Red Deer River Basin Hydrology Overview

Red Deer River Watershed Alliance

Terry Chamulak, Hydrologist
Environment and Protected Areas
March 22, 2023

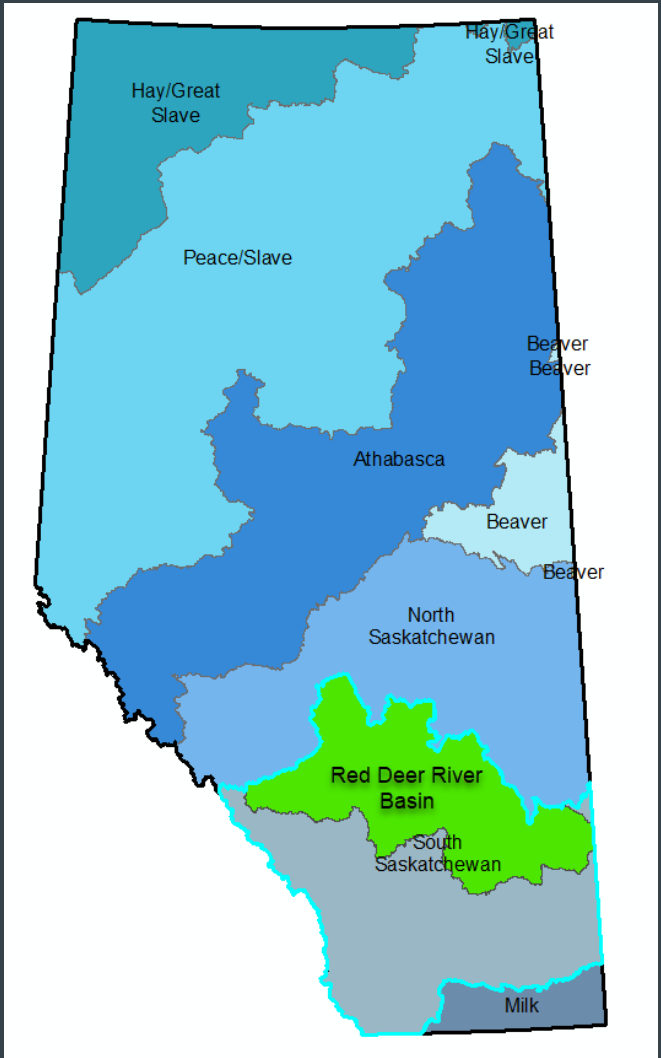
Alberta

Agenda

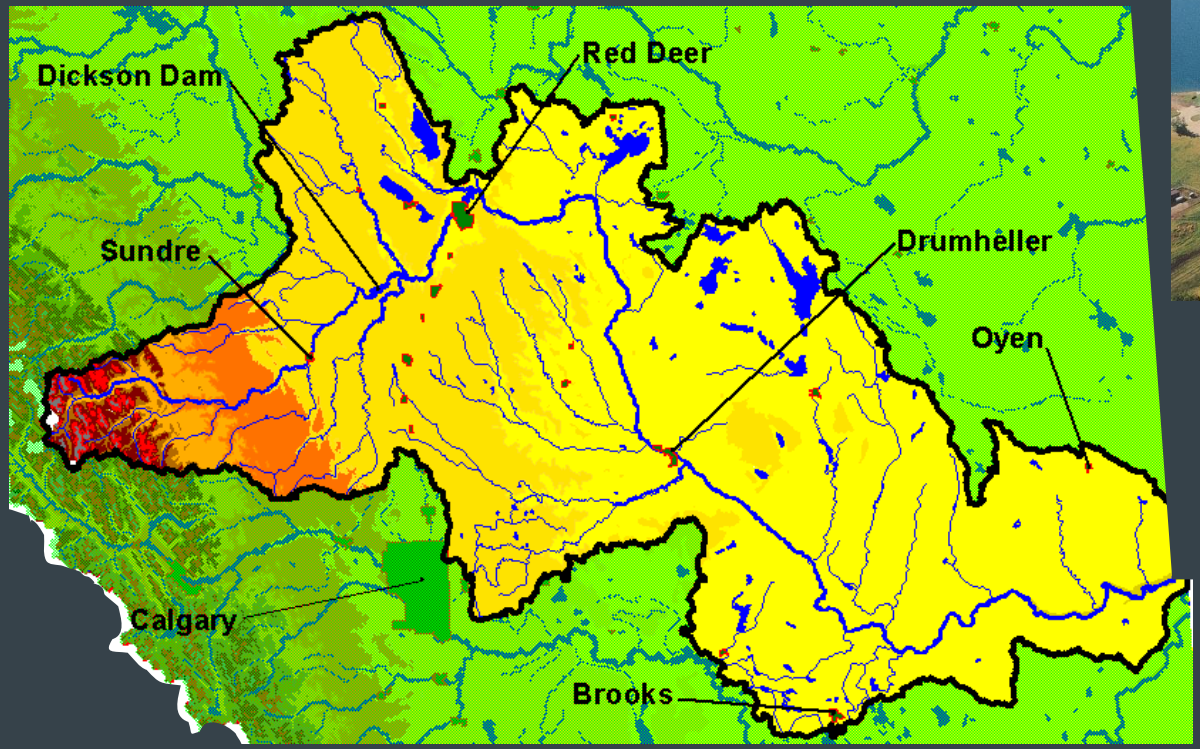
Red Deer River Basin Overview

1. Basin Characteristics
2. Basin Hydrology
