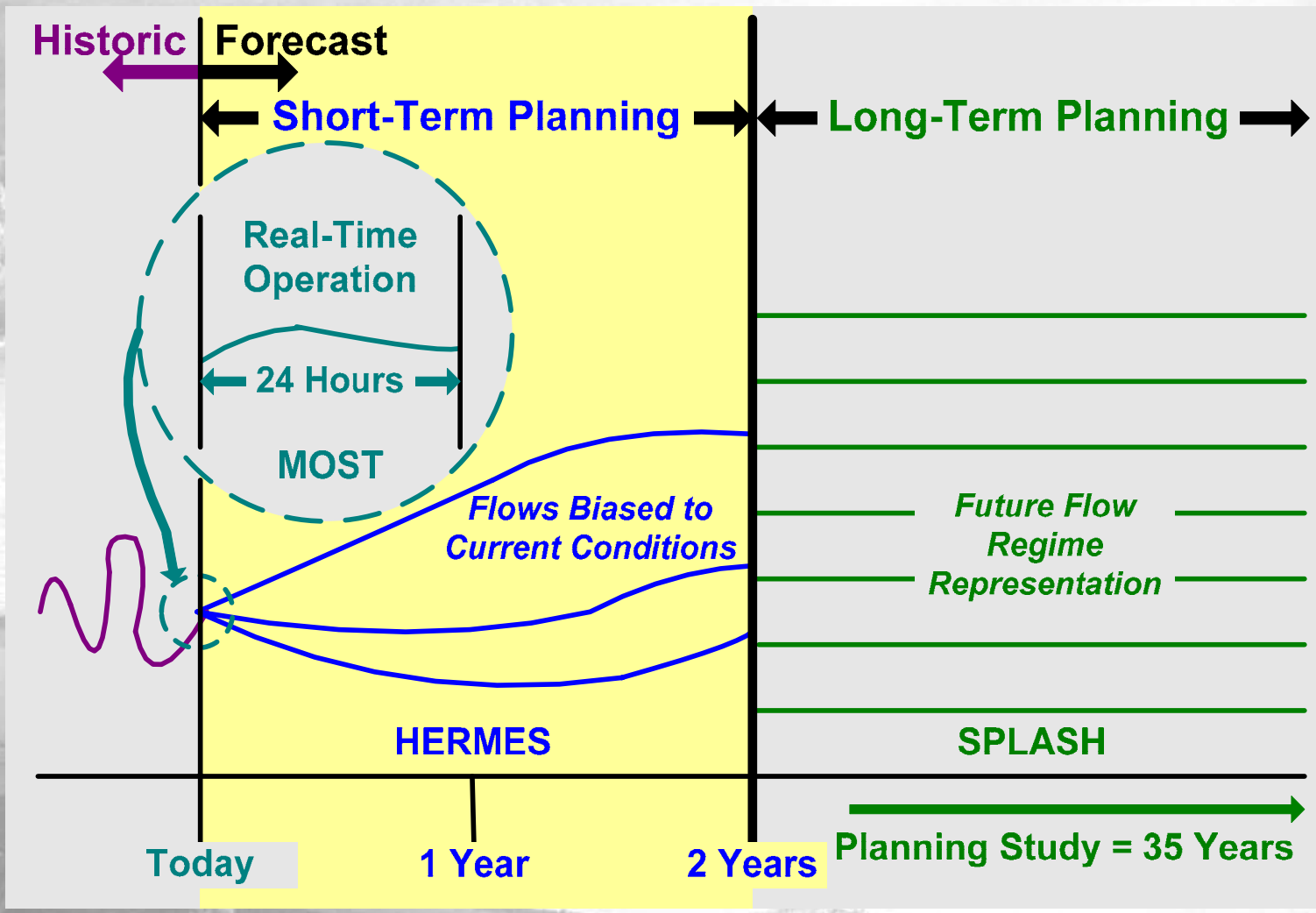
Planning Horizons & Inflow Forecasts



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RESOURCE MANAGEMENT AND OPERATIONS PLANNING

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Power Resource Management

Manage Manitoba Hydro's system of reservoirs, hydro stations, thermal stations, and tielines in the most secure and economic manner possible.

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Power Resource Management

Uncertainty
Licenses
Social and Environmental

- inflows, storage, coal, gas
- imports
- plant capability

- domestic load
- exports
- outages
- losses

Resource Management Decisions

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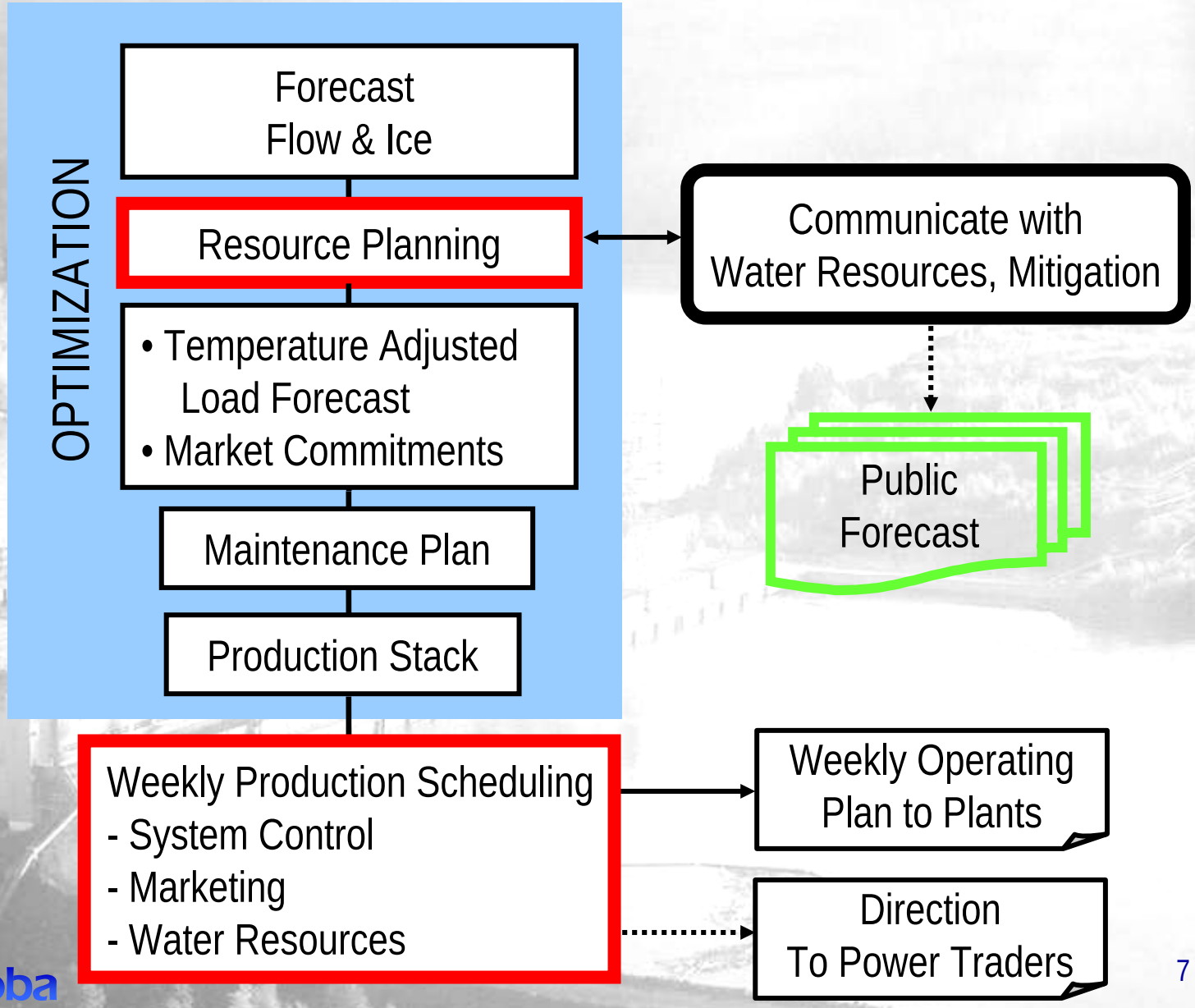
OPERATIONS PLANNING PROCESS



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Decision Support System

OPERATIONS PLANNING TOOLS

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Tools for Power Resource Management

FORECASTING

Flow

Load

Ice Effects

Market

OUTAGES

Available
Generation &
Transmission (HVDC)

HERMES

Hydro-**E**lectric **R**eservoir **M**anagement
Evaluation **S**ystem

Other Supplementary Tools…

SIMULATION

Calibration

Public
Communication

OPTIMIZATION

EMMA

1 Week to 2 Year Plan

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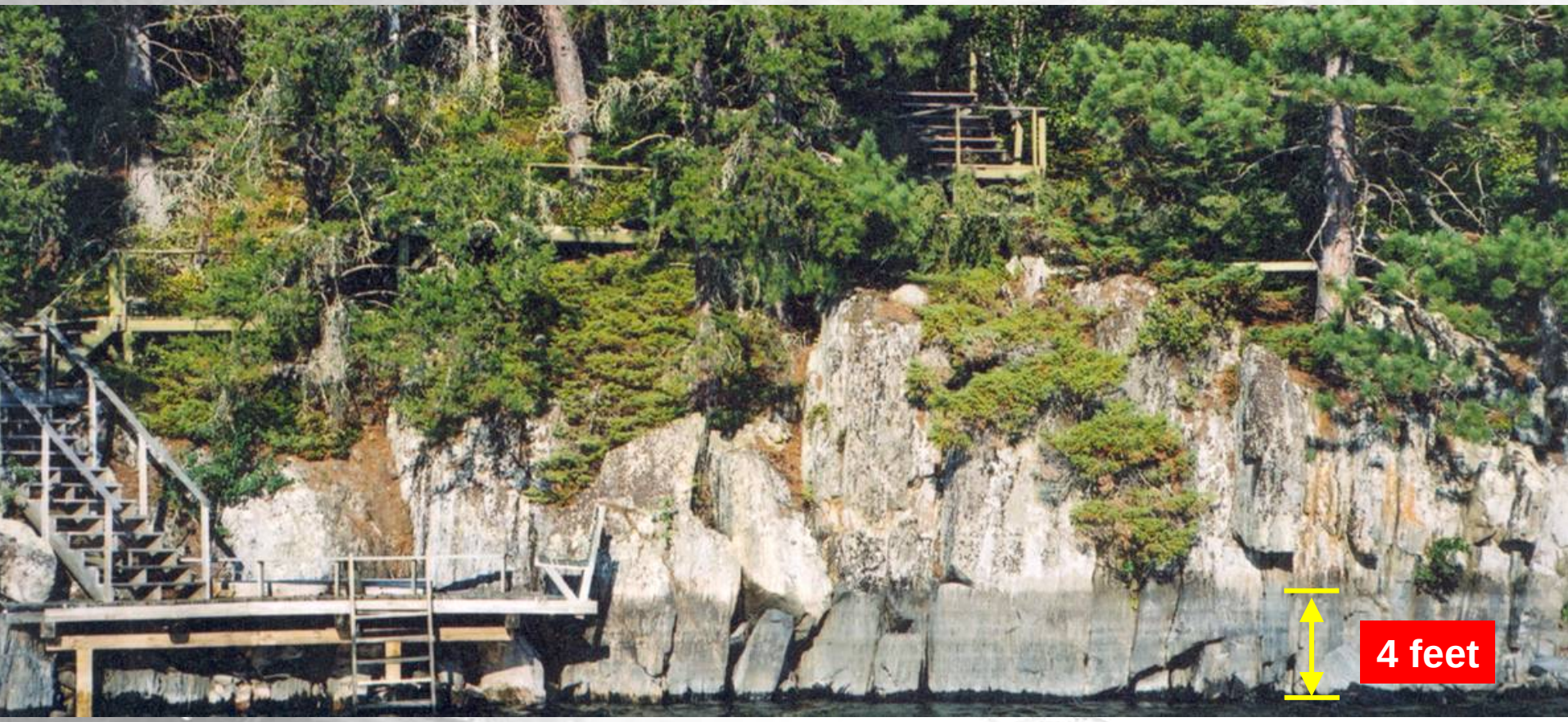
Using DSS

Operations Planning During DROUGHT



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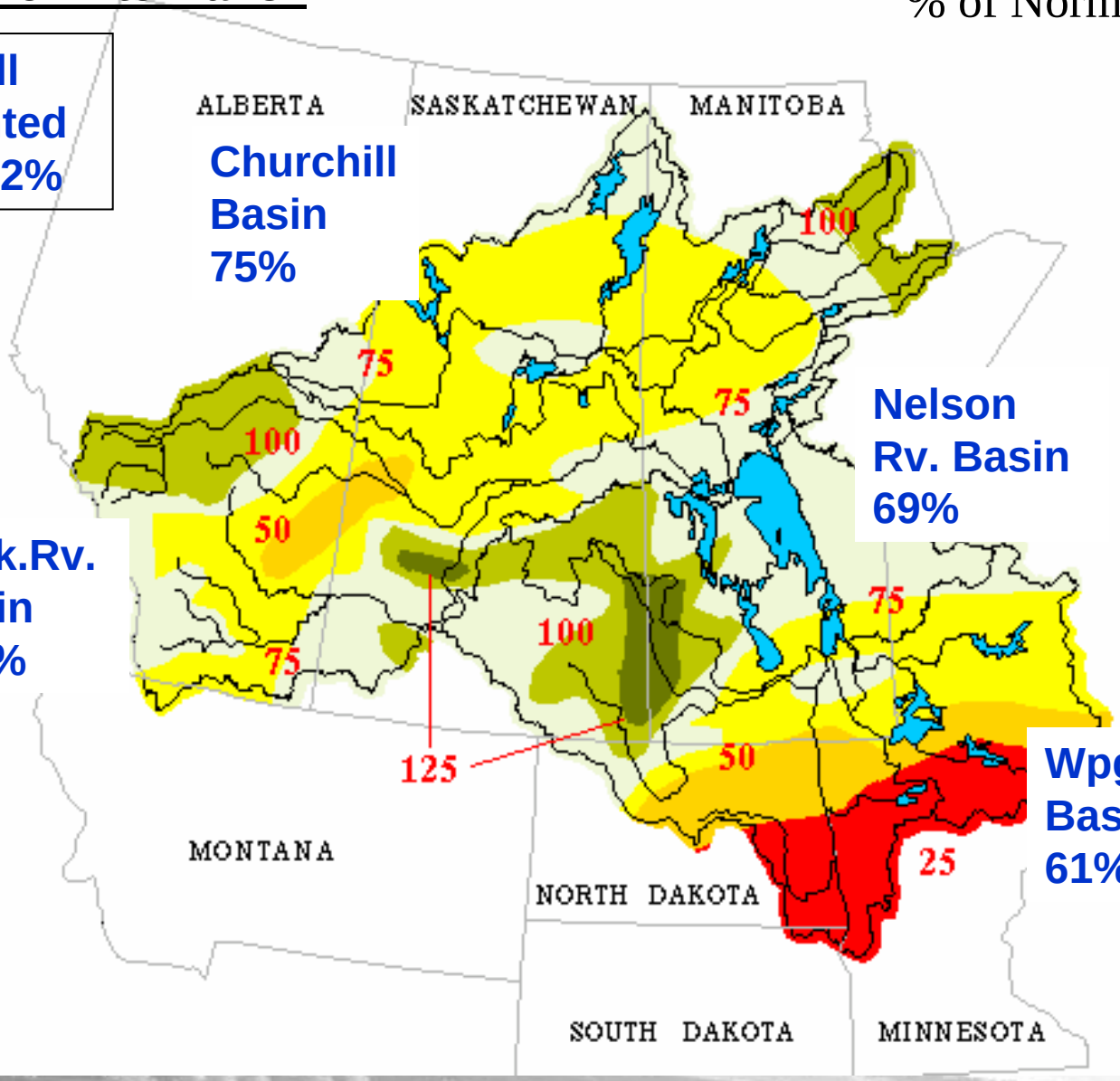
Dry: Winter 02/03 Precipitation

