



The Souris River Study

PPWB Edmonton

November 27, 2019



**International Souris
River Study Board**

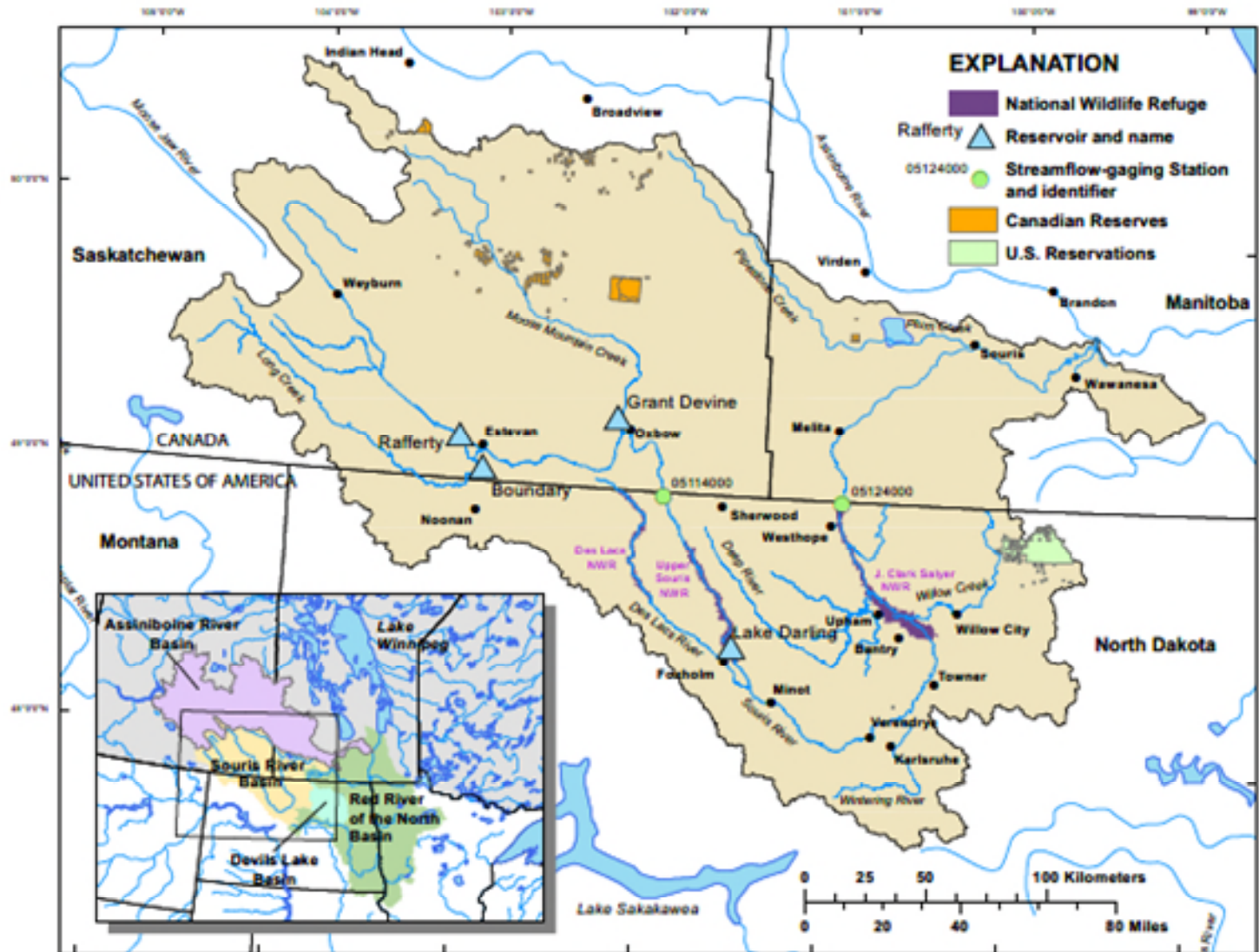


Presentation Overview

- Souris River Context
 - Agreement
 - Basic Operations
 - 2011 Flood
- Souris River Study
 - Elements
 - Products
 - Information



Souris River Basin





1989 Canada-US Agreement on Water Supply and Flood Control in the Souris Basin

- Collaborative construction to provide water supply for Canada and Flood Protection for the US.
 - Defined cost sharing agreement for construction, identified the US Army Corps as the responsible US entity.
 - Canada Saskatchewan Agreement –Designated Saskatchewan as responsible Canadian Entity.
 - Two Annexes
 - Annex A – Operating Plan for Can/US reservoirs
 - Annex B – Low Flow/Apportionment



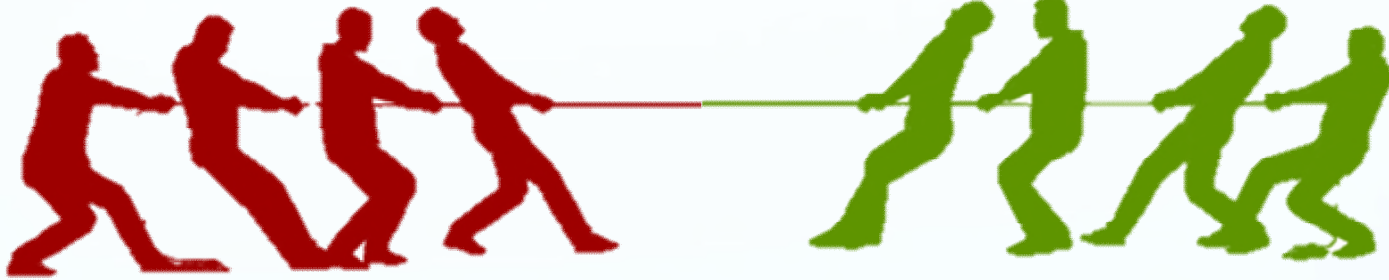
Objectives of the 1989 Agreement

1. Provide 1% (100-year) spring flood protection at Minot ND;
2. To maximize the supply of water in the Souris River Basin within the bounds of the operating agreement.