3. Apportionment and Environmental Flows
4. Licence Allocations

Red Deer River Basin



Red Deer River Basin



Dickson Dam 1983 Construction

Red Deer River Basin
Basin Area: 50,114 sq.km
Mainstem: 1,300 km
Basin spans width of Alberta

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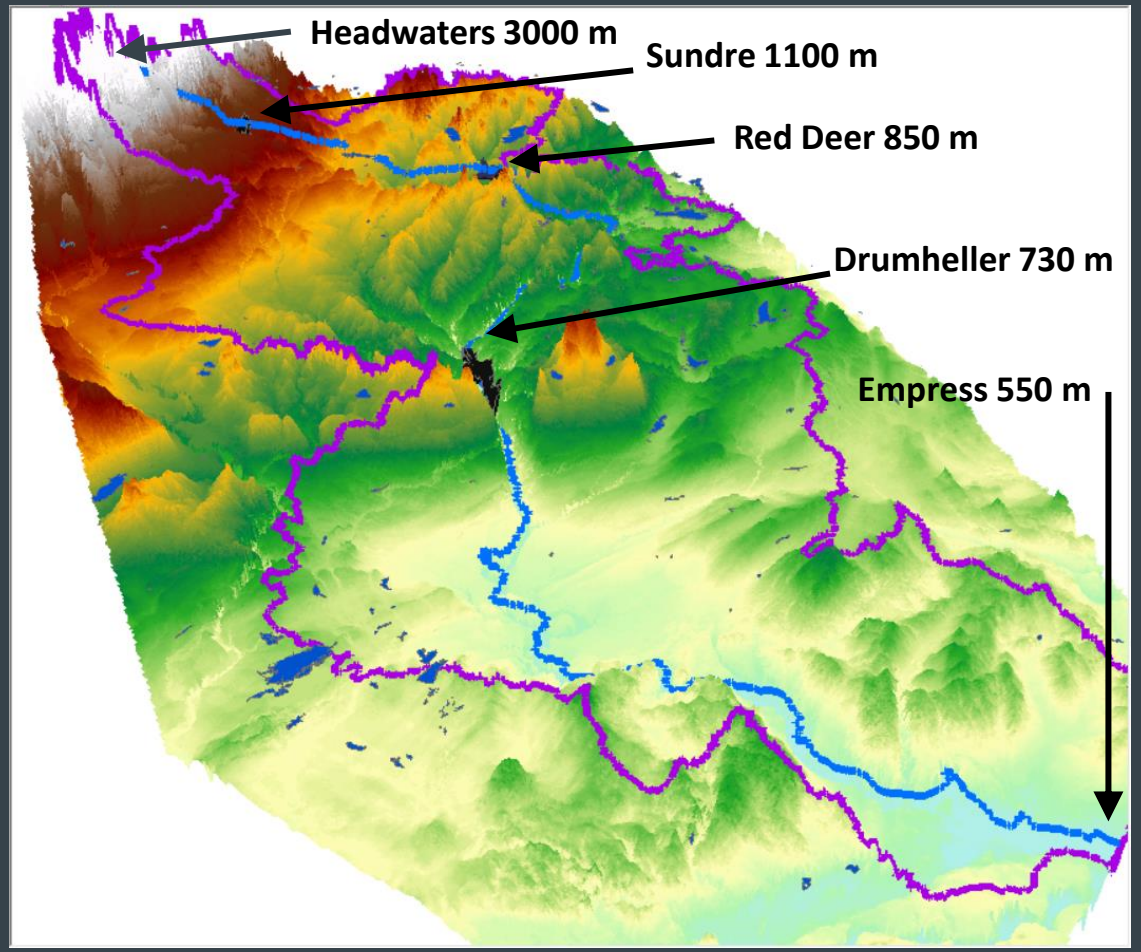
Red Deer Basin Elevations