From Nov.1 to Mar.31

% of Normal

Overall Weighted Ave. 72%



Churchill Basin 75%

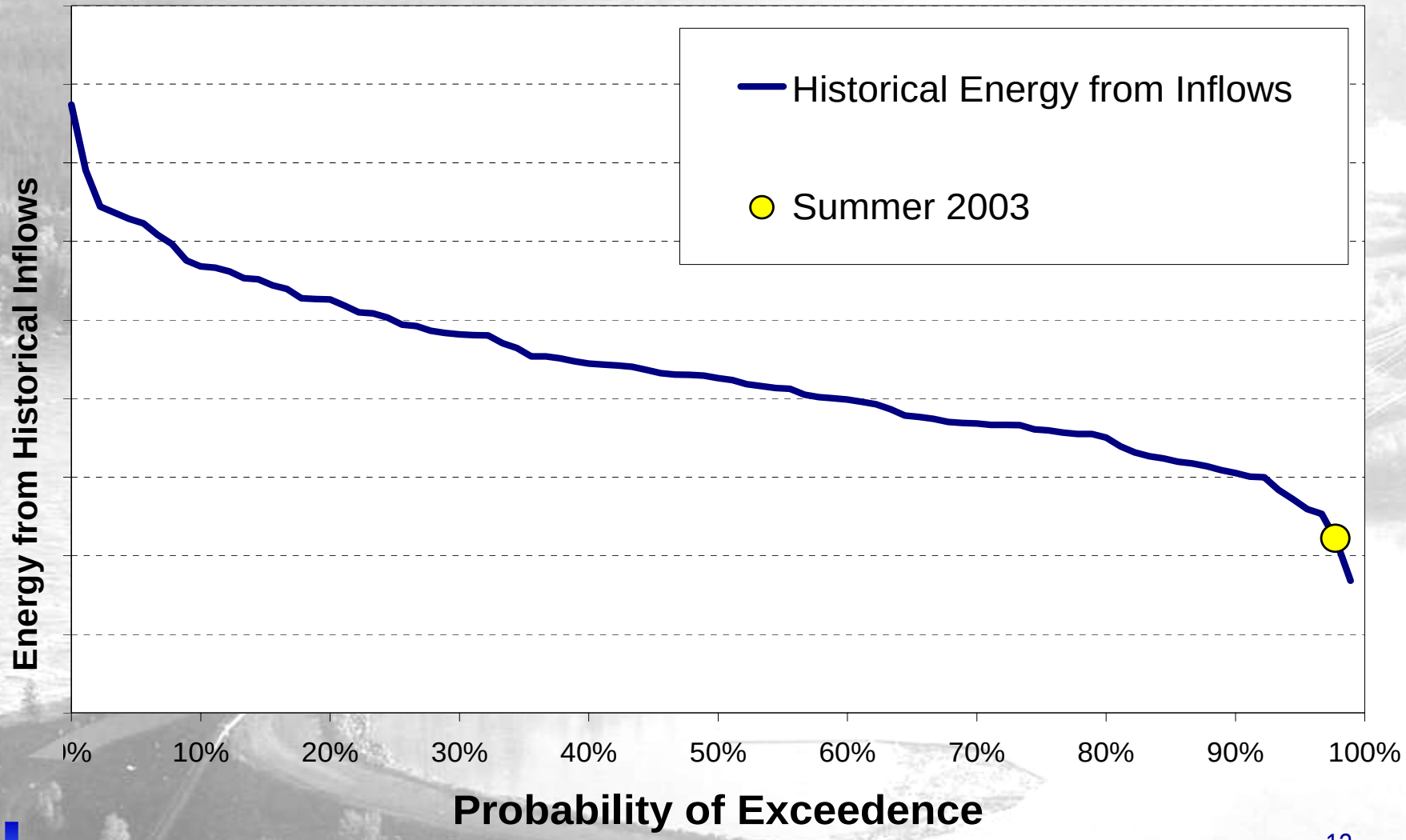
Nelson Rv. Basin 69%

Sask.Rv. Basin 112%

Wpg.Rv. Basin 61%

Energy from Historical Inflows

April 1 to October 31



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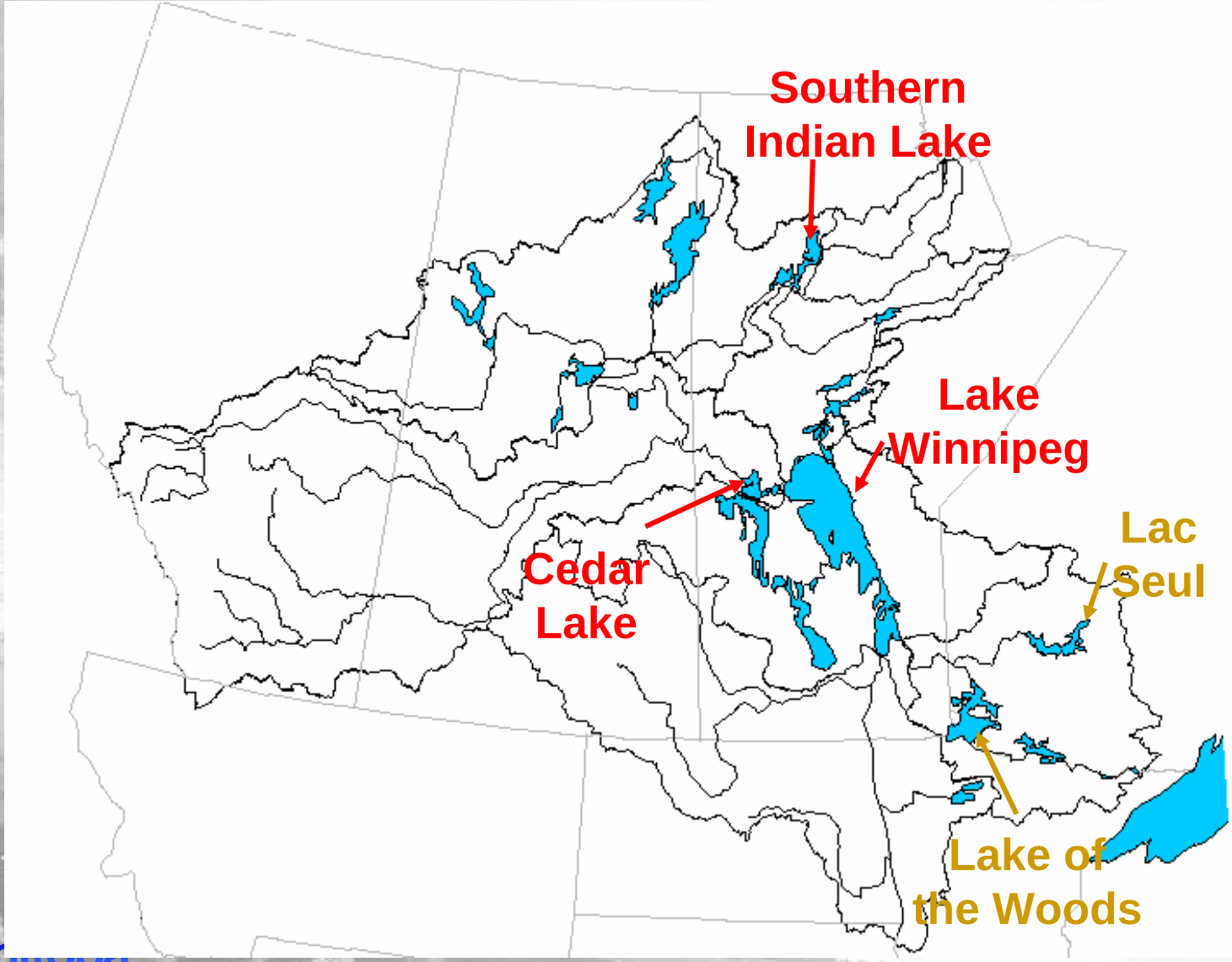
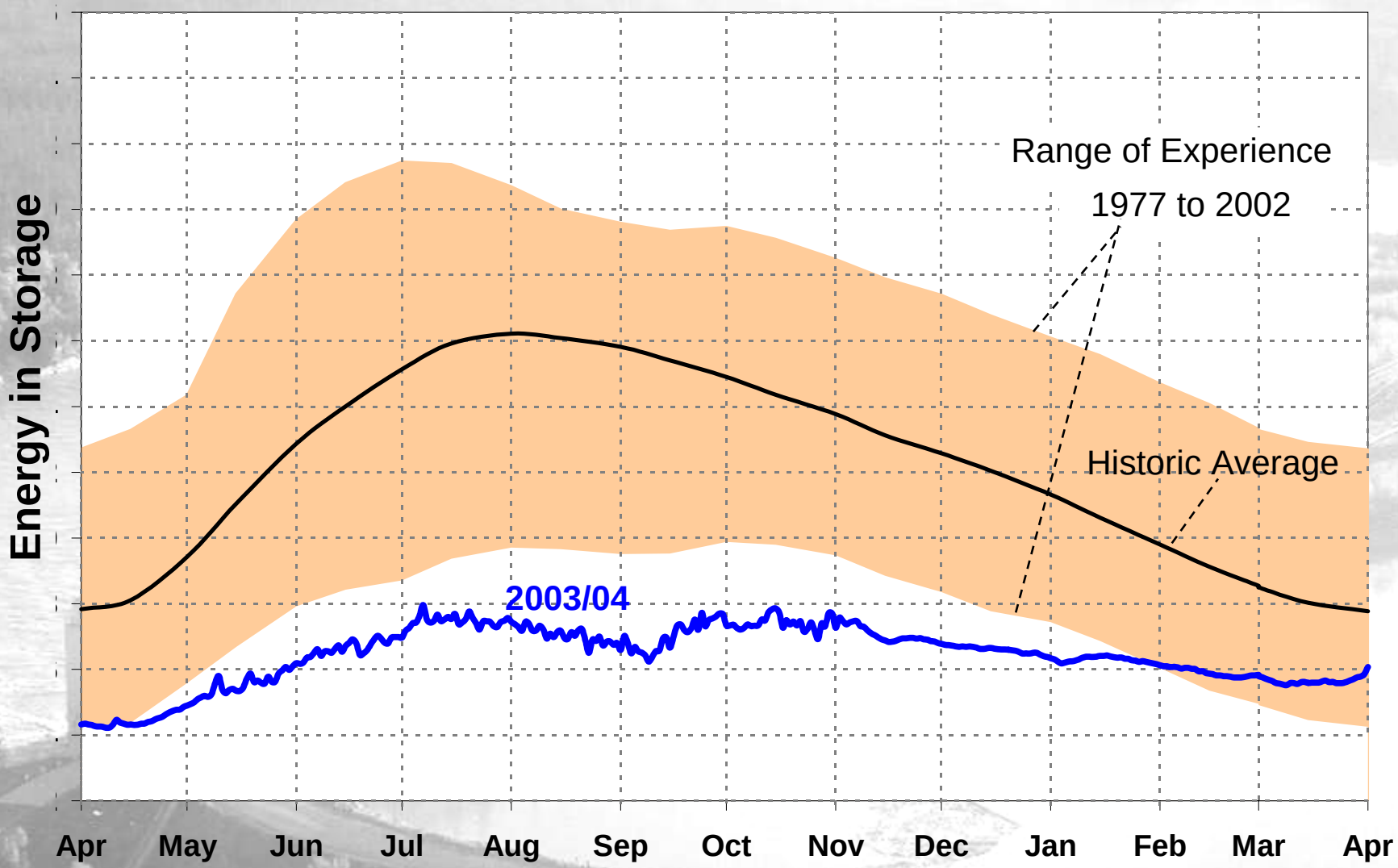
Major Storage Reservoirs



Manitoba Energy in Reservoir Storage



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Operations Planning Criteria
(the “Drought Survival Kit”)

- Hydro Energy Supply
  - Balance of 2003/04 - 95% exceedance probability **CHART**
- Water Reserves
  - On April 1, 2004 sufficient for repeat of 1940/41 inflows (EMMA “Firmness” Run)
  - Adjust after November 1 for snow pack and prolonged drought **CHART**
  - Backstop
- Manitoba Energy Demand **CHART**
  - Winter with 1 in 10 severity
- External Obligations
  - Fulfill all obligations
  - Settle financially if possible
- Hedging Strategy
  - Power and Gas
  - Gradual and Mechanistic