Objectives of the 1989 Agreement

- Competing/Conflicting Objectives



Flood Control

- ✓ *Keep reservoir low*

Water Supply

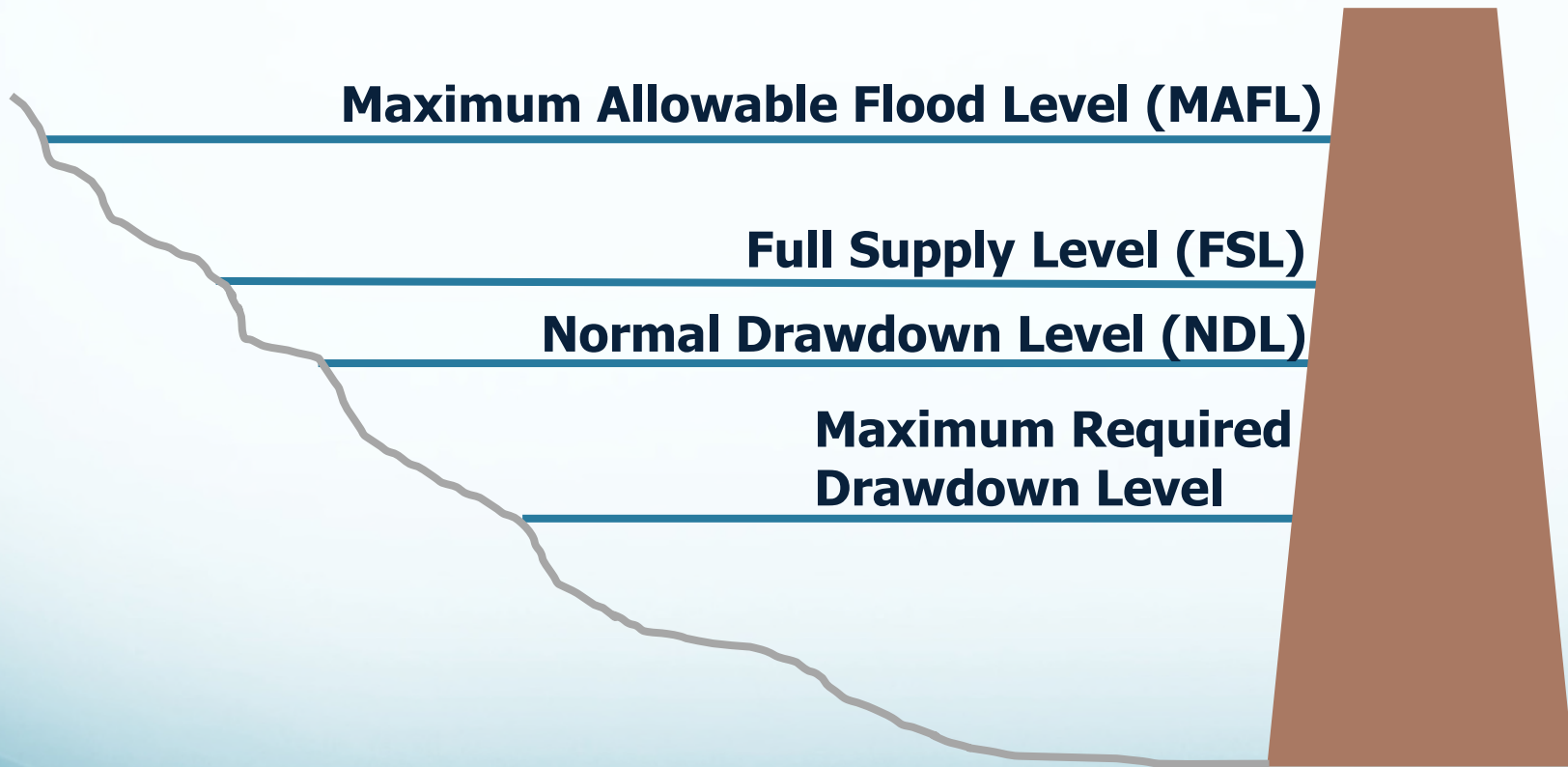
- ✓ *Keep reservoir full*

- Reservoirs must be multi-purpose



How Do the Reservoirs Achieve the Objectives?