Headwaters

Sask Border

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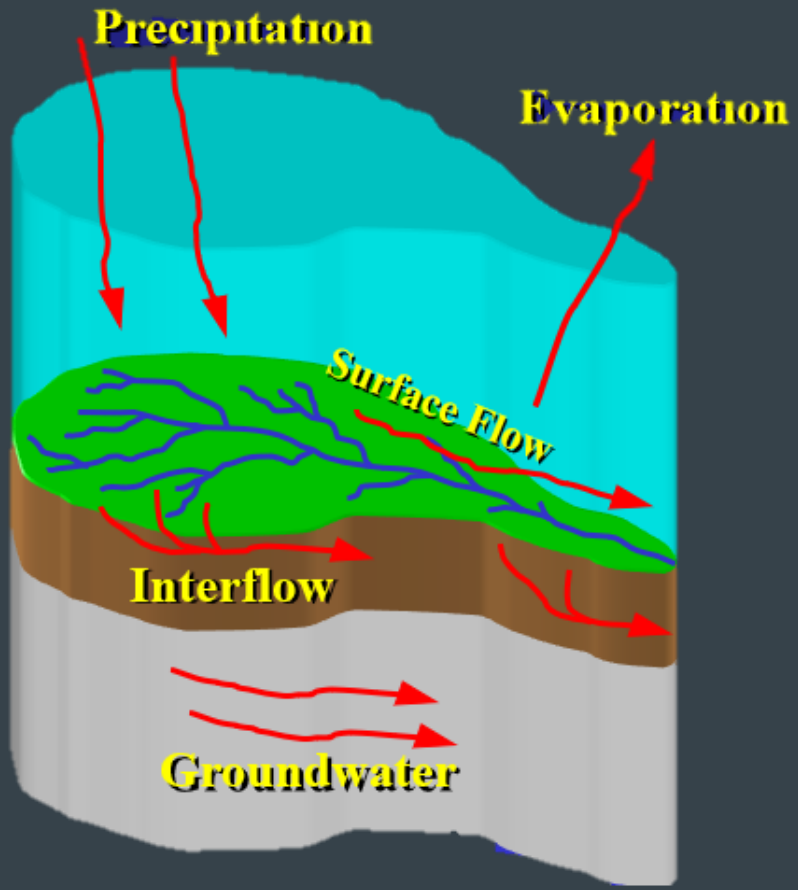
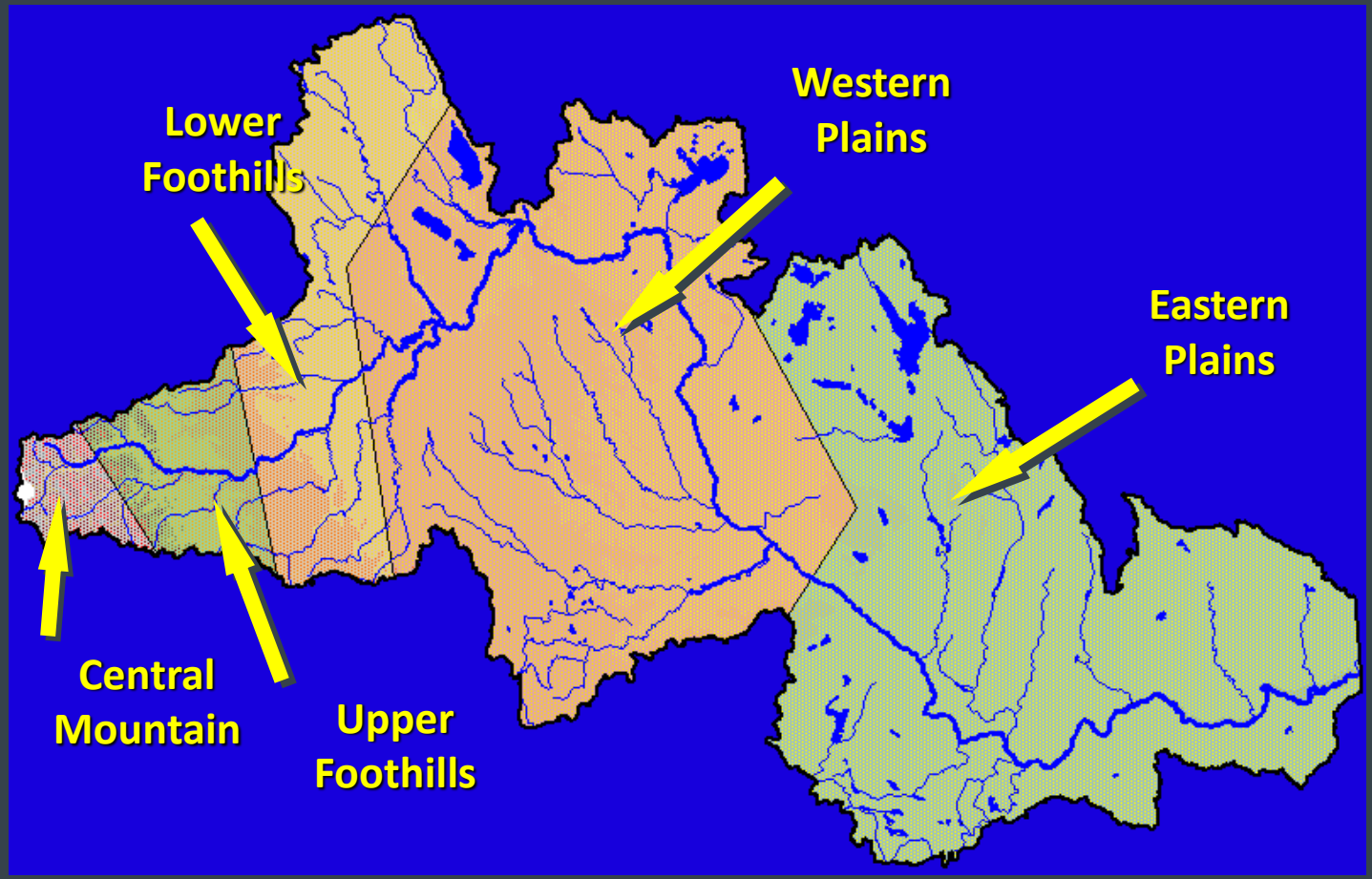