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Lake Winnipeg

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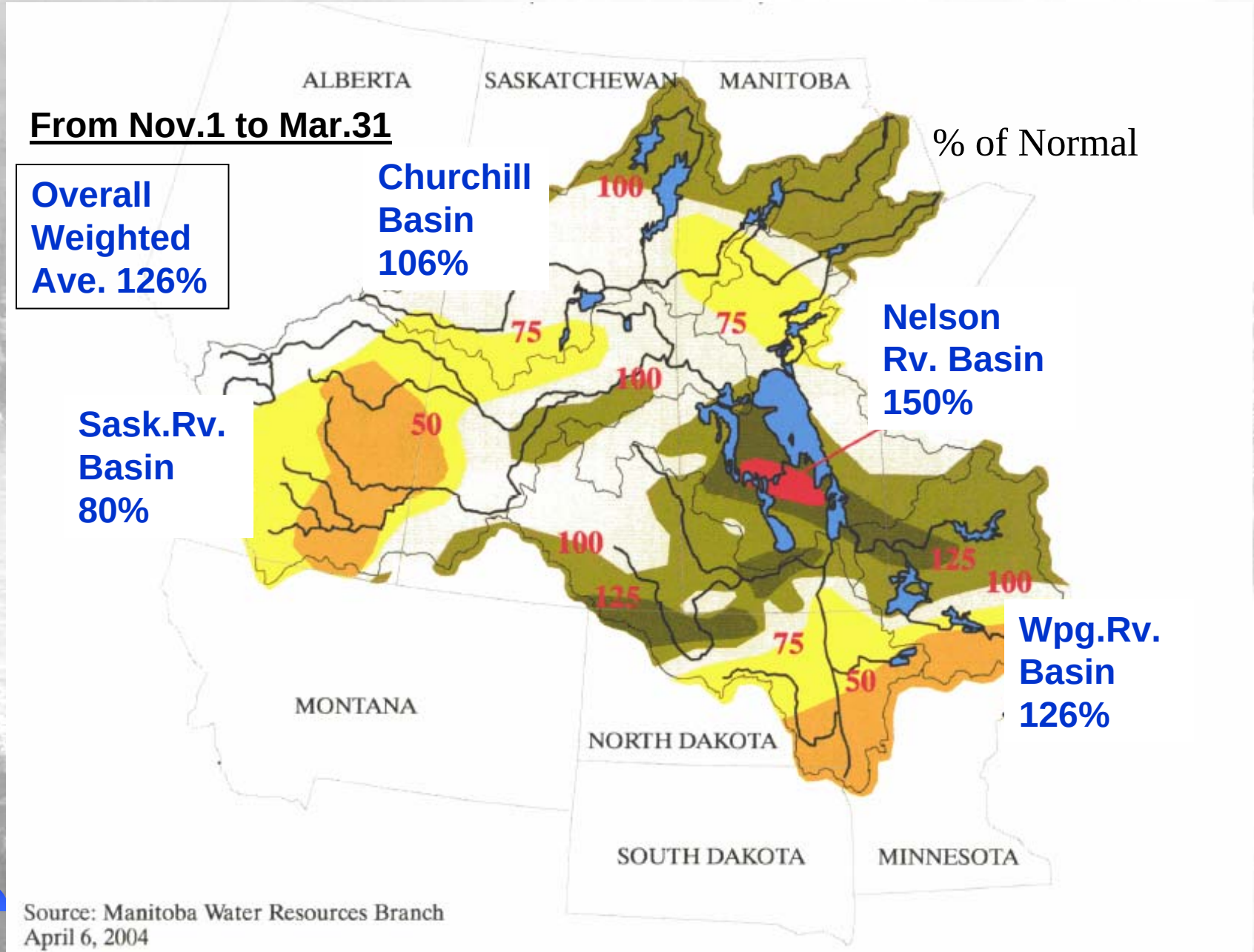
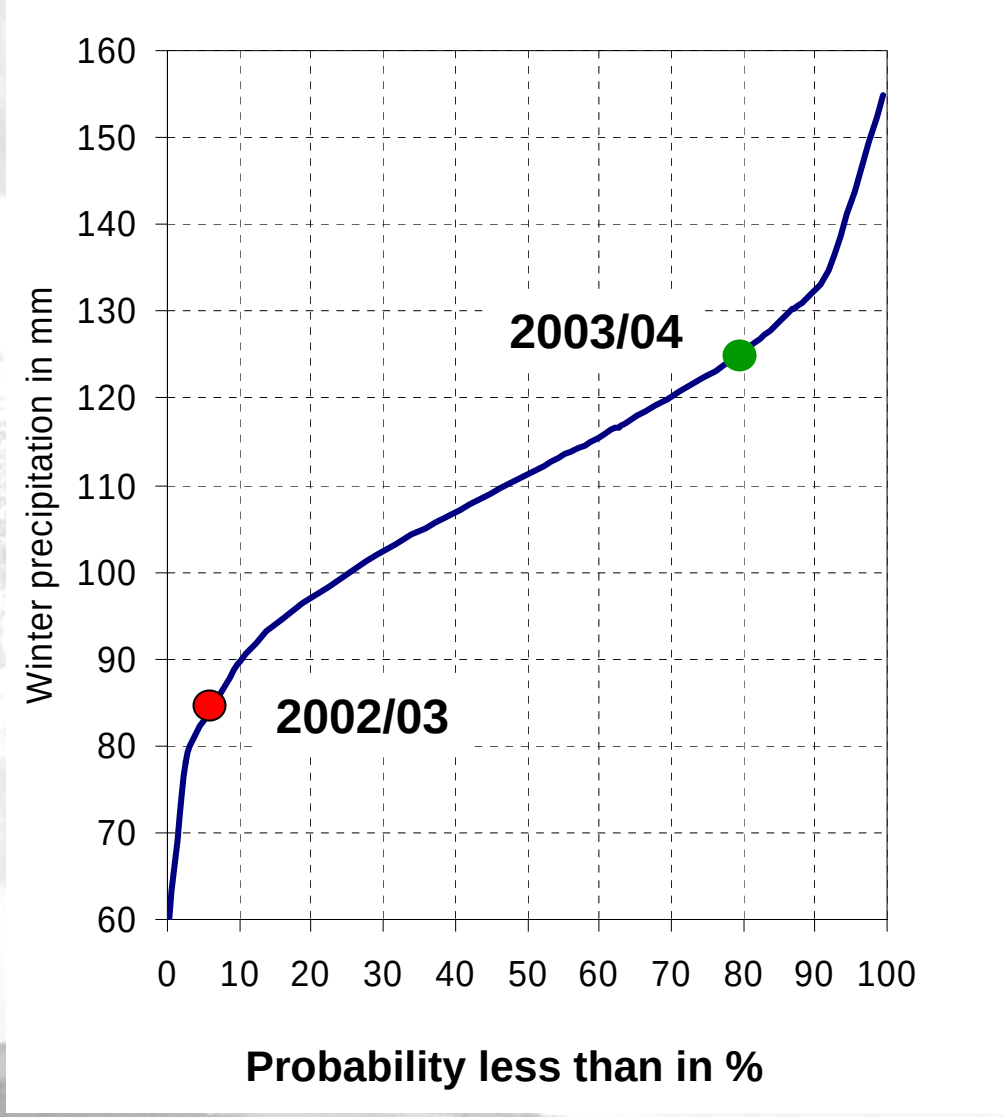
What actually happened?

Winter 03/04 Precipitation



Winter 03/04 Precipitation

- Weighted by basin runoff and generation potential



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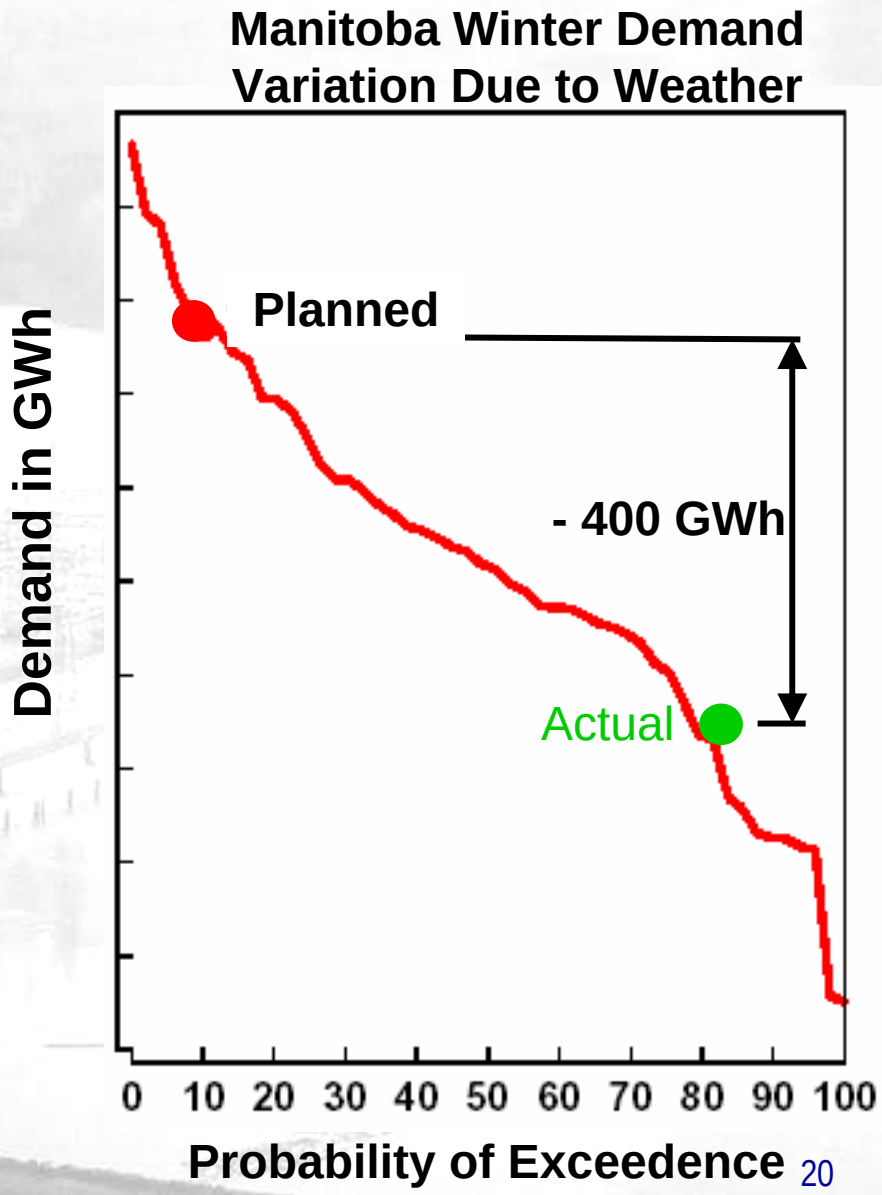
Planned vs. Actual Manitoba Energy Demand



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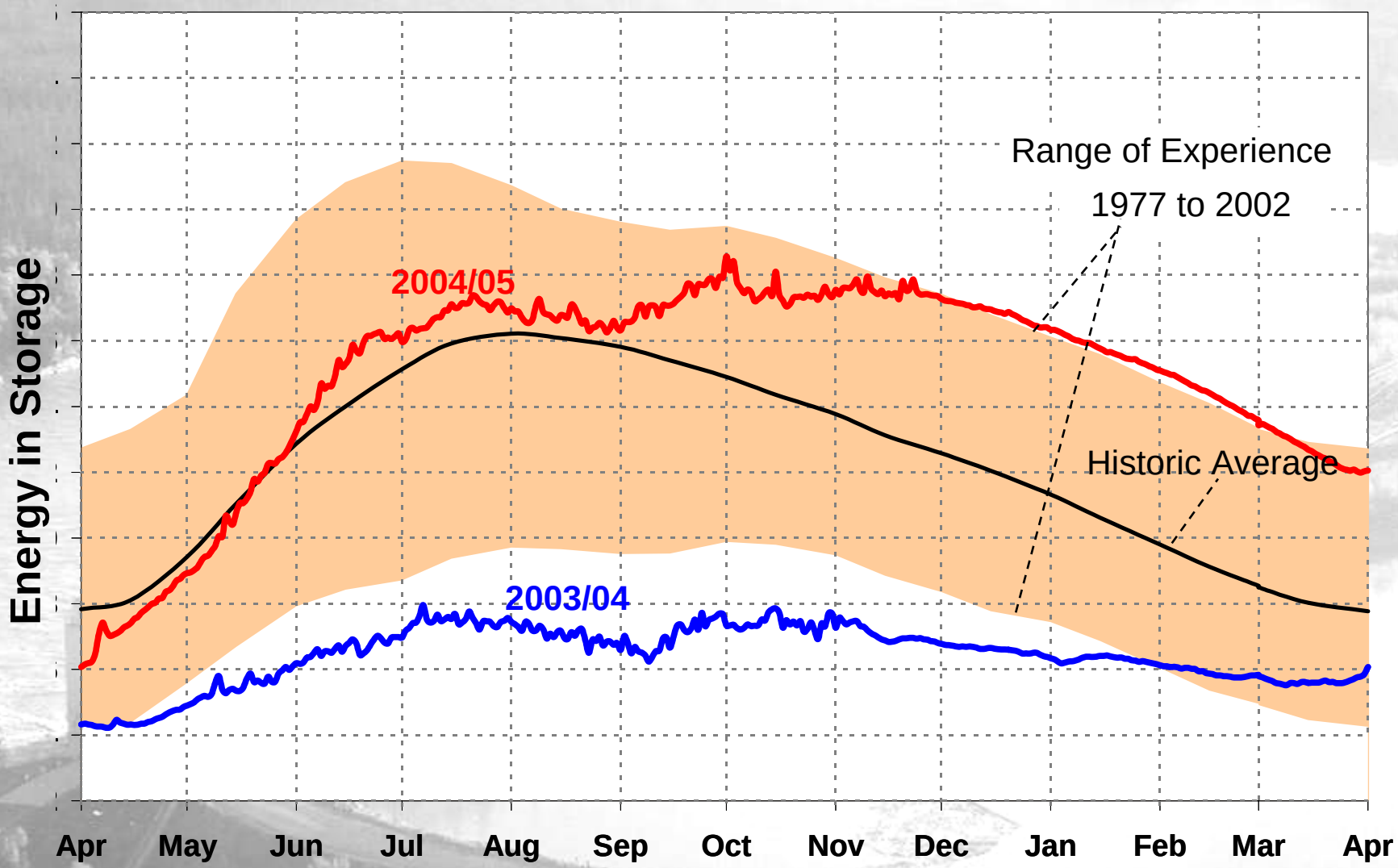
Manitoba Energy in Reservoir Storage



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Other Uses of HERMES DSS

- Operations planning during flood conditions
  - No energy management issues
  - License constraints, and operating limits
- Operations pl
  - Energy mana
  - Capacity ass
- Economic An
- Budgetary Pr

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Future Improvements

- Stochastic approach to energy management
- Improved river routing
- Drought Indicators
- Improve historic relationships between snow accumulation vs. Runoff volume