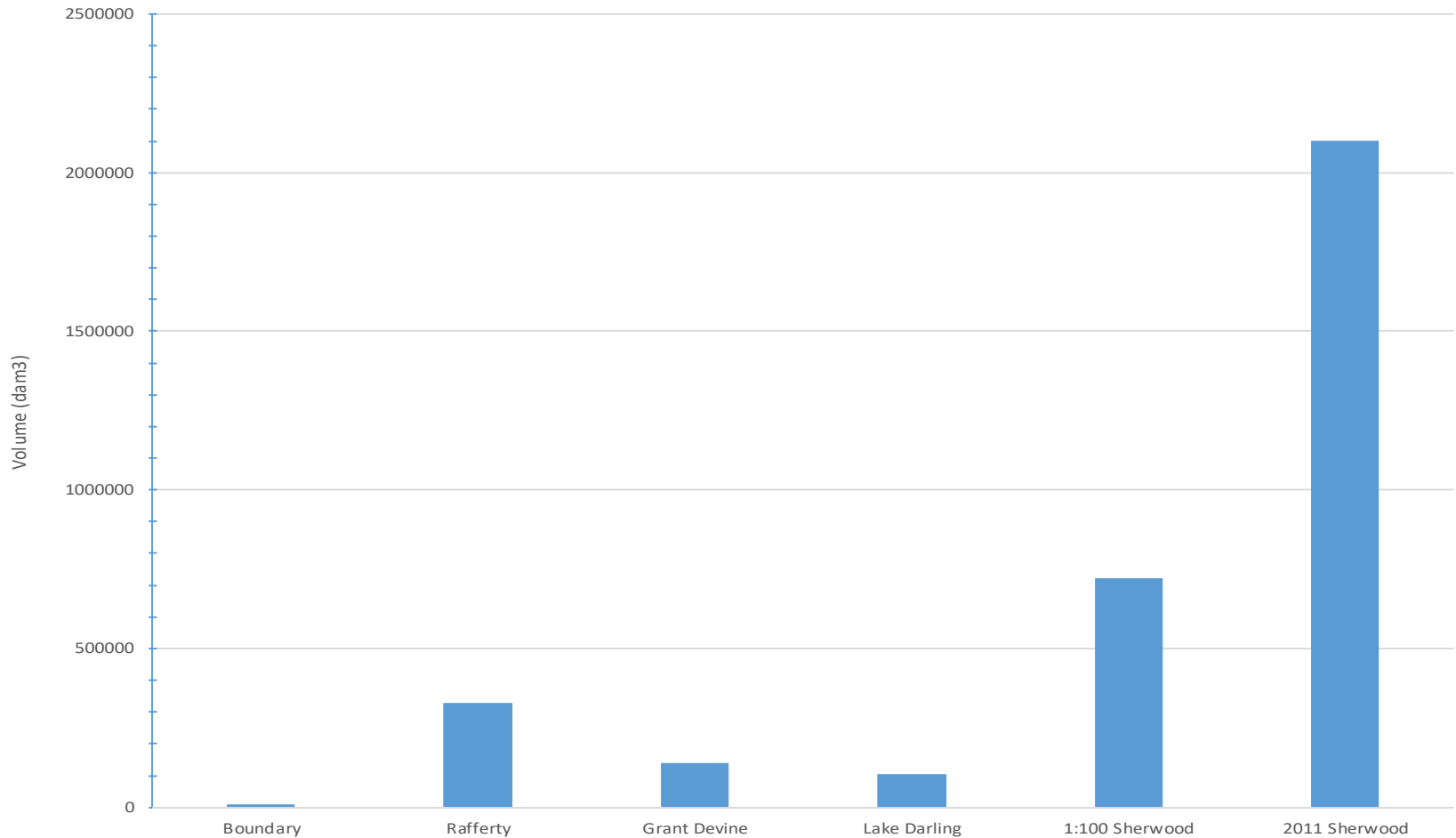
- Operating Level Terminology





Storage and Flow Volumes

Flood Storage Volumes

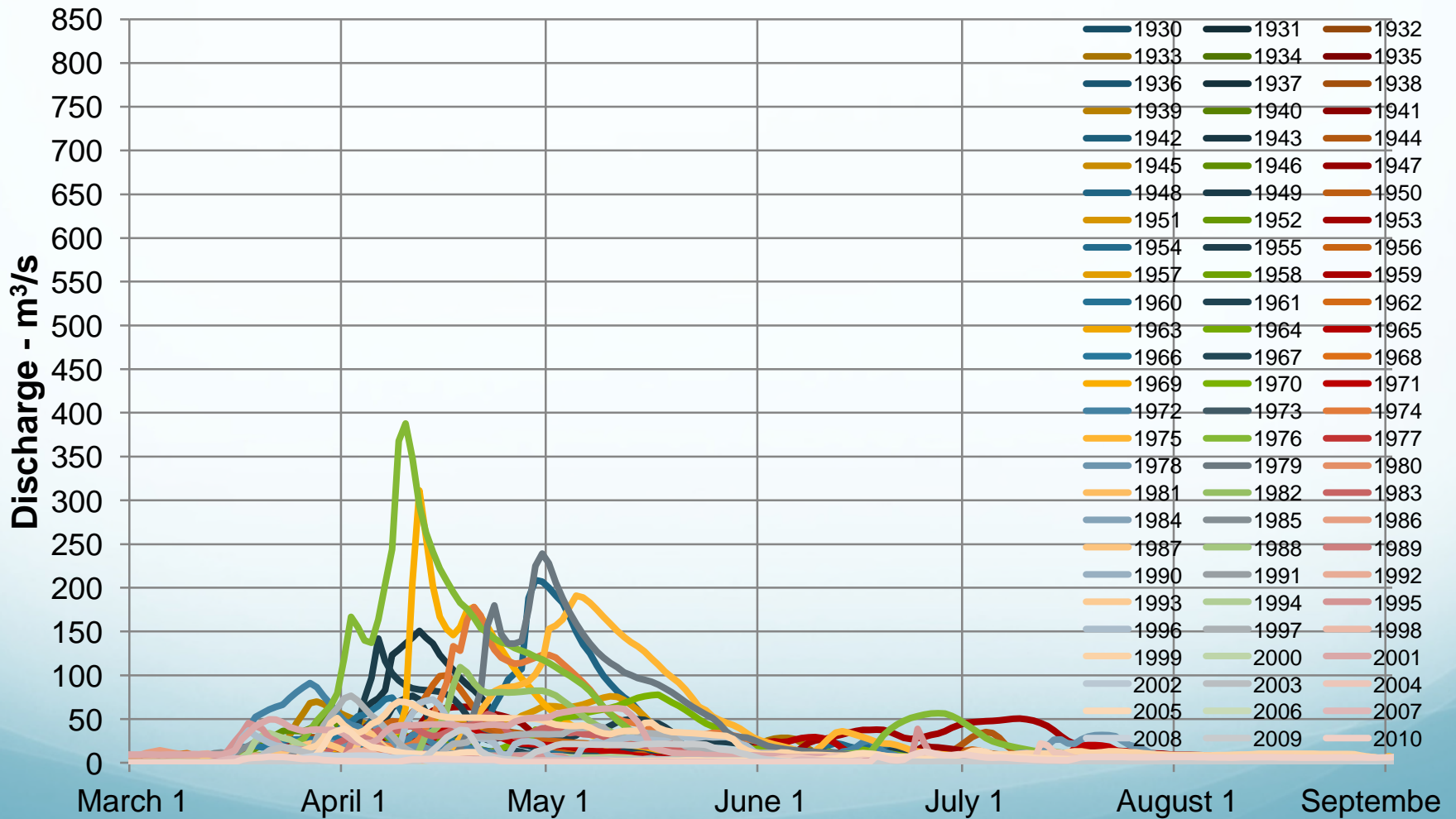


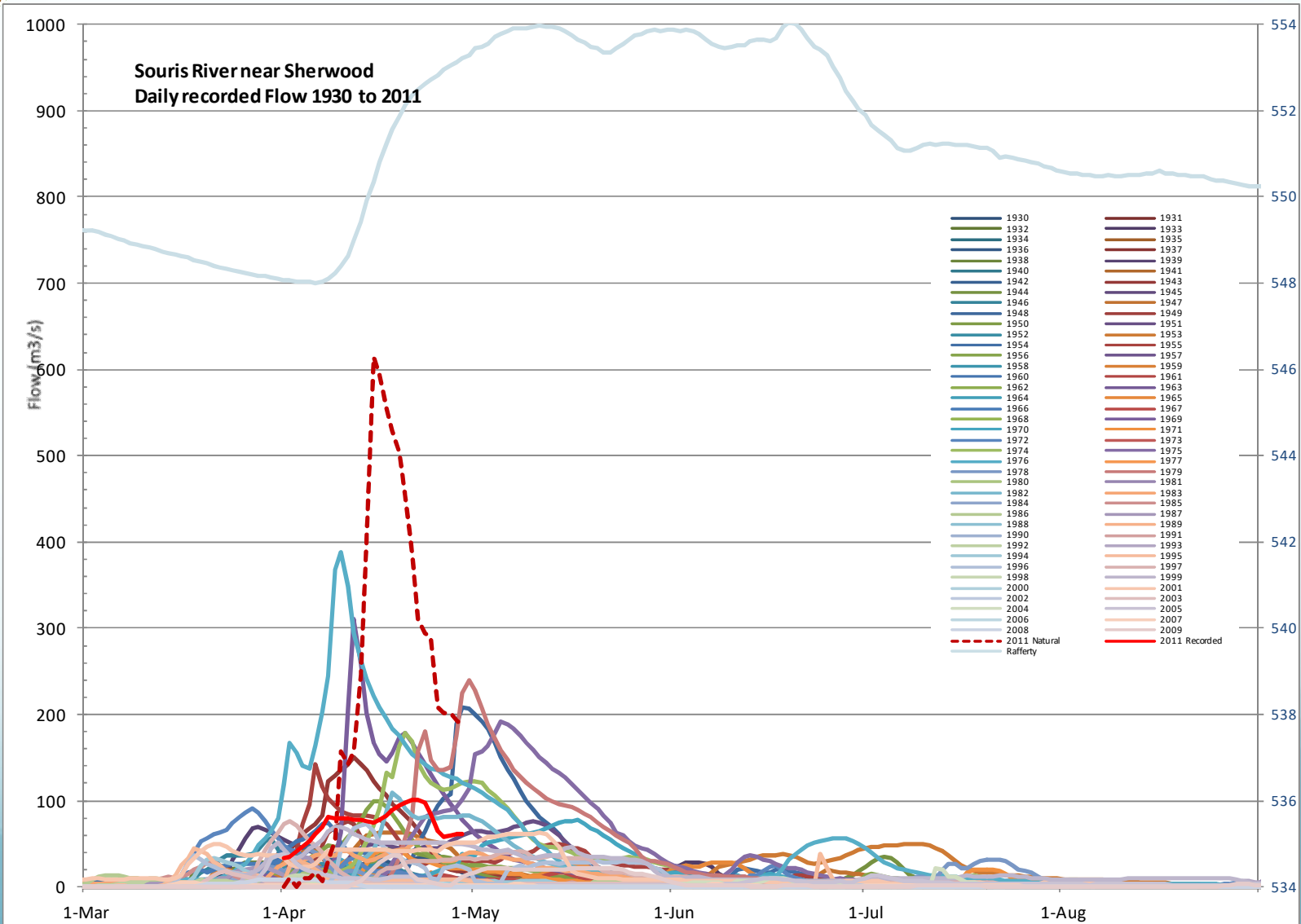


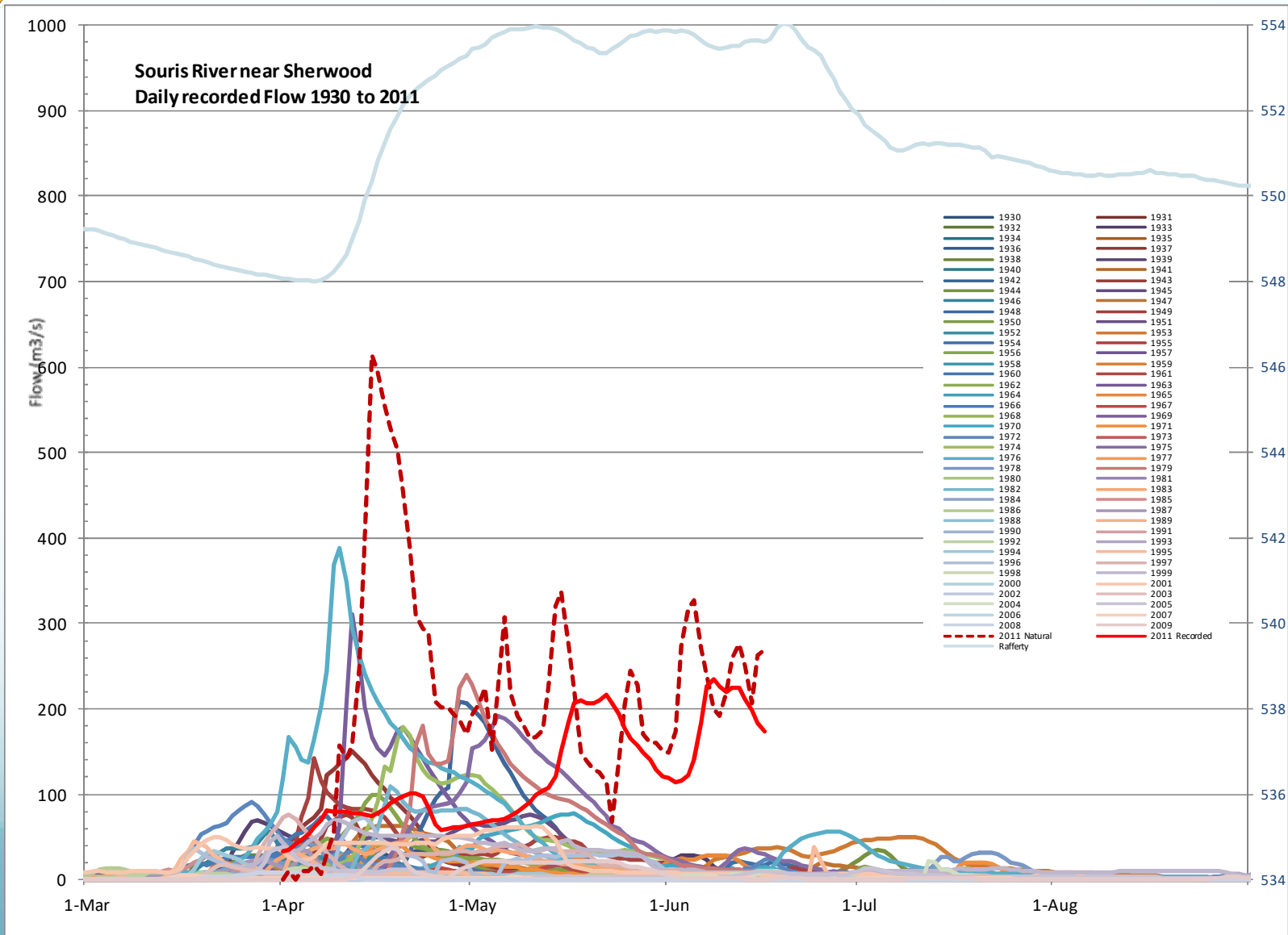
2011 Flood

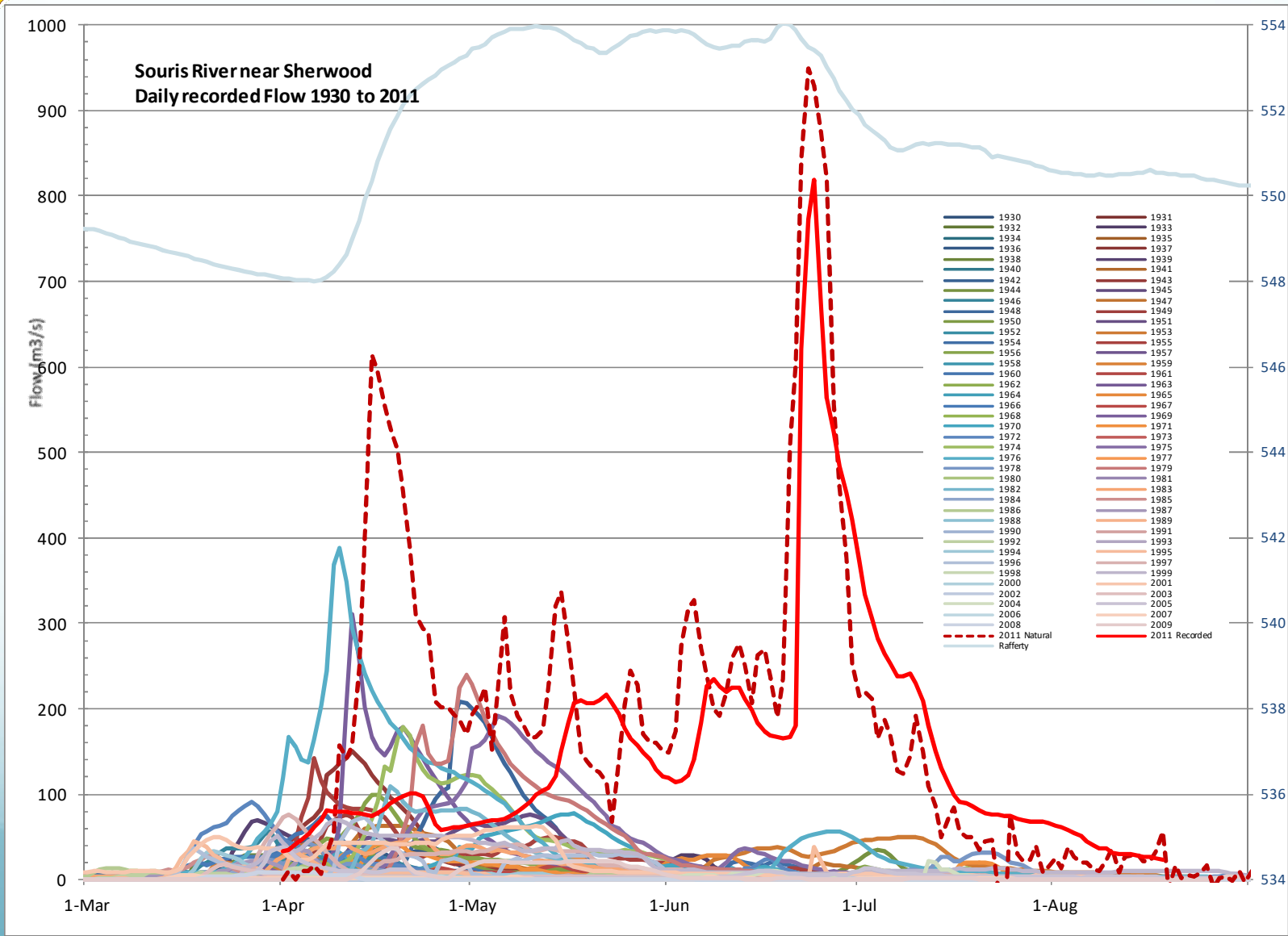


Souris River at Sherwood Annual Observed Hydrographs



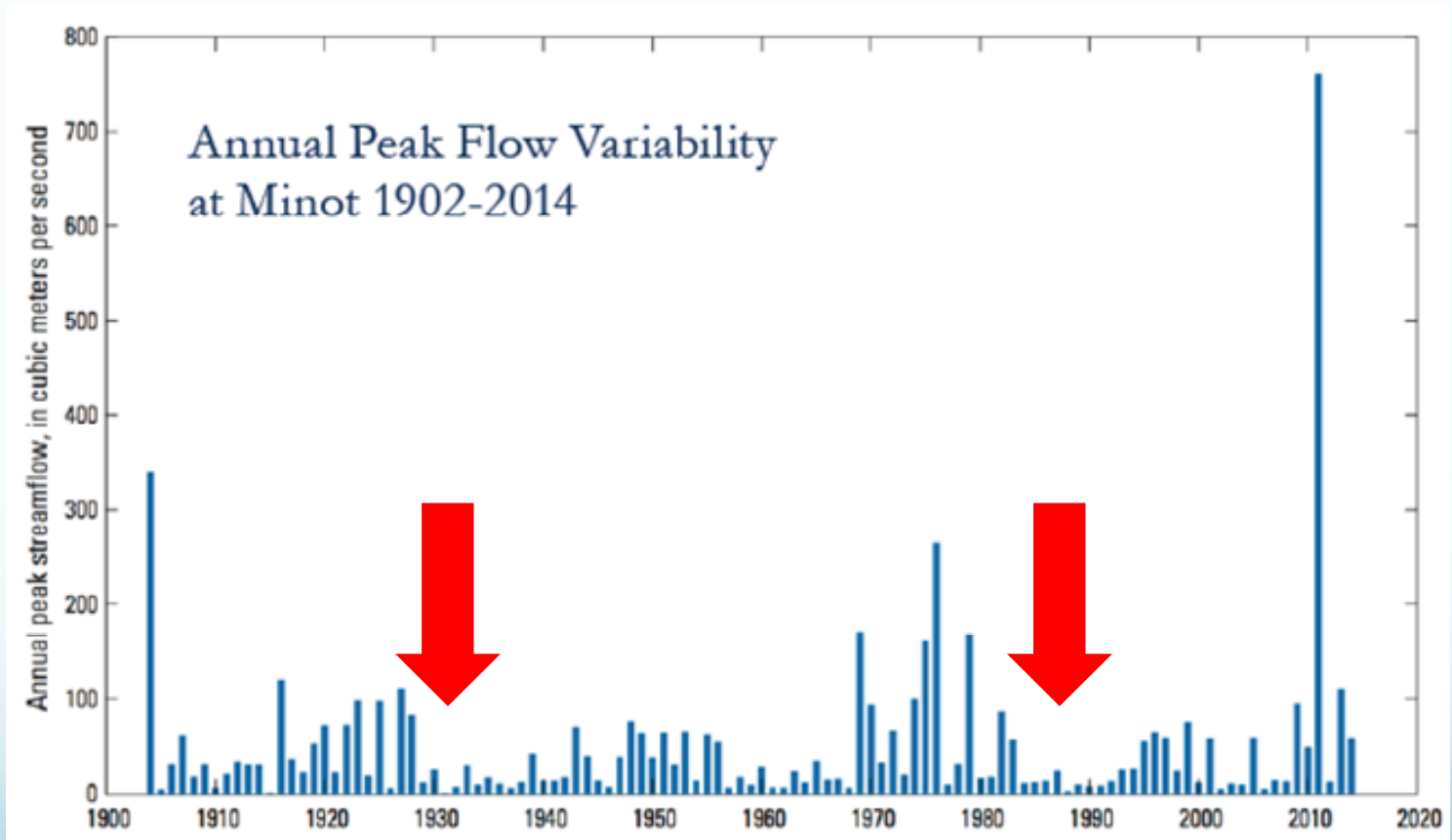








Droughts





Study Challenges

- Create an alternative operating plan that
 - Balances Flood Control and Water Supply
 - Respect Apportionment Agreement
 - Maximize things like ecosystem health/water quality
 - Minimizes damages (infrastructure and agric etc.)
 - Considers Summer Events



Work Plan Progress