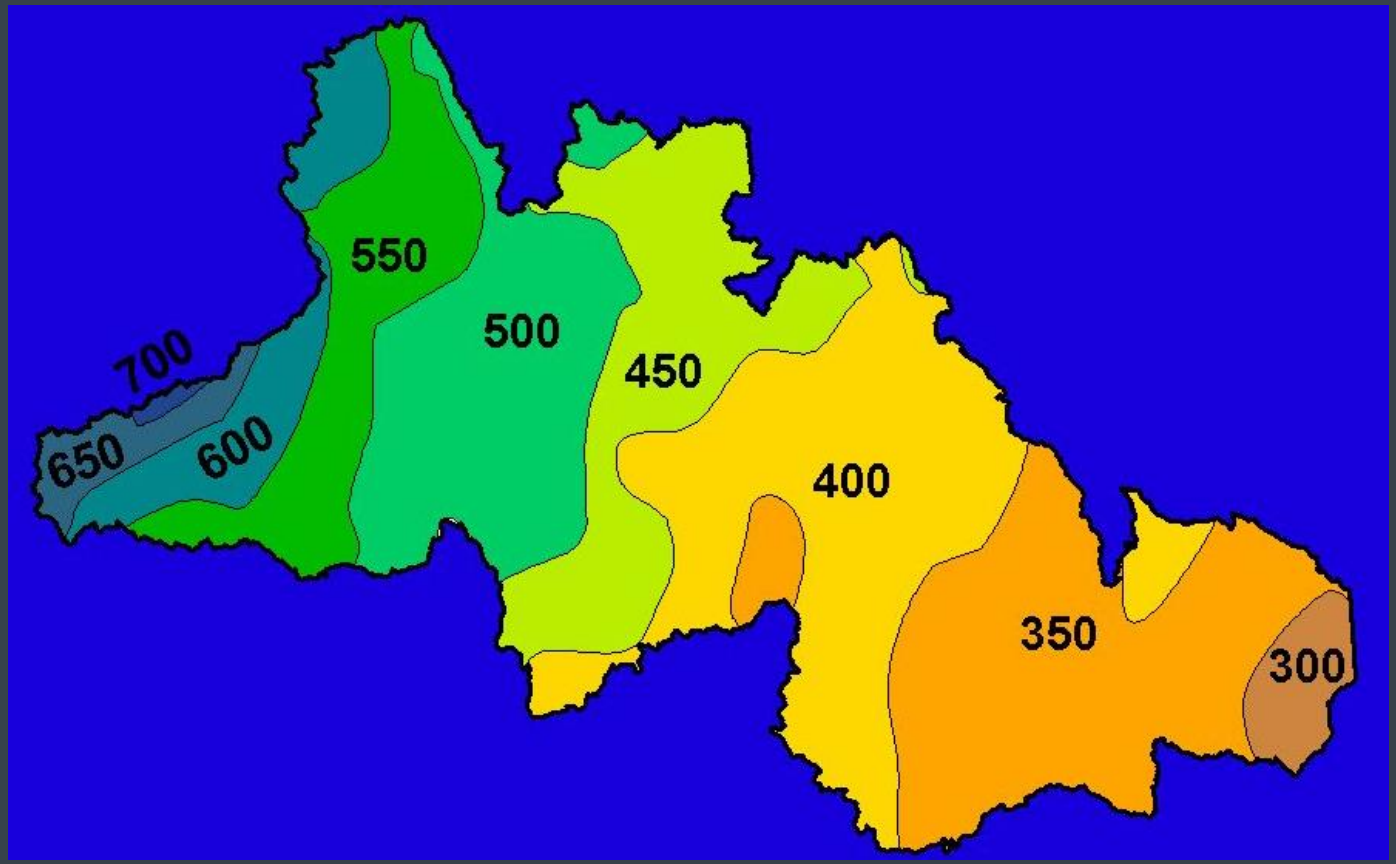
Surface Flow