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Questions

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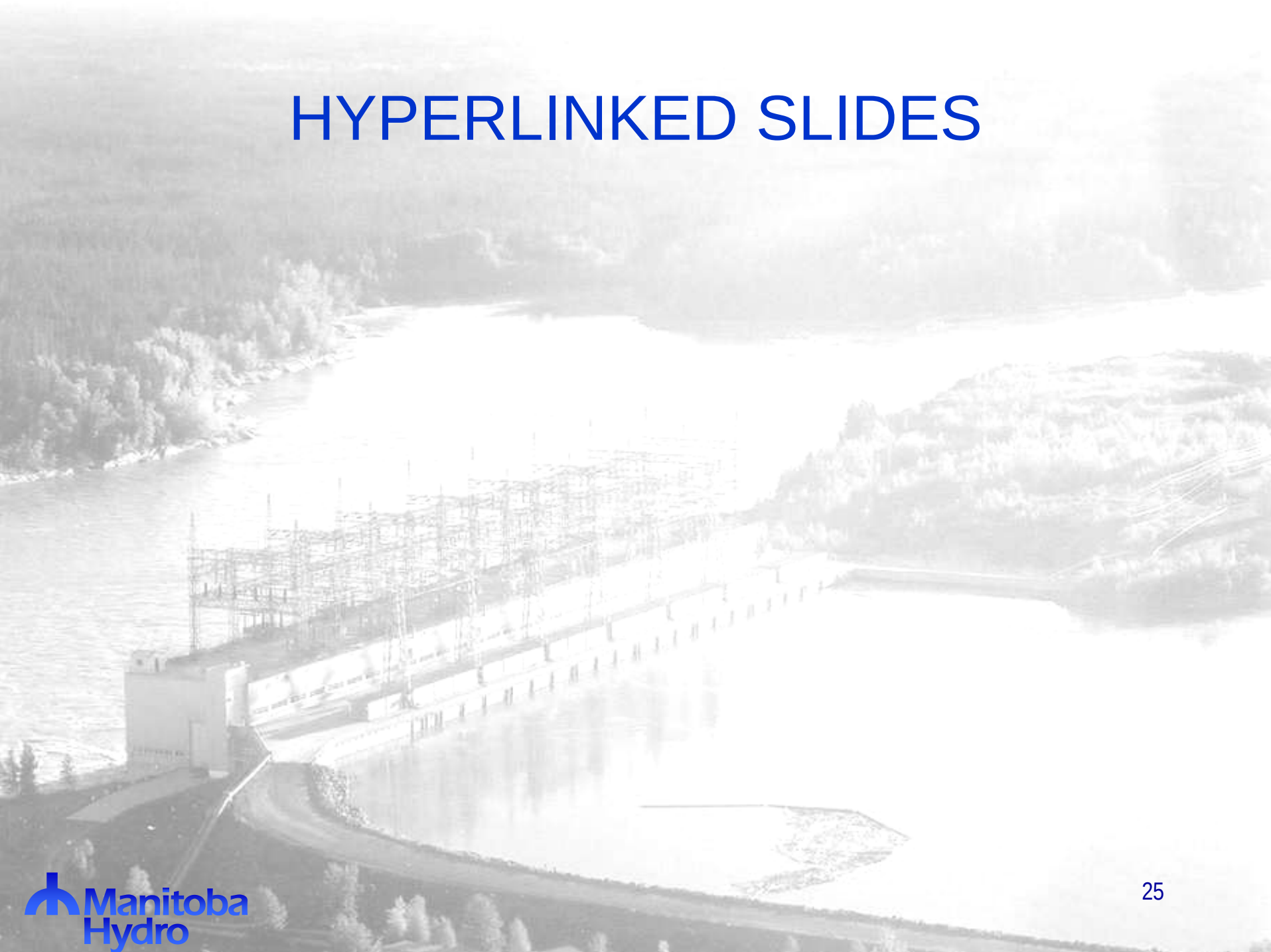
HYPERLINKED SLIDES



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Return

HEIDI 2.2 – Release 20040130

Execution View Misc Help Exit

Flow Forecasting (Default)

DB	/local/db
BASIN	churchill_river_new
LOCATION	island_falls_discharge
FLOW	expected
RUN	0506_expected

Configuration Manager

Main Menu

Hydraulic Performance Forecasting
Flow Forecasting
Load Forecasting
Energy Management
Flow Simulation
Generation Estimates
LWCB Graphs
Daily Hydrometric Data
Market Forecast
SC Maintenance Transferr
Maximum Northern Generation Constraint Calculatorr
MOST Transfer

Menu Manager

File Manager

/local/db

busses	controlledoutlets	data	datums	dhf	economics	flowforecast	genestimates	gengroups	gs_hydro	gs_thermal	hvdc
inflowgroups	lakes	loadcenters	loadforecast	ma	maintcrews	mapp_lc	marketforecast	most_transfer	naturaloutlets	perfforecast	qsim
reportlocations	*runs*	sc_transf	tielines	utilities	operating_reserves	temp.txt	unnamed.txt				

/local/db/qsim

controlledoutlets lakes naturaloutlets plotlines reportlocations *system* sh_history

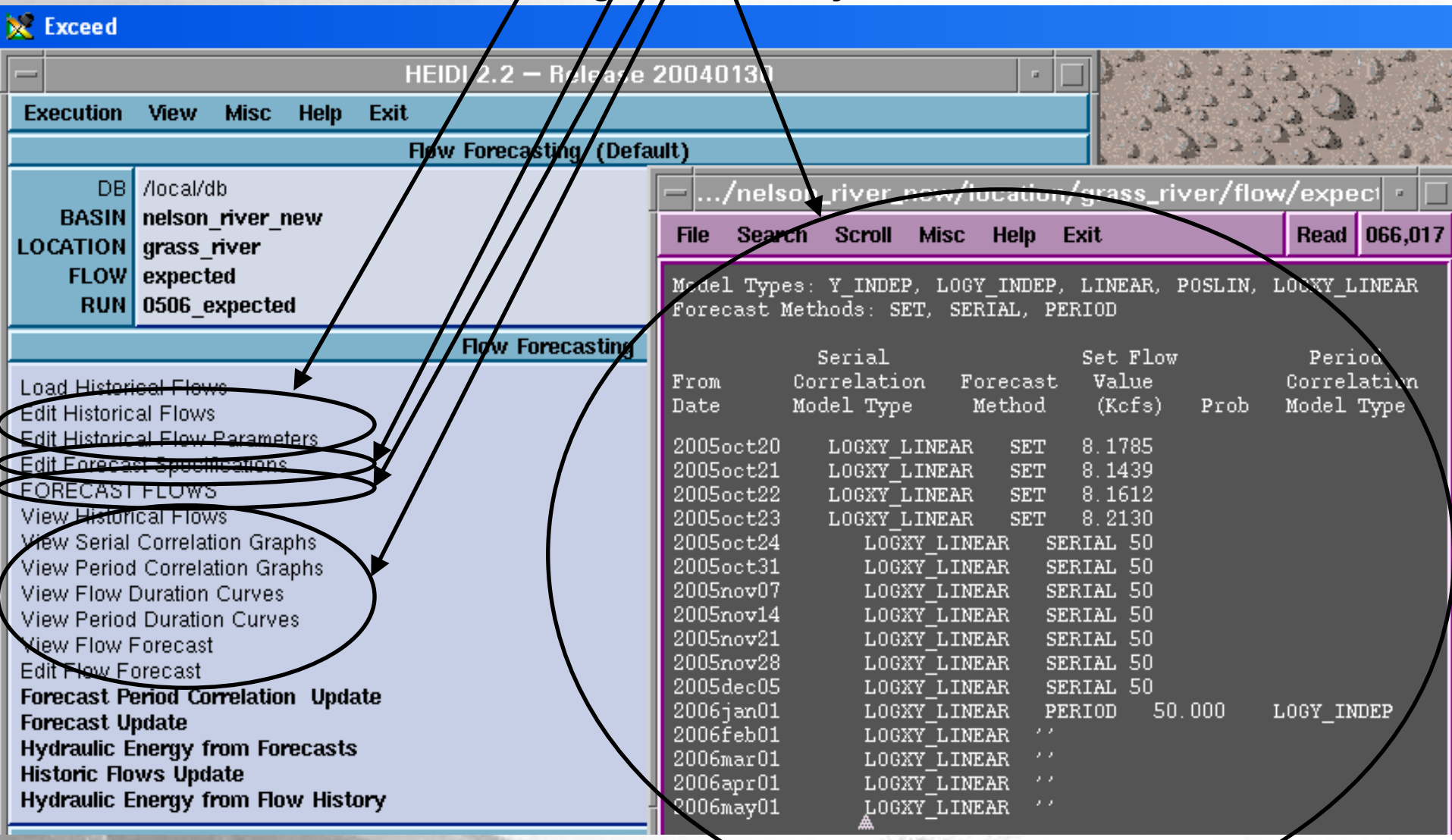
/local/db/runs/0506_expected/reports

Flow Forecasting

Edit Historical Flows used in Regression Analysis

FORECAST FLOWS View Forecasts

Edit Forecast Specification



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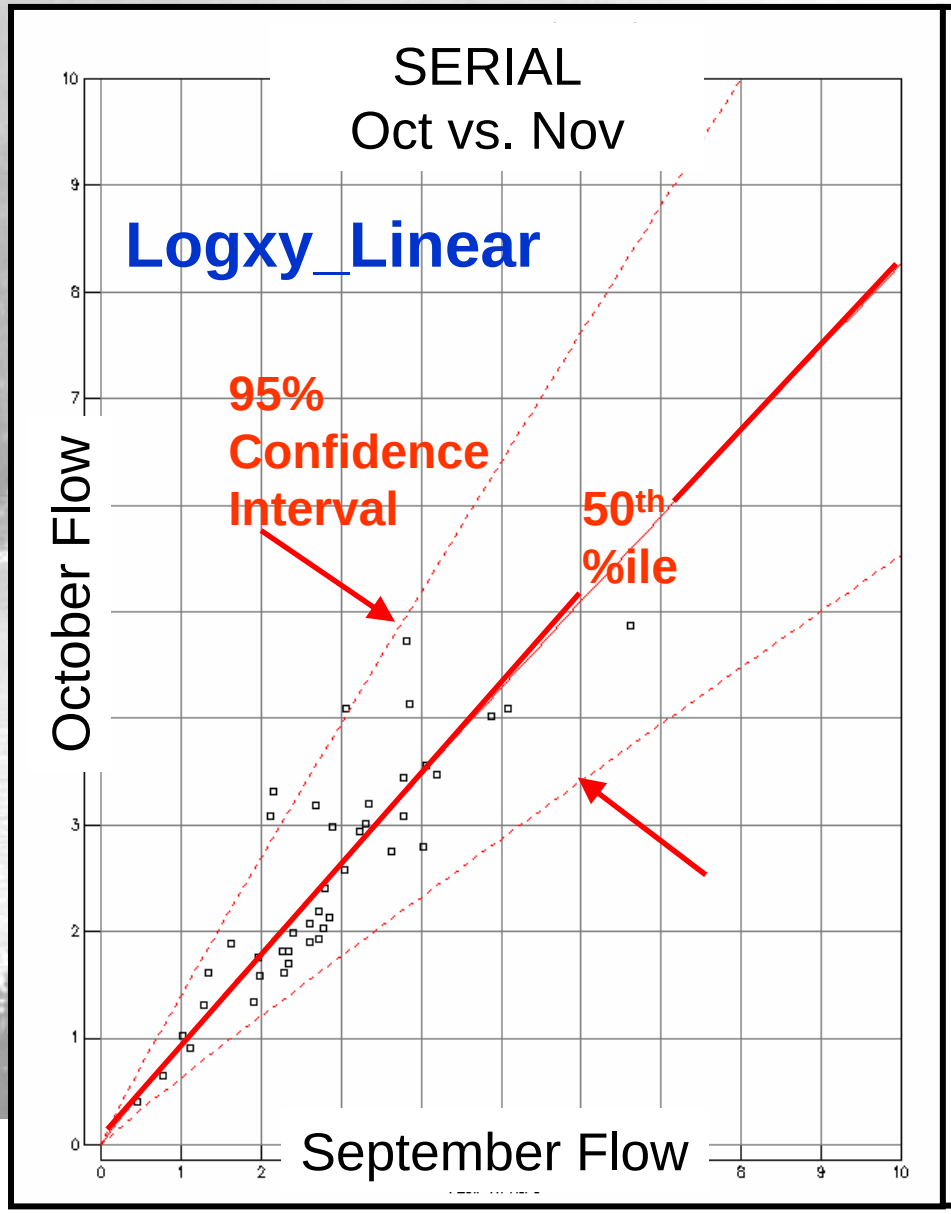
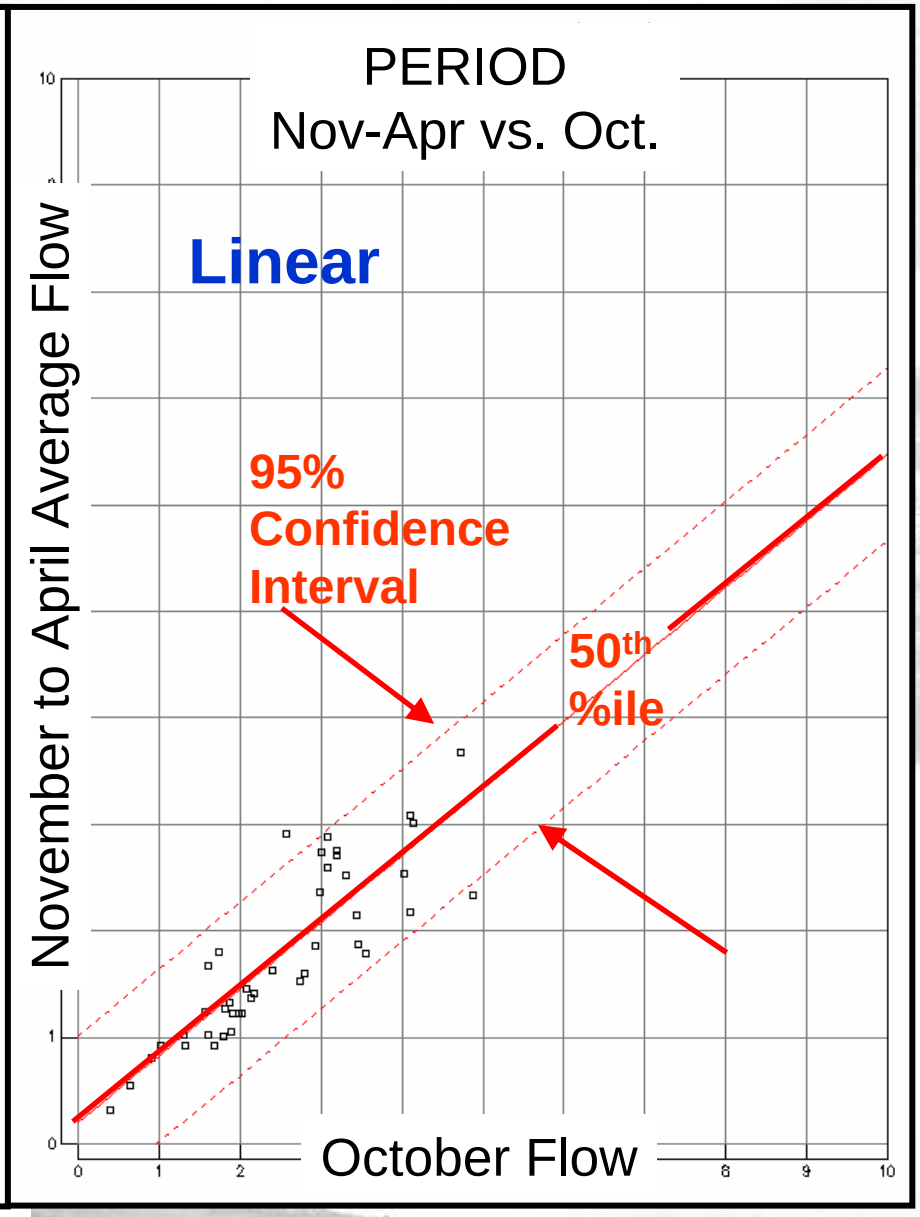
Flow Forecasting