Old No.	New No.	Name	Group	Canada Costs (CND)	USA Costs (USD)
1a, 1b, 2	OR1	1989 Agreement Language Review	Operating Rules Review	6	0
				6	0
3	DW1	Summarize POS Projects and Report Progress since 2013	Data Collection and Management	3	0
4	DW2	Lidar and Bathymetry for Reservoirs		75	0
5	DW3	Review of Hydrometeorological Network Report		15	0
6	DW4	Data Collection for PRM		0	85
				93	85
7	HH1	Regional Hydrology	Hydrology & Hydraulics	44	25
8	HH2	Stochastic Water Supplies		6	185
9	HH3	Artificial Drainage Impacts Review		43	0
10	HH4	Flow Simulation Tools Development (MESH)		76	0
11, A4	HH5	ECCC Climate Change Supplies		47	5
12	HH6	Reservoir Flow Release Planning (RES-SIM)		64	65
13	HH7	Reservoir Flow Release Planning (HEC-RAS)		3	16
new	HH8	Develop PRM Model		4	72
new	HH9	Model System Integration		28	0
new	HH10	Forecasting Assessment		175	0
				490	368
14, A1, A3, A5, A6	PF1	Workshops and Engagment	Plan Forumlation	209	175
15, 16, 17	PF2	Run and Evaluate Alternatives		173	238
new	PF3	Dam Safety		3	75
new	PF4	Roadmap for apport., water quality, and aquatic eco. health		0	0
				385	488
	A1	Administration - Independent Review Group		47	33
	A2	Administration - Study Manager (Canada)		165	0
	A3	Administration - Study Manager (U.S.)		0	106
				212	139
Total				1186	1080



Study Approach

- Operating Rules Review
 - 1&2 Language Review
- Data Collection and Management
 3. Progress Since 2011
 4. Lidar and Bathymetry For Reservoirs
 5. Review of Networks
 - 6. Data Collection – Performance Indicators**

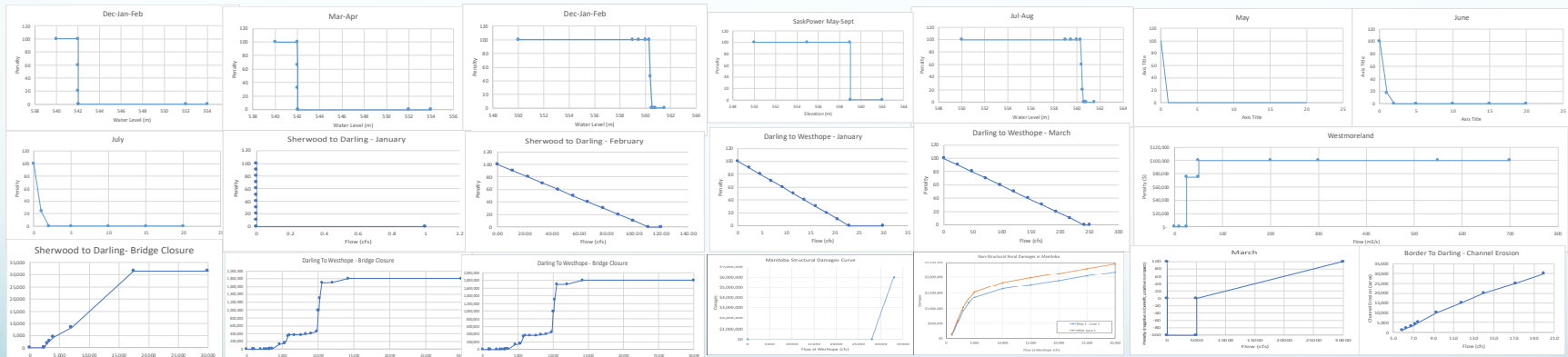
Old No.	New No.	Name	Group	Canada Costs (Cdn)	USA Costs (USD)
3	OR1	1989 Agreement Language Review	Operating Rules Review	0	0
3	DW1	Summarize POS Projects and Report Progress since 2011		3	0
4	DW2	Lidar and Bathymetry for Reservoirs	Data Collection and Management	75	0
5	DW3	Review of Hydro-meteorological Network Report		15	0
6	DW4	Data Collection for PRM		0	85
7	HH1	Regional Hydrology		93	85
8	HH2	Stochastic Water Supplies		44	25
9	HH3	Artificial Drainage Impacts Review		6	180
10	HH4	Flow Simulation Tools Development (MESH)		76	0
11, A4	HH5	ECCC Climate Change Supplies		47	5
12	HH6	Reservoir Flow Release Planning (RES-SIM)	Hydrology & Hydraulics	64	85
13	HH7	Reservoir Flow Release Planning (RES-CAS)		1	36
new	HH8	Develop PRM Model		4	72
new	HH9	Model System Integration		28	0
new	HH10	Forecasting Assessment		175	0
				490	365
14, A1, A3, A1P1		Workshops and Engagement		200	175
15, 16, 17	P12	Run and Evaluate Alternatives		173	238
new	P13	Dam Safety	Plan Formulation	3	75
new	P14	Roadmap for support, water quality, and aquatic eco. health		0	0
				380	488
A1		Administration - Independent Review Group		47	31
A2		Administration - Study Manager (Canada)		145	0
A3		Administration - Study Manager (U.S.)		0	106
				272	137
			Total	1160	1000



Work Plan Progress

Task No.	Task Name	Group	Canada Costs (CAD)	USA Costs (USD)
01	2019 Agreement Language Review		0	0
3	DW1 Summary PCS Projects and Report Progress since 2013	Operating Rules Review	6	0
4	DW2 Lidar and Bathymetry for Reservoirs	Data Collection and Management	75	0
5	DW3 Review of Hydro-meteorological Network Report		15	0
6	DW4 Data Collection for PMA		2	85
7	HH1 Regional Hydrology		44	2
8	HH2 Stochastic Water Supplies		5	185
9	HH3 Artificial Drainage Impacts Review		43	0
10	HH4 Flow Simulation Tools Development (MESH)		76	0
11 A4	HH5 ECC Climate Change Supplies		4	0
12	HH6 Reservoir Flow Release Planning (RES-SM)	Hydrology & Hydraulics	64	65
13	HH7 Reservoir Flow Release Planning (REC-RAS)		3	36
new	HH8 Developing PMA Model		4	72
new	HH9 Model System Integration		28	0
new	HH10 Forecasting Assessment		125	0
14 A1, A1, A5, APP1	Workshops and Engagement		400	58
15, 16, 17	Run and Evaluate Alternatives		200	126
new	PF3 Dam Safety	Plan Formulation	0	75
new	PF4 Readiness for support, water quality, and aquatic eco. health		0	0
A1	Administration - Independent Review Group		385	48
A2	Administration - Study Manager (Canada)		165	0
A3	Administration - Study Manager (U.S.)		0	105
			212	180
			1148	650

- Data Collection and Management group tasks DW1-DW4 are mostly complete
 - DW1-draft report summarizing Plan of Study projects since 2013 has been written
 - DW2-lidar and bathymetry data for reservoirs has been obtained/collected
 - DW3-draft report of review and update of the Hydro-meteorological data network is complete
- DW4-data collection to be used as input to Prescriptive Modelling System (HH8) is mostly complete – **Performance Indicators.**





Hydrology And Hydraulics

- 7. Regional Hydrology Dataset
- 8. Stochastic Hydrology Dataset
- 9. Drainage Impacts Review
- 10. Flow Simulation Tools (MESH)
- 11. Climate Change Supplies
- 12. 13. Flow Release Planning (HEC RES-SIM and RAS)
- New PRM Optimization
- New Forecasting Assessment

Old No.	New No.	Name	Group	Canada Costs (CND)	USA Costs (USD)
1a, 1b, 2	OR1	1989 Agreement Language Review	Operating Rules Review	6	0
3	DW1	Summarize POS Projects and Report Progress since 2013		6	0
4	DW2	Lidar and Bathymetry for Reservoirs	Data Collection and	75	0
5	DW3	Review of Hydrometeorological Network Report	Management	15	0
6	DW4	Data Collection for PRM		0	85
7	HH1	Regional Hydrology		44	25
8	HH2	Stochastic Water Supplies		6	185
9	HH3	Artificial Drainage Impacts Review		43	0
10	HH4	Flow Simulation Tools Development (MESH)		76	0
11, A4	HH5	ECCC Climate Change Supplies		47	5
12	HH6	Reservoir Flow Release Planning (RES-SIM)	Hydrology & Hydraulics	64	65
13	HH7	Reservoir Flow Release Planning (HEC-RAS)		3	16
new	HH8	Develop PRM Model		4	72
new	HH9	Model System Integration		28	0
new	HH10	Forecasting Assessment		175	0
				490	368
14, A1, A3, A5, A1P1	PF2	Workshops and Engagement		209	175
15, 16, 17	PF2	Run and Evaluate Alternatives		173	238
new	PF3	Dam Safety	Plan Formulation	3	75
new	PF4	Roadmap for sport, water quality, and aquatic eco. health		0	0
				385	488
	A1	Administration - Independent Review Group		47	33
	A2	Administration - Study Manager (Canada)		165	0
	A3	Administration - Study Manager (U.S.)		0	106
				212	139
			Total	1166	1008



Plan Formulation

14. Workshops and Engagement

15. 16, 17 Run and Evaluate Alternatives

New Dam Safety

New Roadmap for Apport, Water Quality, and Ecosystem Health.