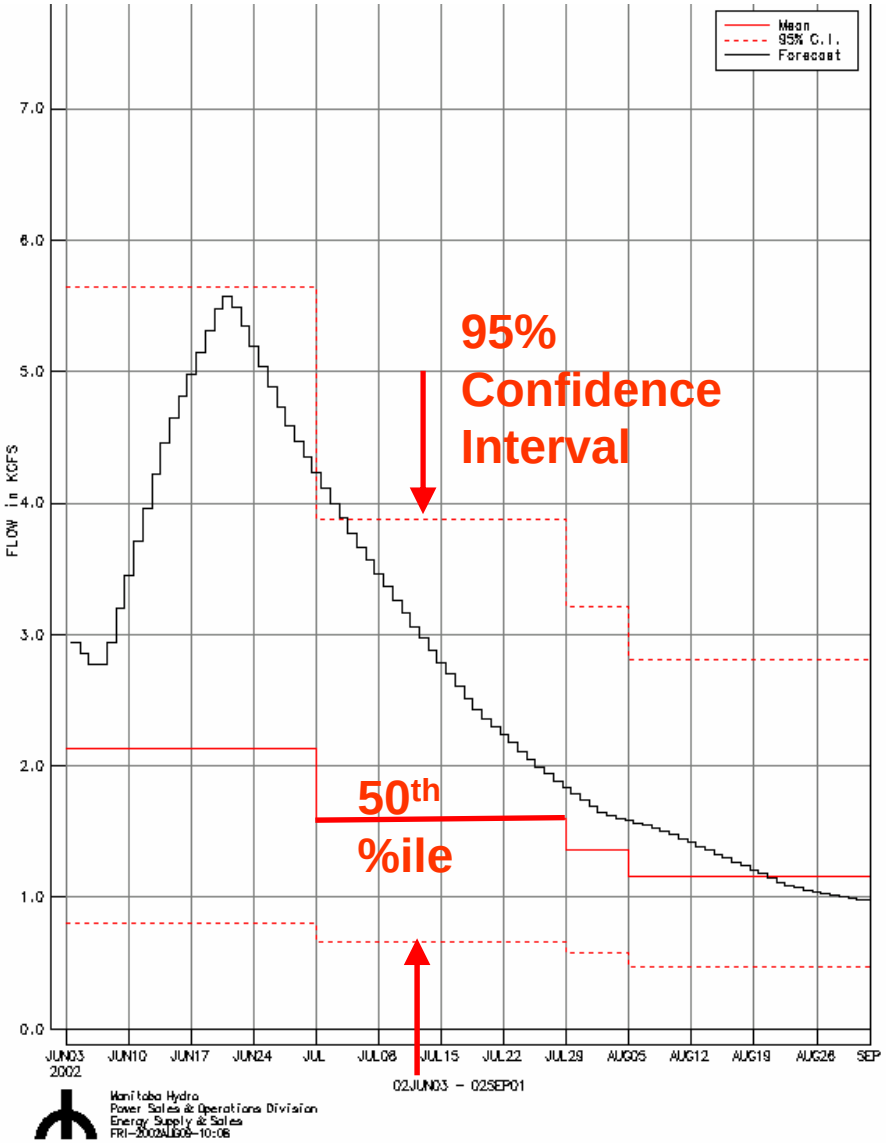


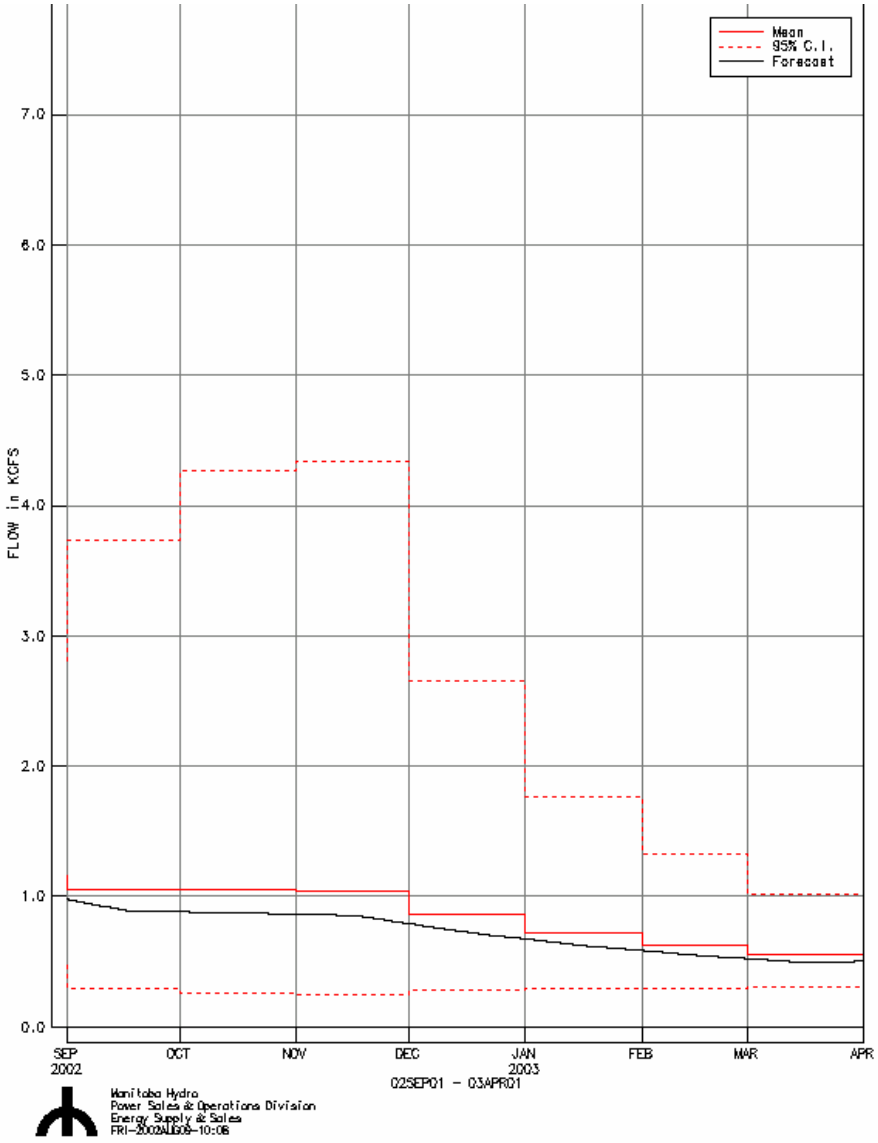


Flow Forecasting

Return

Example Flow Forecast For Tributary River – Sturgeon River

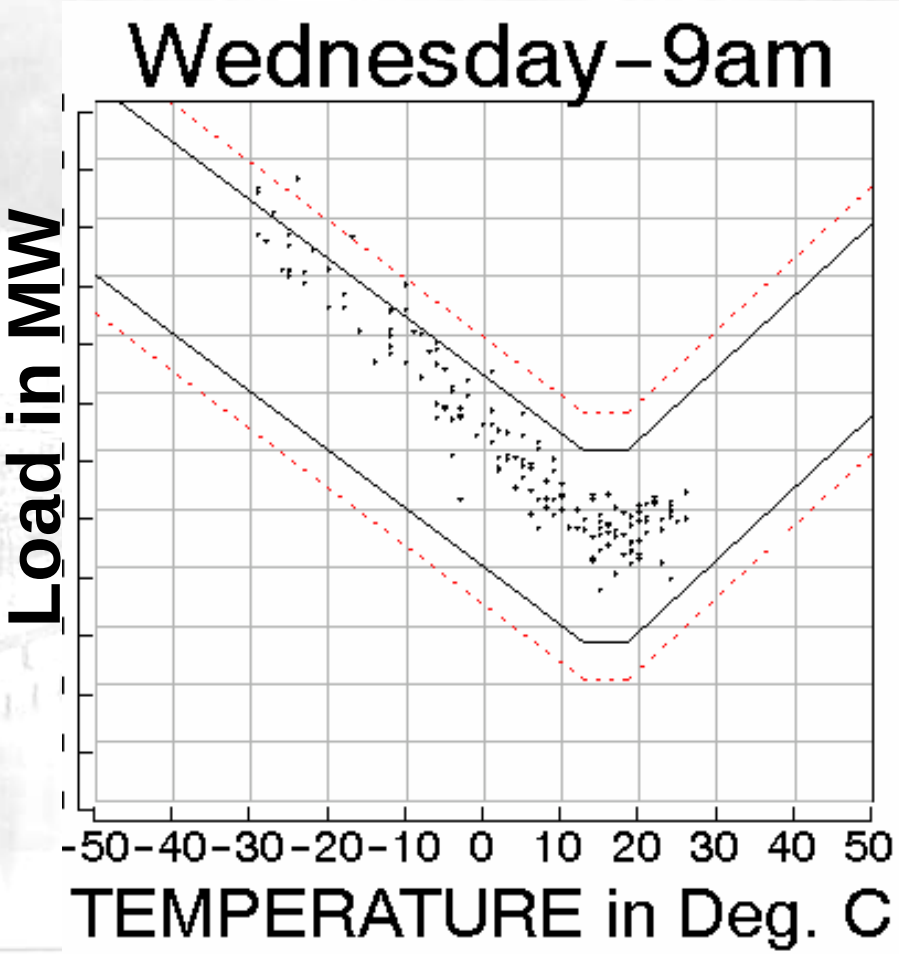




Load Forecasting

Return

- Domestic
- Load = *f* (YYYY.mm.dd.hh, Δ temp) =
- Short-term weather forecast used for weekly plan
- Aligned to 1-20 yr forecast



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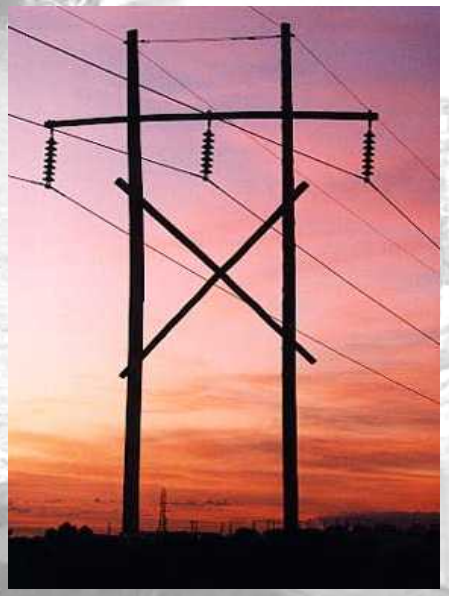
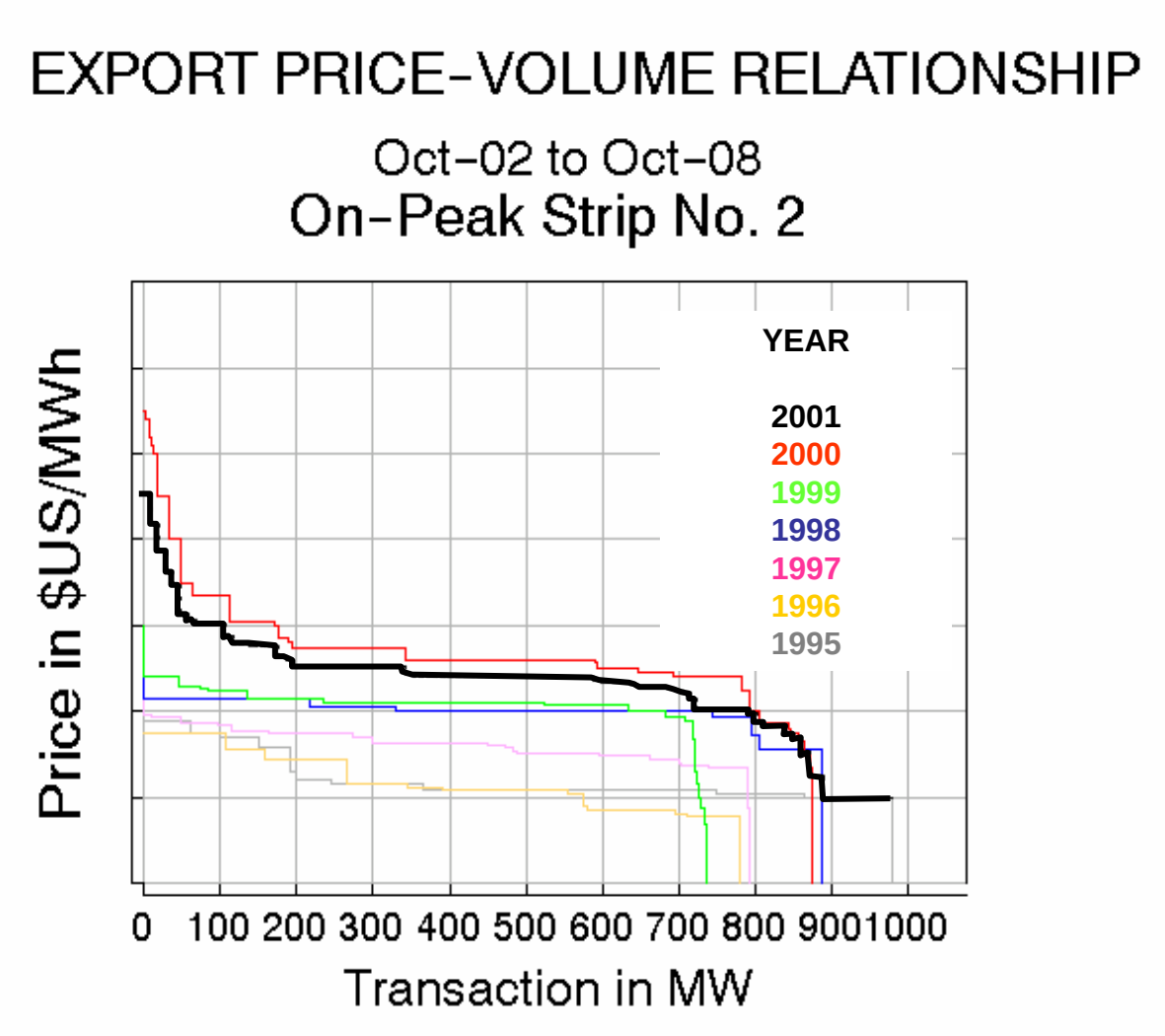
Export Market Forecast

Supply/demand influence:

as volume increases, export price decreases





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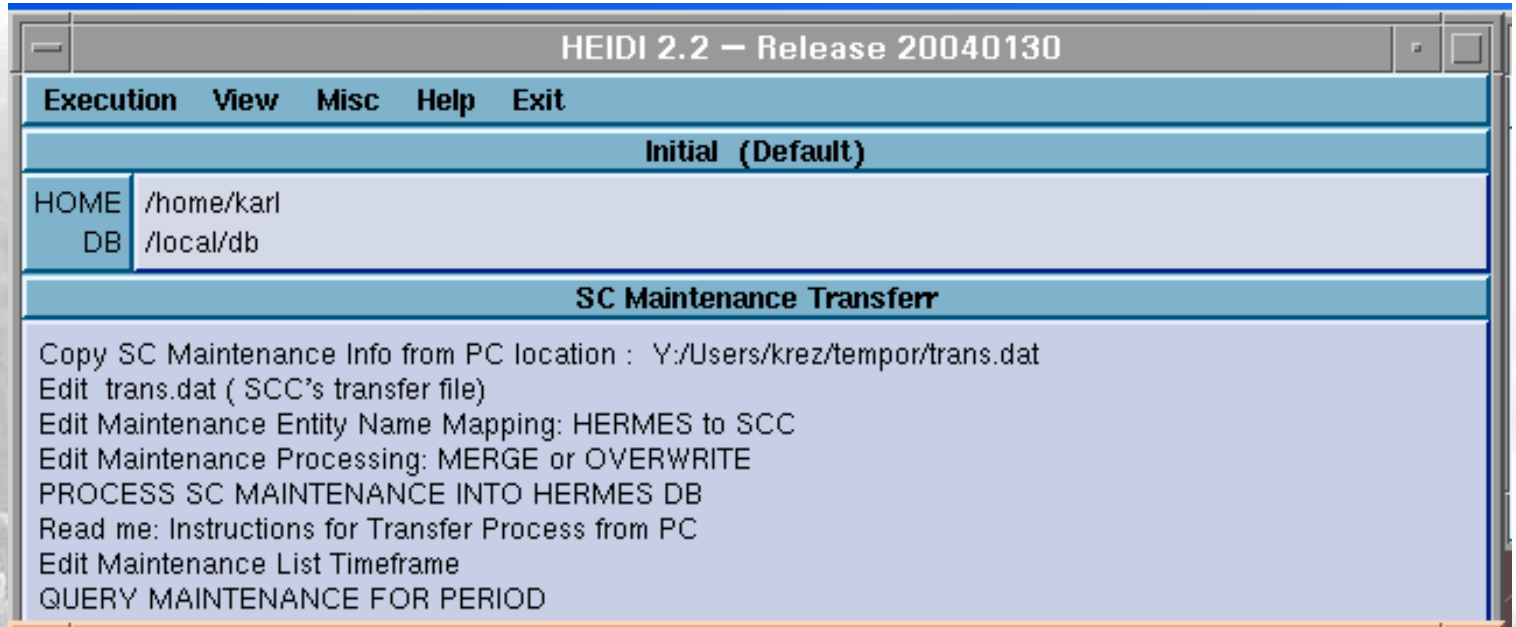
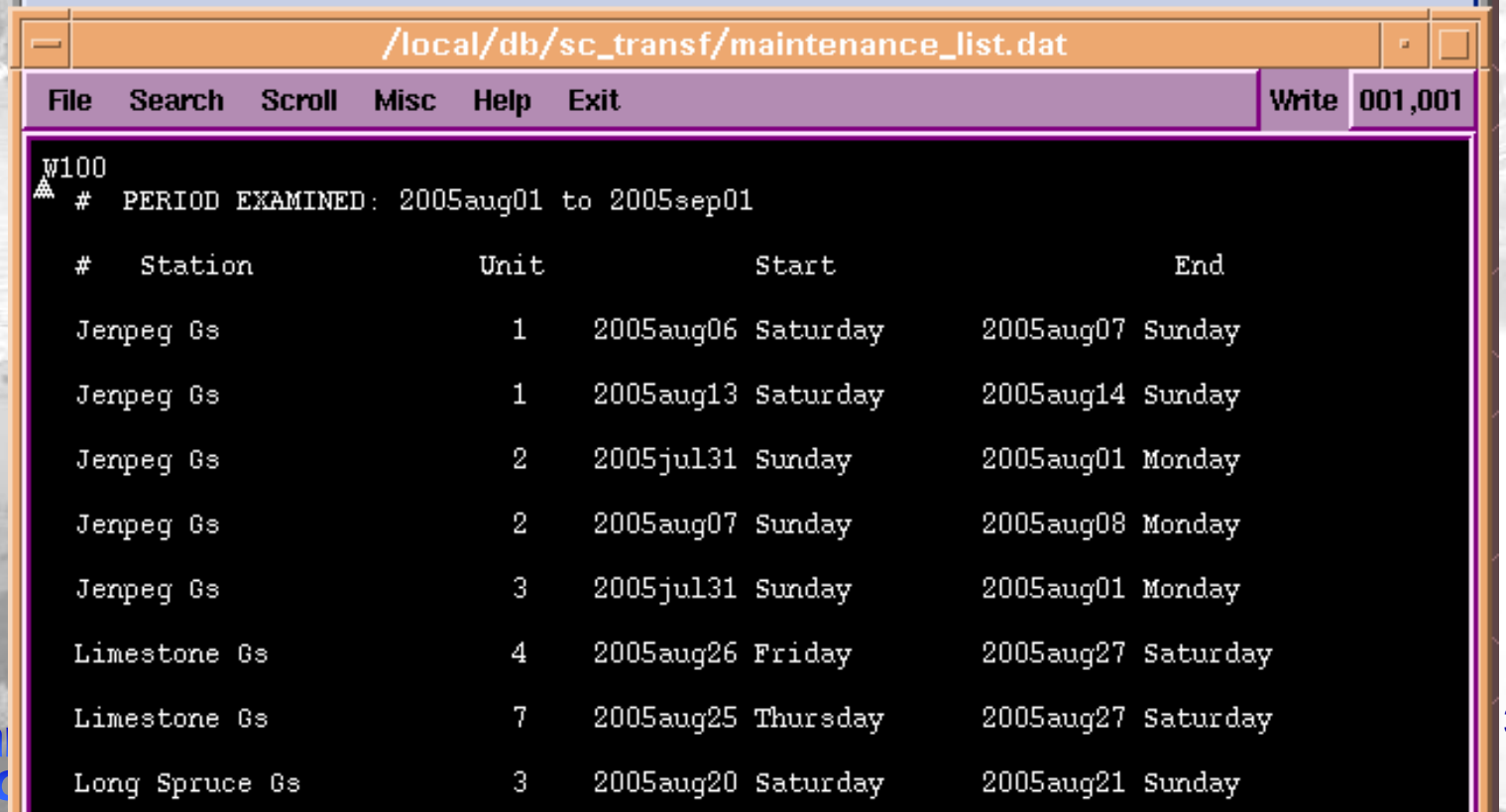

HEIDI 2.2 — Release 20040130
Execution View Misc Help Exit
Initial (Default)
HOME /home/karl
DB /local/db
SC Maintenance Transferr
Copy SC Maintenance Info from PC location : Y:/Users/krez/tempor/trans.dat
Edit trans.dat (SCC's transfer file)
Edit Maintenance Entity Name Mapping: HERMES to SCC
Edit Maintenance Processing: MERGE or OVERWRITE
PROCESS SC MAINTENANCE INTO HERMES DB
Read me: Instructions for Transfer Process from PC
Edit Maintenance List Timeframe
QUERY MAINTENANCE FOR PERIOD


/local/db/sc_transf/maintenance_list.dat
File Search Scroll Misc Help Exit
Write 001,001
W100
PERIOD EXAMINED: 2005aug01 to 2005sep01
Station Unit Start End
Jenpeg Gs 1 2005aug06 Saturday 2005aug07 Sunday
Jenpeg Gs 1 2005aug13 Saturday 2005aug14 Sunday
Jenpeg Gs 2 2005jul31 Sunday 2005aug01 Monday
Jenpeg Gs 2 2005aug07 Sunday 2005aug08 Monday
Jenpeg Gs 3 2005jul31 Sunday 2005aug01 Monday
Limestone Gs 4 2005aug26 Friday 2005aug27 Saturday
Limestone Gs 7 2005aug25 Thursday 2005aug27 Saturday
Long Spruce Gs 3 2005aug20 Saturday 2005aug21 Sunday

Return

Outage Planner

HVDC & Generation Equipment - All - 10-13-2005 to 11-25-2005

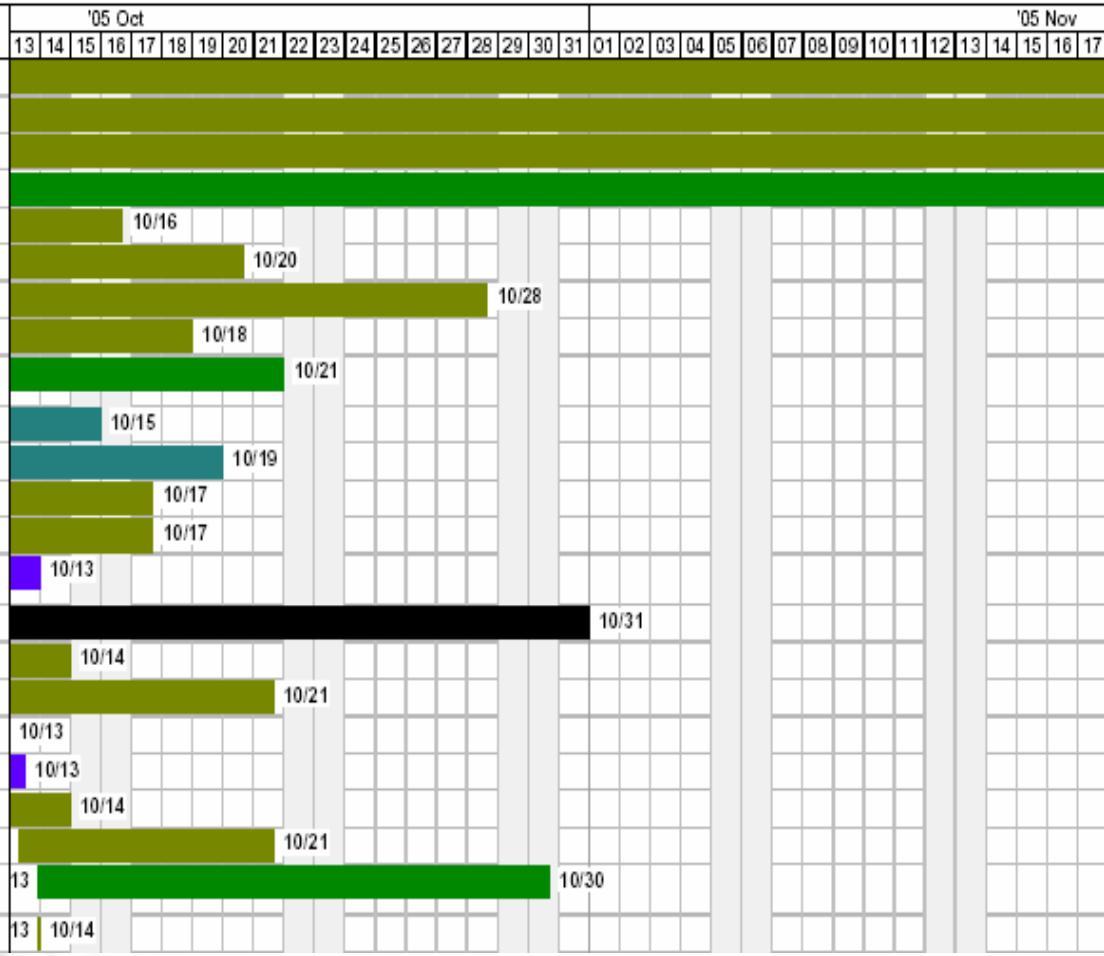
ID	Equip.	Station	Start	Finish
1	G4	Pointe Du Bois G.S.	Wed 04/06/30 12:40 PM	Fri 06/02/03 5:00 PM
2	G16		Thu 05/03/10 2:23 PM	Sun 06/01/15 4:55 PM
3	G15		Tue 05/06/07 5:05 PM	Thu 05/12/01 3:55 PM
4		Do	Tue 05/ 8 AM	We 4:55 PM
5		Jer	Wed 05 :48 PM	Sun 4:55 PM
6		Se s G.S.	Mon 05 4 AM	Thu 3:55 PM
7		Gr G.S.	Mon 05 9 AM	Fri 5:55 PM
8	H 1	Po is G.S.	Tue 05/ 00 PM	Tue 5:00 PM
9	Uni G5	Lo G.S.	Tue 05/ 17 PM	Fri 5:55 PM
10	T 2	He	Fri 05/1 AM	Sat 7:55 PM
11		Do nday	Fri 05/1 AM	We 7:55 PM
12		Se	Sat 05/ 5 PM	Mor 4:55 PM
13			Sat 05/ 5 PM	Mor 4:55 PM
14	Ur k -	Ke	Tue 05/ 2 AM	Thu 9:55 PM
15		Do	Tue 05/ 8 AM	Mor 5:55 PM
16		Po is G.S.	Tue 05/ 25 AM	Fri 5:30 PM
17		Sla G.S.	Wed 05 4 AM	Fri 5:55 PM
18		Gr G.S.	Wed 05 :00 PM	Thu 4:55 AM
19		Ke	Thu 05/ 5 AM	Thu 12:30 PM
20		Po is G.S.	Thu 05/ 5 AM	Fri 5:30 PM
21			Thu 05/ 5 AM	Fri 5:55 PM
22	Unit 6 Bank - G6	Limestone G.S.	Thu 05/10/13 10:05 PM	Sun 05/10/30 4:55 PM
23	G4	Great Falls G.S.	Thu 05/10/13 10:05 PM	Fri 05/10/14 3:55 AM