Old No.	New No.	Name	Group	Canada Costs (CND)	USA Costs (USD)
1A, 1b, 2	OK1	1989 Agreement Language Review	Operating Rules Review	6	0
				6	0
3	DW1	Summarize PDS Projects and Report Progress since 2013		3	0
4	DW2	Lidar and Bathymetry for Reservoirs	Data Collection and	75	0
5	DW3	Review of Hydrometeorological Network Report	Management	15	0
6	DW4	Data Collection for PRM		0	85
				93	85
7	HH1	Regional Hydrology		44	25
8	HH2	Stochastic Water Supplies		6	185
9	HH3	Artificial Drainage Impacts Review		43	0
10	HH4	Flow Simulation Tools Development (MESH)		76	0
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14, A1, A2, A5, A1FF1	PF1	Workshops and Engagement		209	175
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	A3	Administration - Study Manager (U.S.)		0	106
				212	139
				1166	1000



Workshops and Engagement

- Public Advisory Group
- Resource Agency Advisory Group
- Indigenous Engagement
- ISRB Engagement



Basin Interest

- How are basin interests determined
 - Through an online questionnaire
 - Continued engagement with
 - Public
 - Resource and Agencies
 - Indigenous Nations

Public Concerns	Number of Responses	% of Total
Flooding	15	58%
Stagnant water in summer/fall	8	31%
Lack of recreation/boating access	2	8%
Bank Erosion	2	8%
Recreation safety issues	1	4%

Total Responses: 26

What People Value	Number of Responses	% of Total
Wildlife/Habitat/Fishing	30	47%
Drinking Water (People/Livestock)	16	25%
Recreation	15	23%
Aesthetics/Beauty	15	23%
Irrigation	5	8%
Tourism	1	2%
Local Culture	1	2%
Power Generation	1	2%

Total Responses: 64

Changes Public Wants to See	Number of Responses	% of Total
Operate only for flood control	5	24%
Keep reservoirs lower in winter	5	24%
Higher flows in summer	2	10%
Less variability in flow	3	14%
Maintain natural flow	2	10%
Current operation is ok	2	10%
Normal Rafferty pool to 550 m	1	5%
Less artificial drainage	1	5%

Total Responses: 21



The Two Boards

- The International Souris River Study Board (ISRSB)
 - A temporary board created to investigate reservoir operation on the Souris River.
- The International Souris River Board (ISRB)
 - A permanent created to oversee operations within the Souris River Basin.



Visualization Tool

USGS | Souris River | SpotWx | Home | SPC SREF Run:2019112715 | Canadian Weather Radar - Envir... | CMC PCPN TYPE | New Watershed Intranet Home |

dev-webapps.usgs.gov/ndijc/

Apps | Take Chrome every... | EOSDIS Worldview | SpotWx | Home

ISRSB Hydrologic Visualization Tool

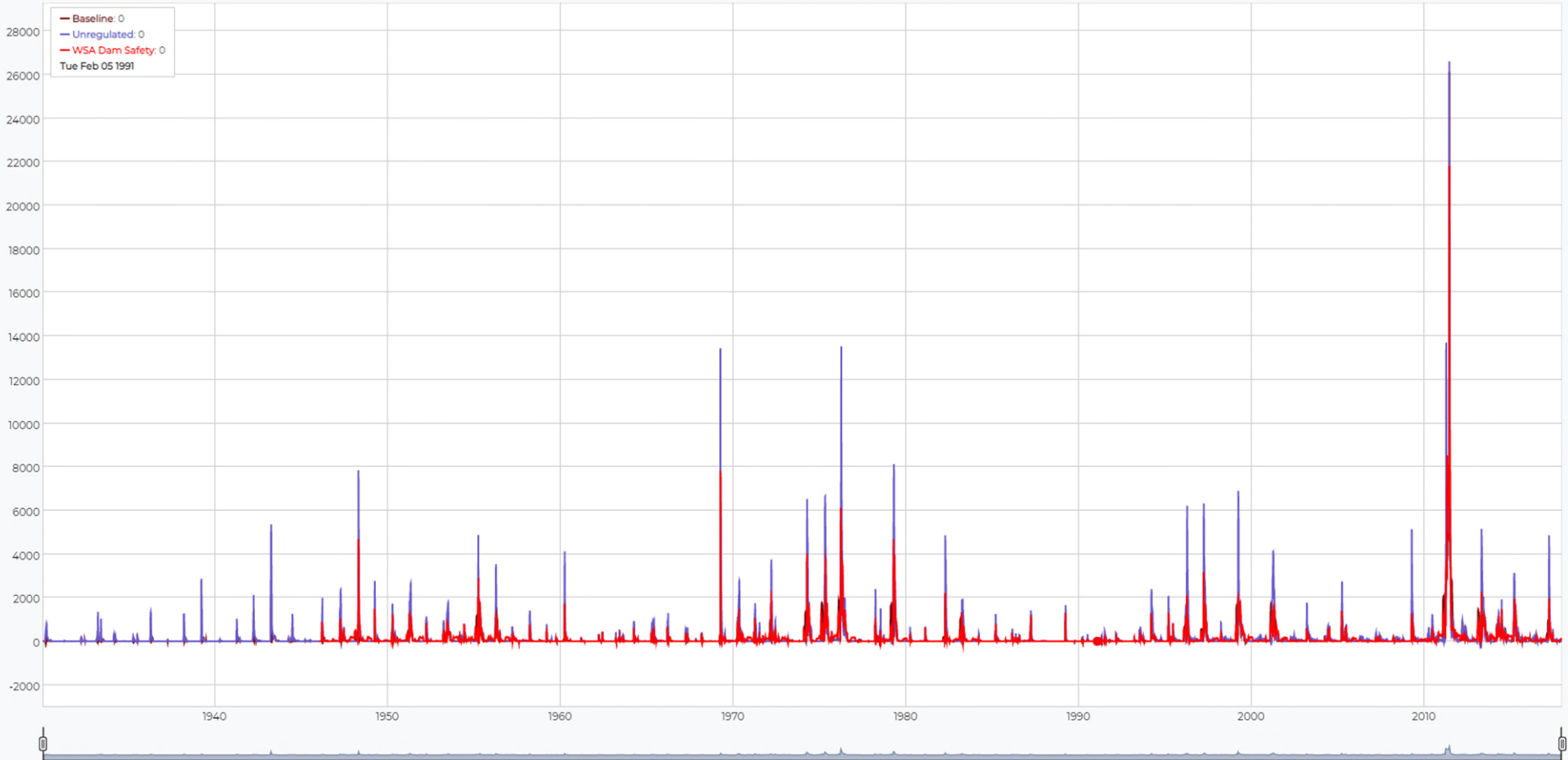
Legend: **STREAM** (red pin), **LAKE** (blue pin). [Click a marker to view data](#) | [List View](#)