Equipment Idenifiers

STATIONS

START DATE

END DATE



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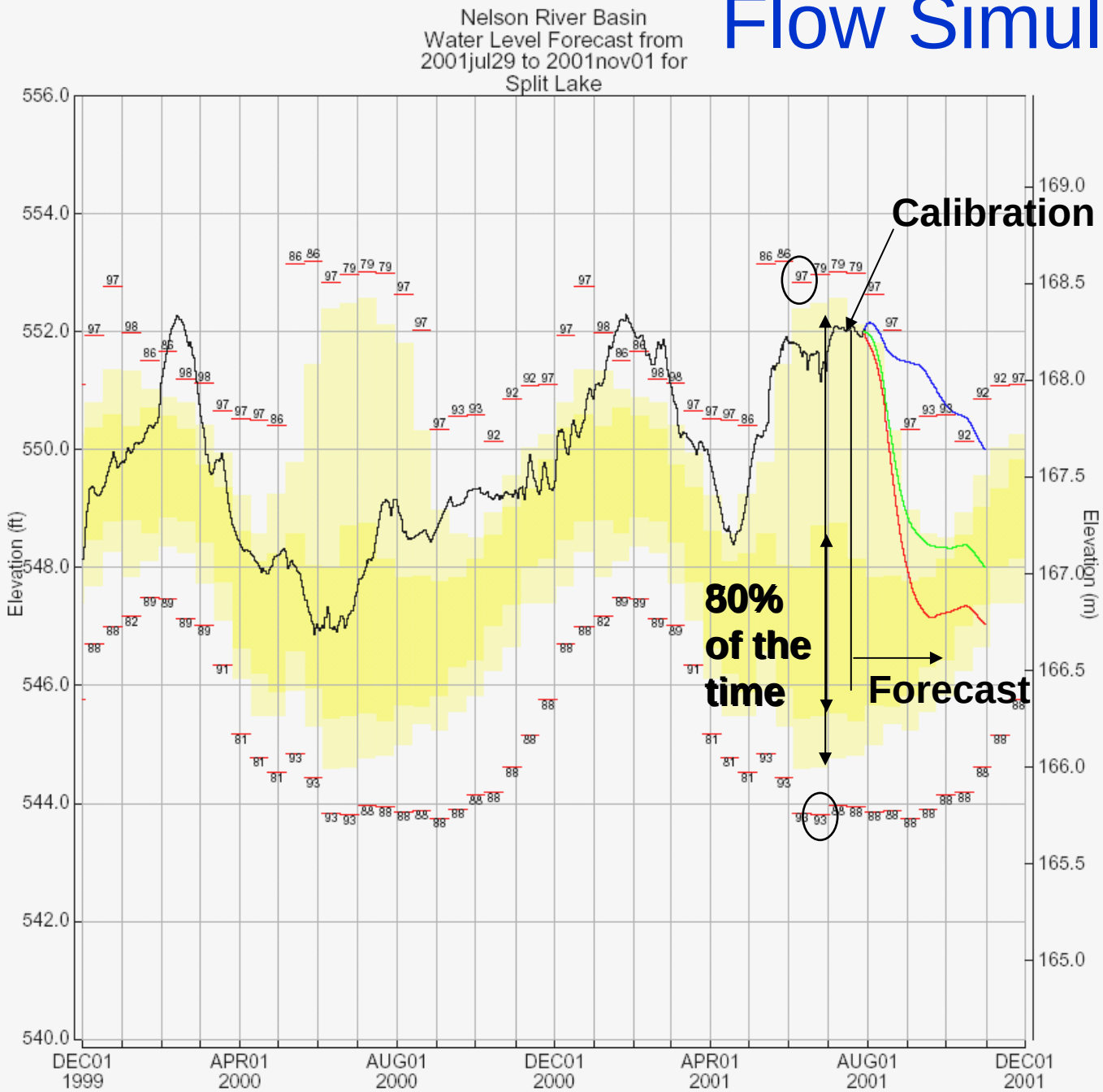
Flow Simulation

Return



LEGEND

Forecast of Average Water Levels

High Water Supplies
Expected Water Supplies
Low Water Supplies

Historical Data

50 — Maximum level recorded and its year of occurrence

Levels have been:
- above this range 10% of time
- within this range 80% of time
- below this range 10% of time

Levels have been:
- above this range 25% of time
- within this range 50% of time
- below this range 25% of time

77 — Minimum level recorded and its year of occurrence

Actual daily average levels

Water level recorded on datum:
GS Of Canada 1929 Adj

Minimum, maximum, decile, and quartile levels for each 14 day period are based on daily values from the historic record from September 1, 1977 to March 1, 1999

For more information please contact:
Dave Cormie 474-3806
John Crawford 474-3916

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Power Planing and Operations
Energy Supply and Sales
WED-2001AUG01-07:58

Exceed

HEIDI 2.2 — Release 20040130

Execution View Misc Help Exit

Energy Management (0506_expected)

MAOPTS	-monitor
DB	/local/db
TITLE	Energy Management Plan
RUN	0506_expected
GENESTIMATE	0506_expected
LTMODEL	lt.02may01_05may01
LDC	0506_expected
INTERESTRATE_TS	medium
EXCHANGERATE	medium
FLOW	expected
FLOWRATING	medium
FLOWBOUNDS_TS	medium
LAKEBOUNDS	oct01
STAGEBOUNDS	expected
OUTLET_CONFIGURATION	upper_nelson_controlled
STORAGE_RESERVE_GROUPING	end_of_2005_06
COOLINGTEMPPROB_TS	medium
IMPORT_INTMARKETLIMIT_TS	medium
EXPORT_INTMARKETLIMIT_TS	medium
ENERGY_FORECAST_ADJ	official
AMBIENTTEMPPROB_TS	medium
HISTLOADS	manitoba
HISTTEMPS	winnipeg
INCREMENTAL_SALE_ANALYSER	off

Energy Management

Import Flow Simulation Results
Run EMMA
Job Status
Print Reports
Export Results

Return

Environment Variables

- Import QSIM

- Reports

- Export Results

Precipitation - [Precipitation Graphs]

Reports / Graphs Maintenance Uploads Window Help

Start Date: 2005 9 26

End Date: 2005 10 3

Basins: Churchill River Basin, Nelson River Basin, Saskatchewan River Basin, Winnipeg River Basin

Subbasins: Assiniboine U/S Bdn., Dauphin River, L. Seul/L. St. Joseph, Lake of the Woods, Lake Winnipeg Local, Lower Churchill, Nelson River Local, North Sask. Mountain

Stations

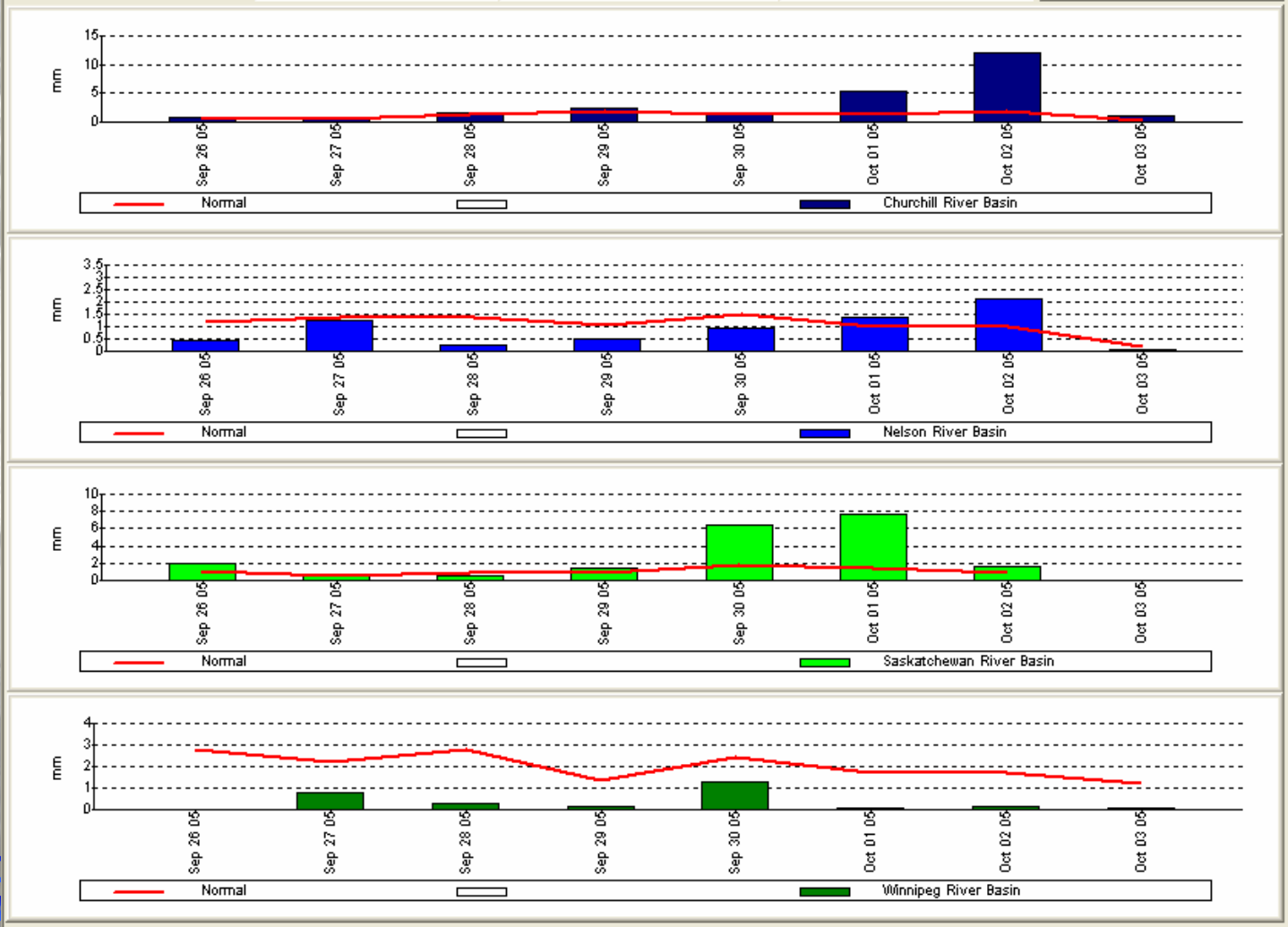
Plot Daily

Plot Weekly

Plot Weekly (Mon - Sun)

Clear All

Show All



DCP_DB

Query Update Window Help

Plot/Select Stage

Select One

South Indian Lk | Lake Winnipeg | Thompson | Outlet Lakes | Upper Church.
Cross Lake | Sipiwesk | Split Lake | Stephens Lake | Russell+ Eager
Manasan | Opegano | Wuskwatim | Footprint Lake
Other

3660 Rows Retrieved

Plot

Select

Select One

Hourly | Daily Average | Weekly Average | Monthly Average

Monthly Range is recommended for plot duration

Start Date 2005 9 3

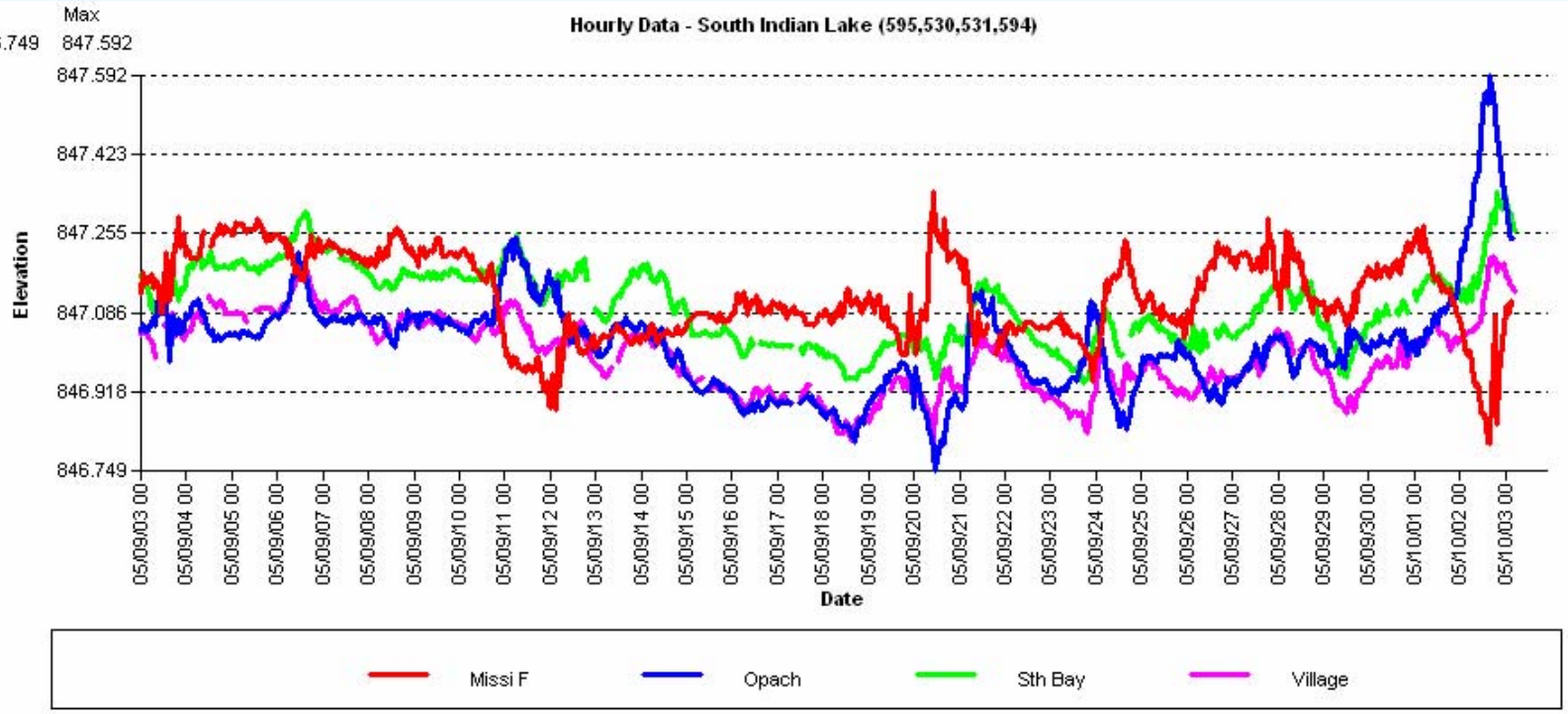
End Date 2005 10 3

Select One

Metric | Imperial | Percent

DCP Stage (Elevation) DATA

Min 846.749 Max 847.592



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Daily Hydrometric Data

Info Help Exit

Extract Data

Field Numbers: 121 (Separate with commas) Browse ...