Scale: 3,004,511 | Lat: 49.0841 | Lon: -99.7584

50 km | 50 mi



05114000 Souris River near Sherwood, ND STREAMFLOW feet³/second



+ Alternatives	✕ Clear	👁 View	ℹ Info
🔧 Units	⬆ Scale	📍 Site Map	📄 Download

Close



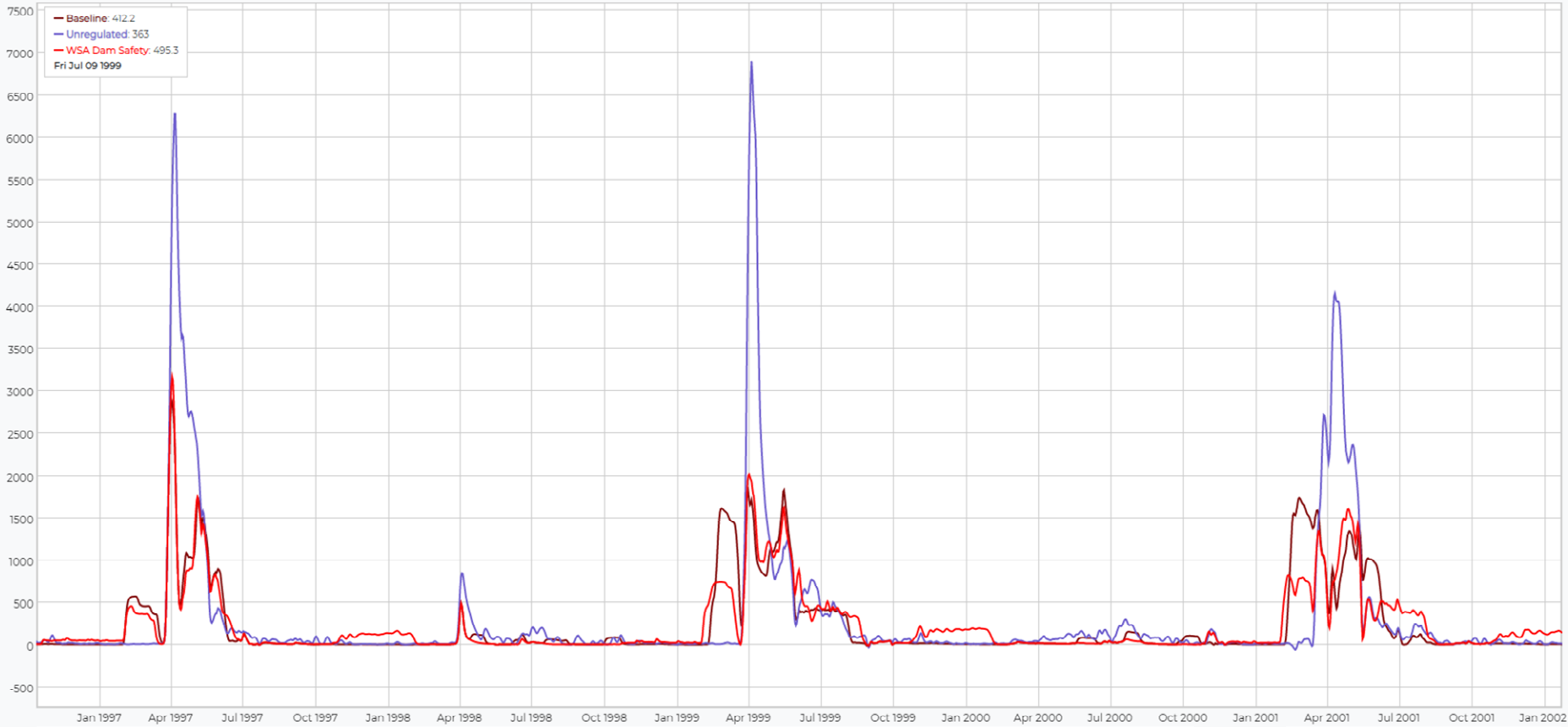
Example Output

USGS | Souris River Plot - Google Chrome

dev-webapps.usgs.gov/ndijc/site.html?id=016A



05114000 Souris River near Sherwood, ND
STREAMFLOW feet³/second



+ Alternatives ✕ Clear 👁 View ▾ ⓘ Info
🔧 Units ▾ ⬆ Scale ▾ 📍 Site Map 📄 Download

Close



Study Progress to Date

- Developed modeling tools to evaluate scenarios
- Gathered feedback from public, resource and agency, and indigenous nations to evaluate alternatives
- Engaged the ISRB
- Tested a number of Scenarios
- Final PHASE 5 Planning Underway



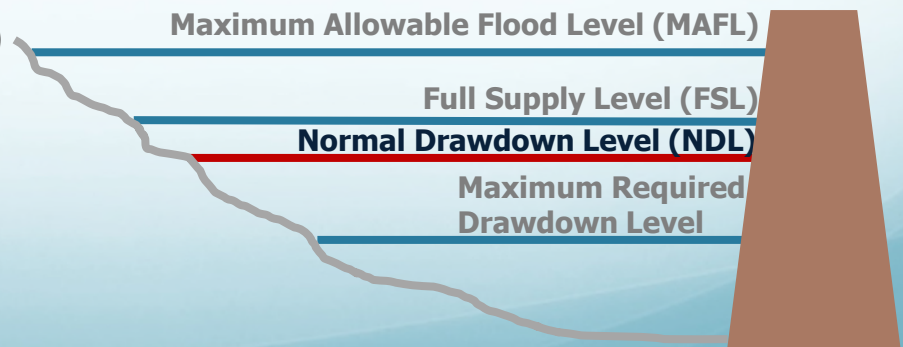
Questions and Comments





How Do the Reservoirs Achieve the Objectives?

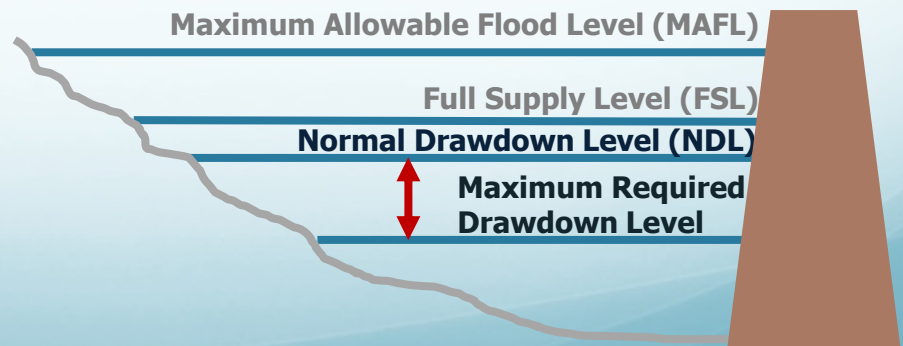
- Drawdown to Normal Drawdown Level
 - Elevation that the reservoirs must be at or below prior to February 1, regardless of conditions
 - Drawdown is initiated in late October to ensure flows are steady during the ice formation period.
 - Try to complete just before February 1.
- Normal Drawdown Levels
 - Rafferty = 549.5 m (1802.82 ft)
 - Grant Devine = 561.0 m (1840.55 ft)
 - Lake Darling = 1596 ft (486.46 m)
 - No NDL at Boundary





How Do the Reservoirs Achieve the Objectives?

- Drawdown below NDL
 - The amount reservoirs are drawn down to below NDL are determined by the Spring Runoff Forecasts.
 - February 1 forecast, subsequent forecasts are issued on or near the 15th and last day of each month until runoff occurs.
- Drawdown below NDL occurs if Flood Operations are in effect
 - Forecasts are used to determine level of drawdown





2011 Flood

- Subsequent slides will be showing flooding around Roche Percee



International Souris River Board



2011 Flood

- Roche Percee – May 14, 2011 (~210cms), dykes holding





2011 Flood

- Roche Percee – June 23, 2011 (~660cms), dykes overtopped



International Souris River Board