From Date: 2005apr01 (Leave blank for first available date)

To Date: (Leave blank for last available date)

Destination: /home/jason/x (Will be Overwritten)

Header Comments: No / Yes

Output Codes: No / Yes

Missing Value: ? / -99999

Units: Imperial / Metric

Extract View

Graph Data

Title: (Leave blank for default and use \n for newline)

Plots Per Page: 1 (Choose from 1 to 4)

Lower Limit: 20 (Leave blank for default)

Upper Limit: 80 (Leave blank for default)

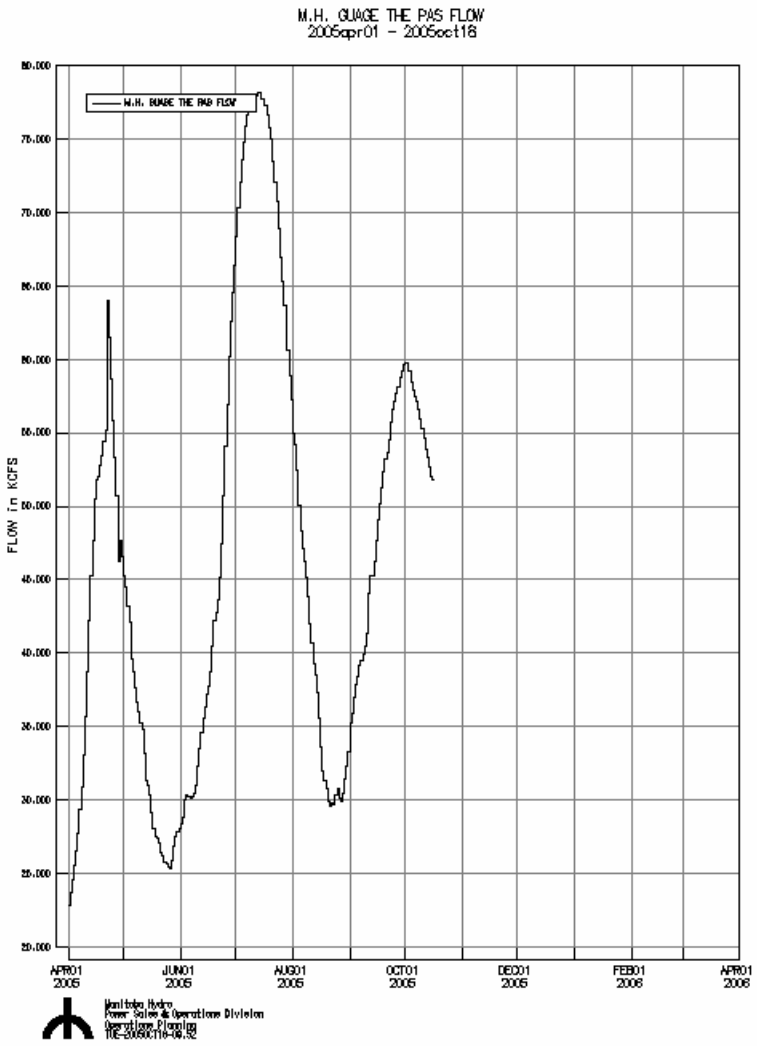
Frame Type: One Month / Six Months / Calendar / Fiscal / Two Years / Decade / Century

Graph View

Done.

dhf:20050401–20060401

Directory Graph Page Export Misc Help Exit



GRANDGS_ESS,SCADA[EMS] SCZPSO1 (A) PSO

Edit Navigate EMP Applications PSO Displays Help

Return

GRAND RAPIDS GS

03-Oct-2005 15:46:21

Forebay	841.99 F S	
Tailrace	717.23 F S	

Status		Reserves		Discharge	
Total MW	477 S			Total	52.185 KCFS S
		Spinning	Ready	Plant	52.185 KCFS S
Max. MW	480	7	0	Spillway	0.000 KCFS S
Unit ID					
G1	119.5	0.0	0.0		12.858 KCFS S
G2	121.6	0.0	0.0		13.071 KCFS S
G3	117.9	0.3	0.0		12.928 KCFS S
G4	119.1	6.3	0.0		12.893 KCFS S

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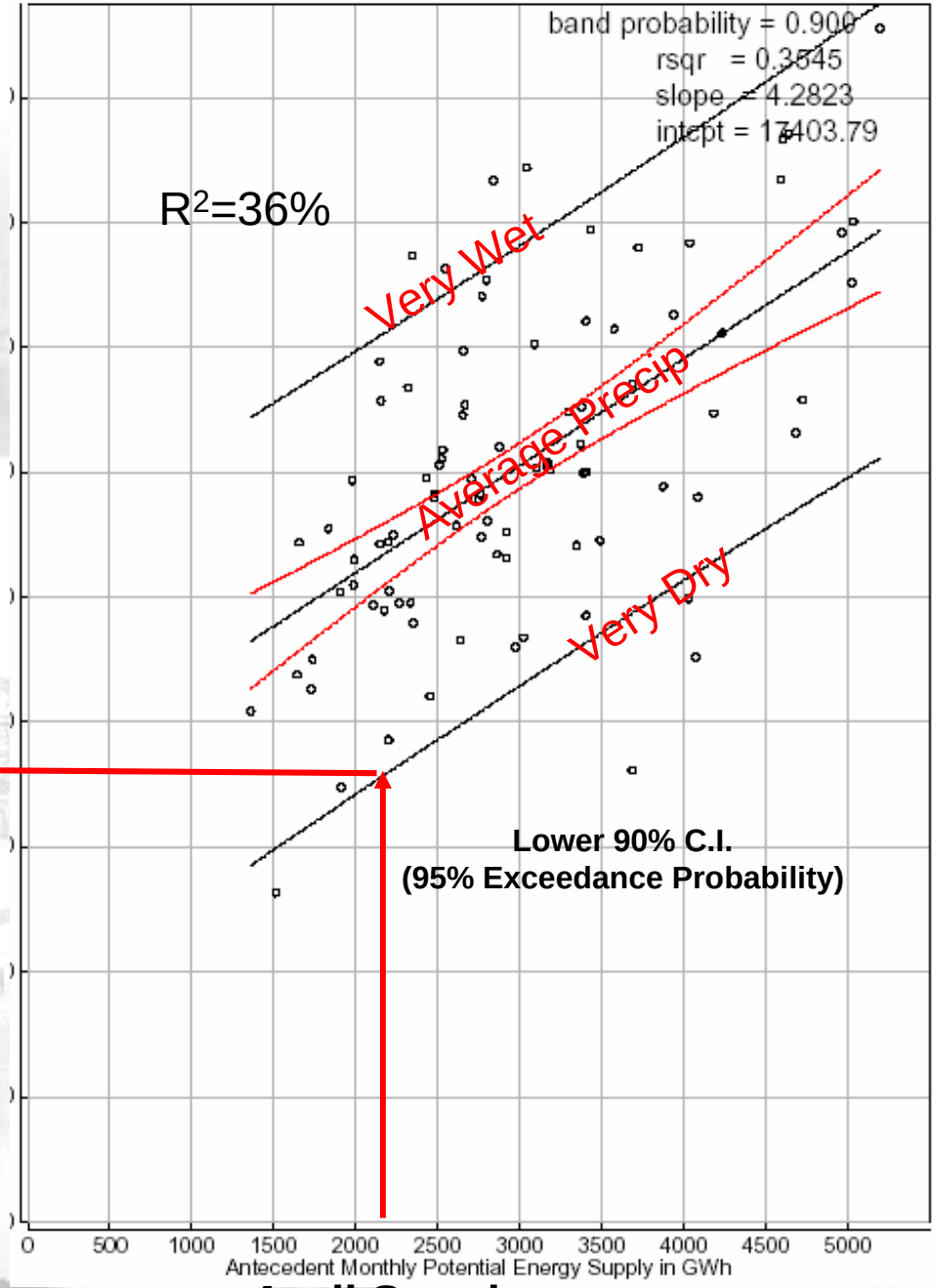
Potential Hydro Energy Supply From Inflows

April
as
Leading Indicator
for
May – March

Base Case Supply
(May to March)
Used for Planning

Return



April Supply

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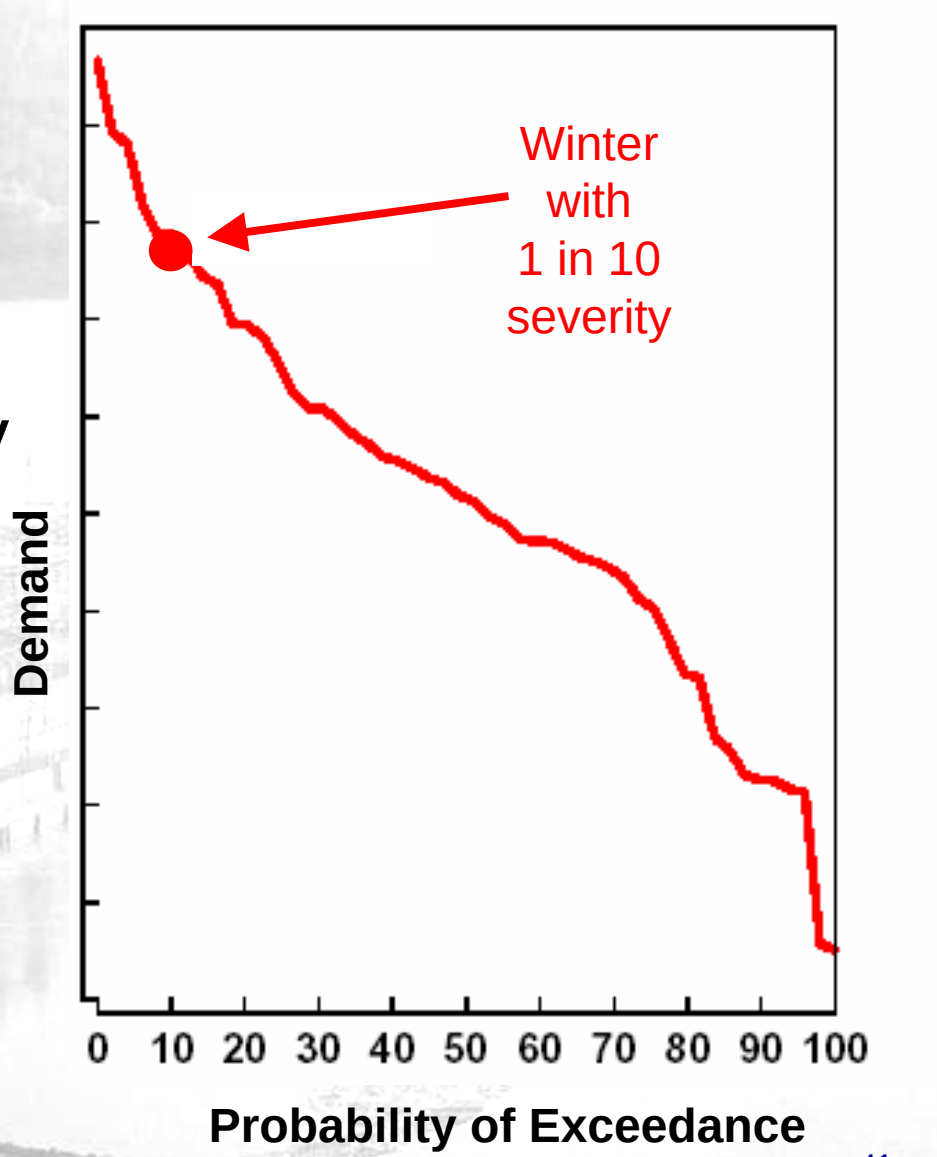
Manitoba Energy Demand

- Exceedance probability
  - Winter 10%

BACK

Manitoba Winter Demand Variation Due to Weather



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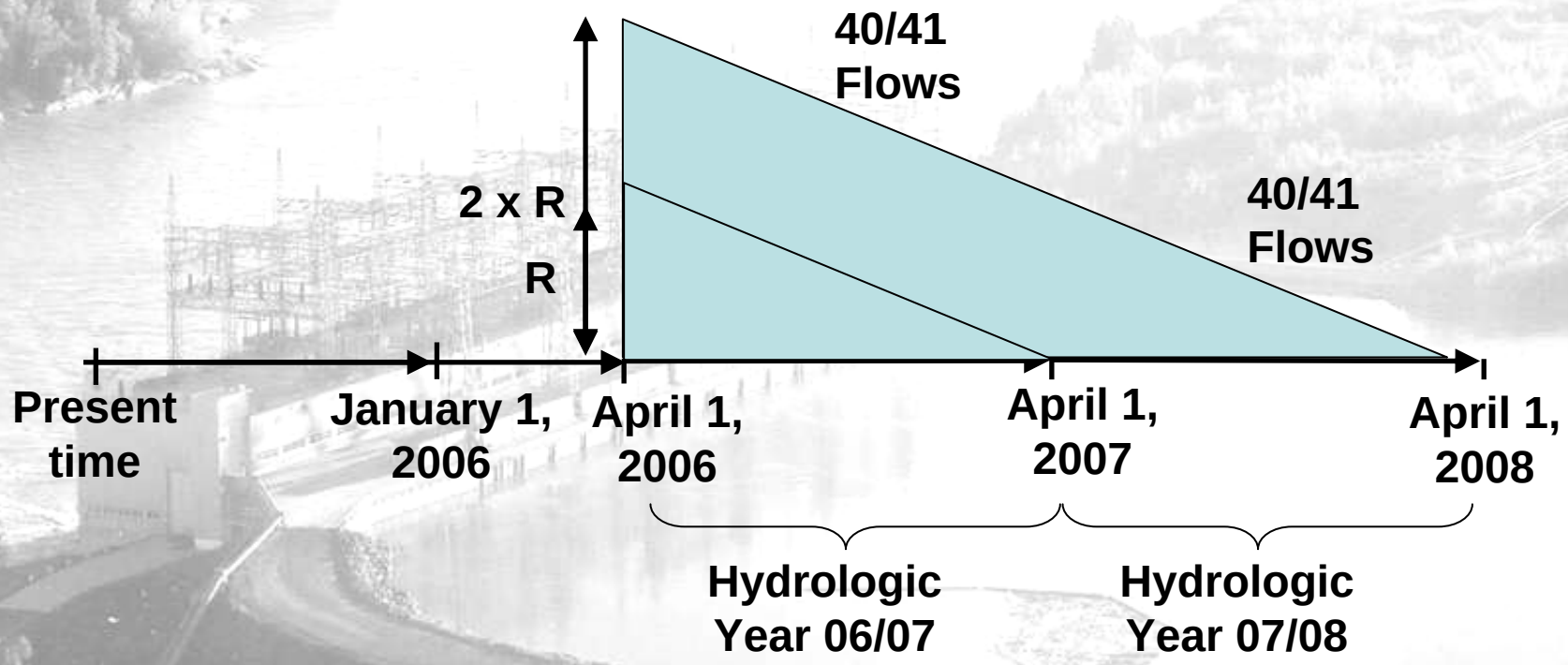
Adjusting Spring Storage Targets for Snow Pack Conditions

BACK



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