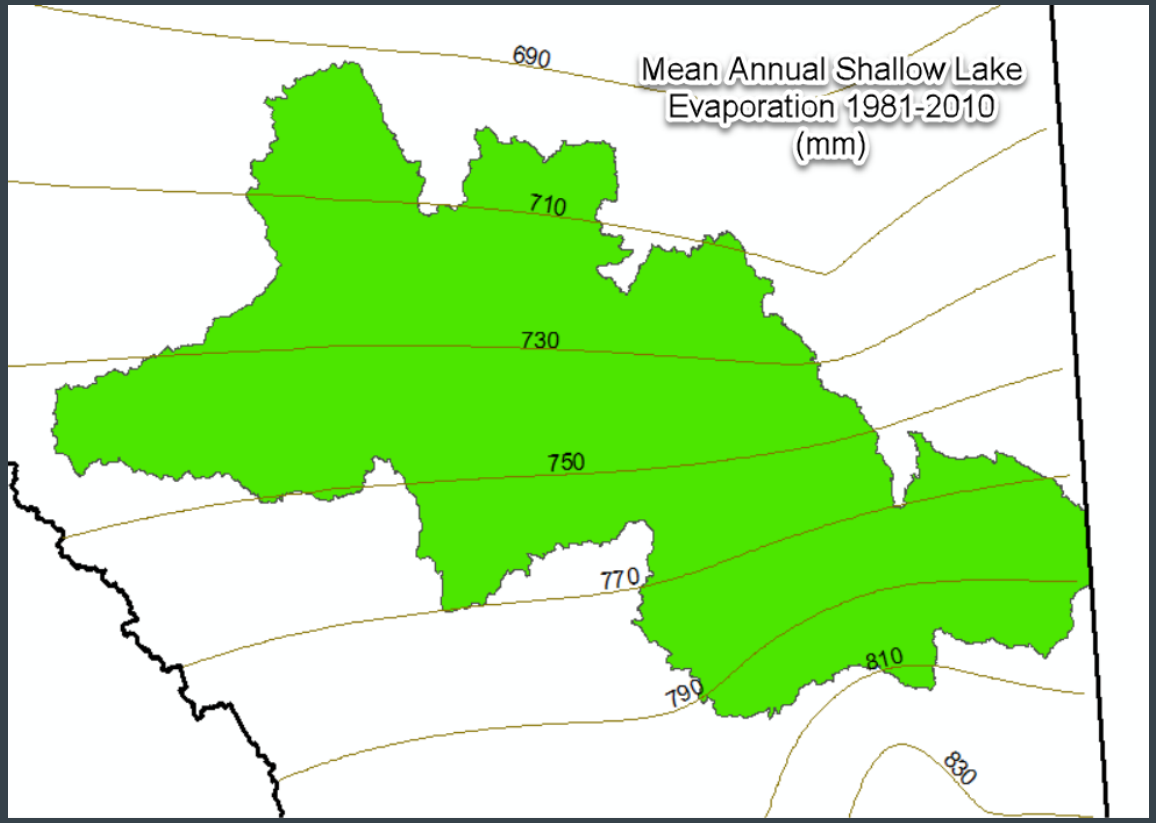
Hydrologic Zones

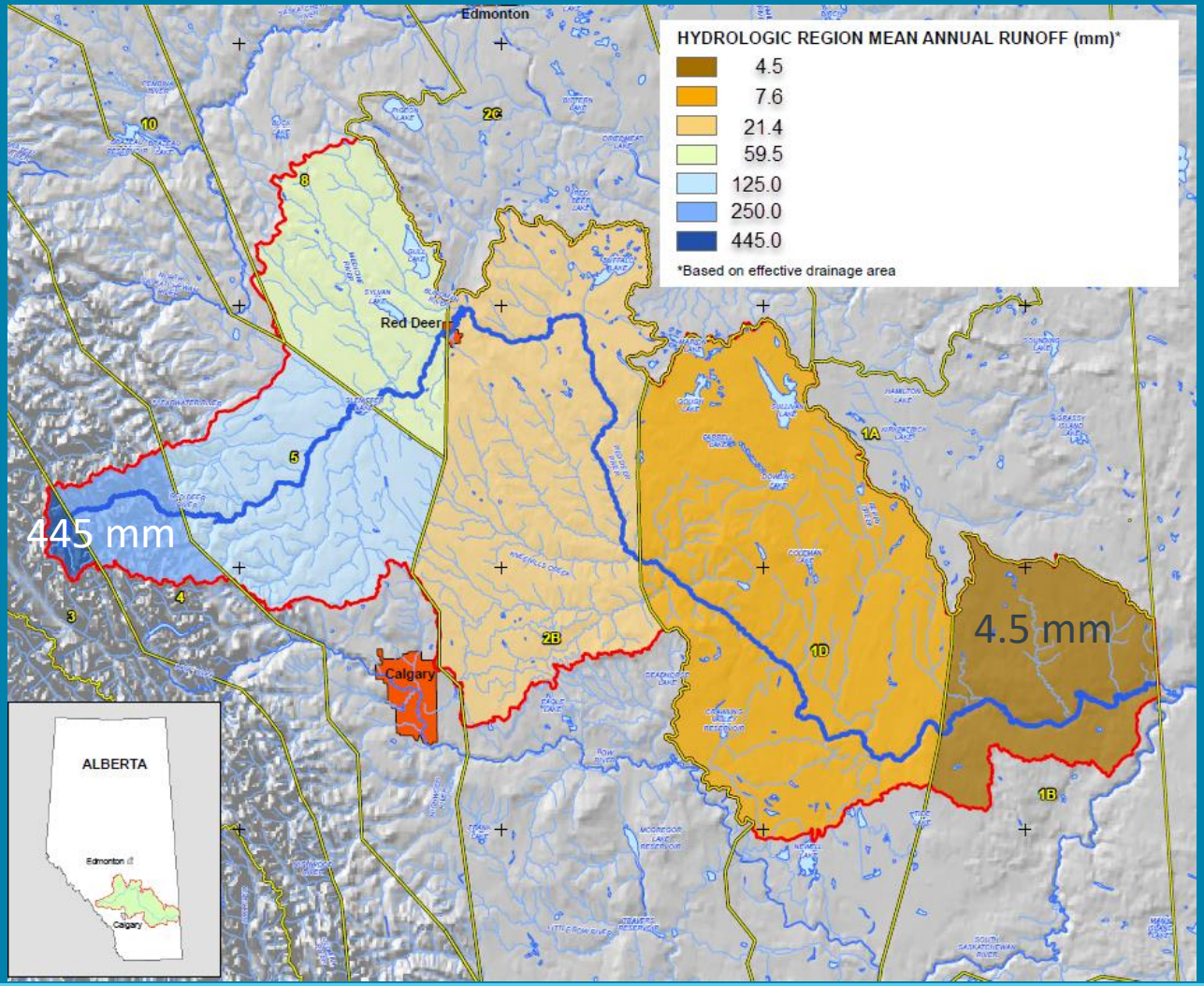


Mean Annual Precipitation (mm)



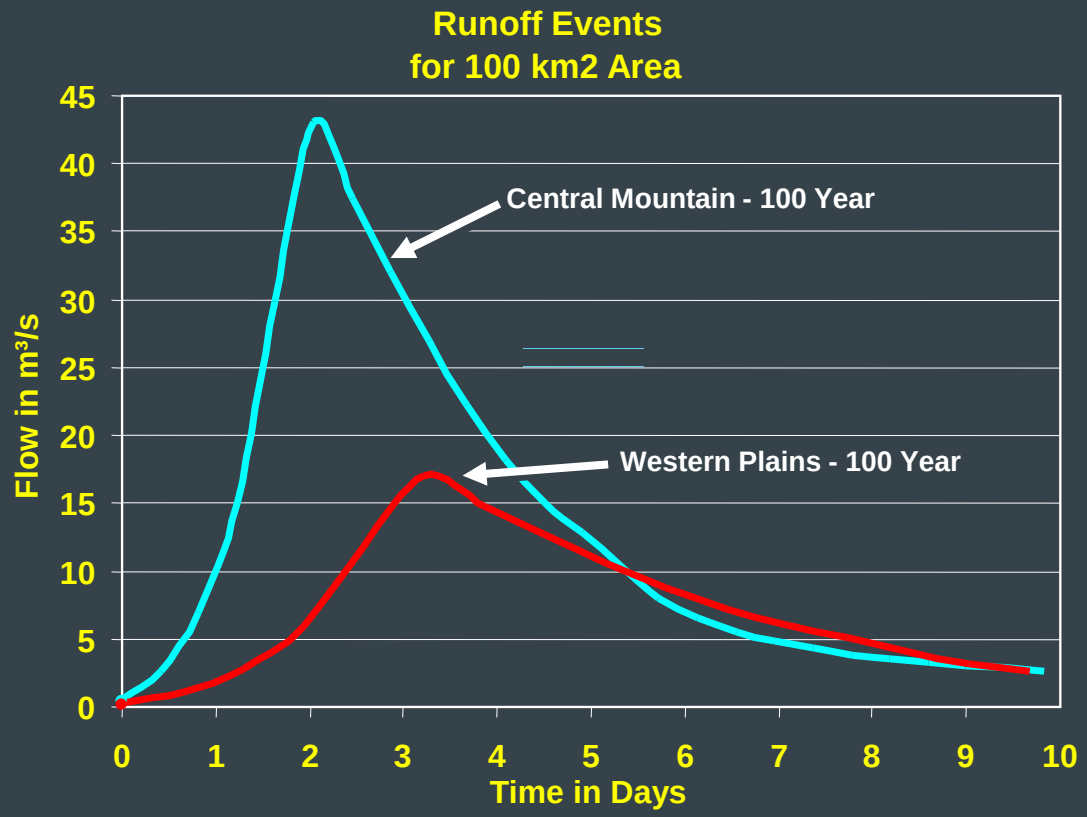
Mean Annual Shallow Lake Evaporation (mm)





Mean Annual Runoff

Typical Runoff Hydrograph



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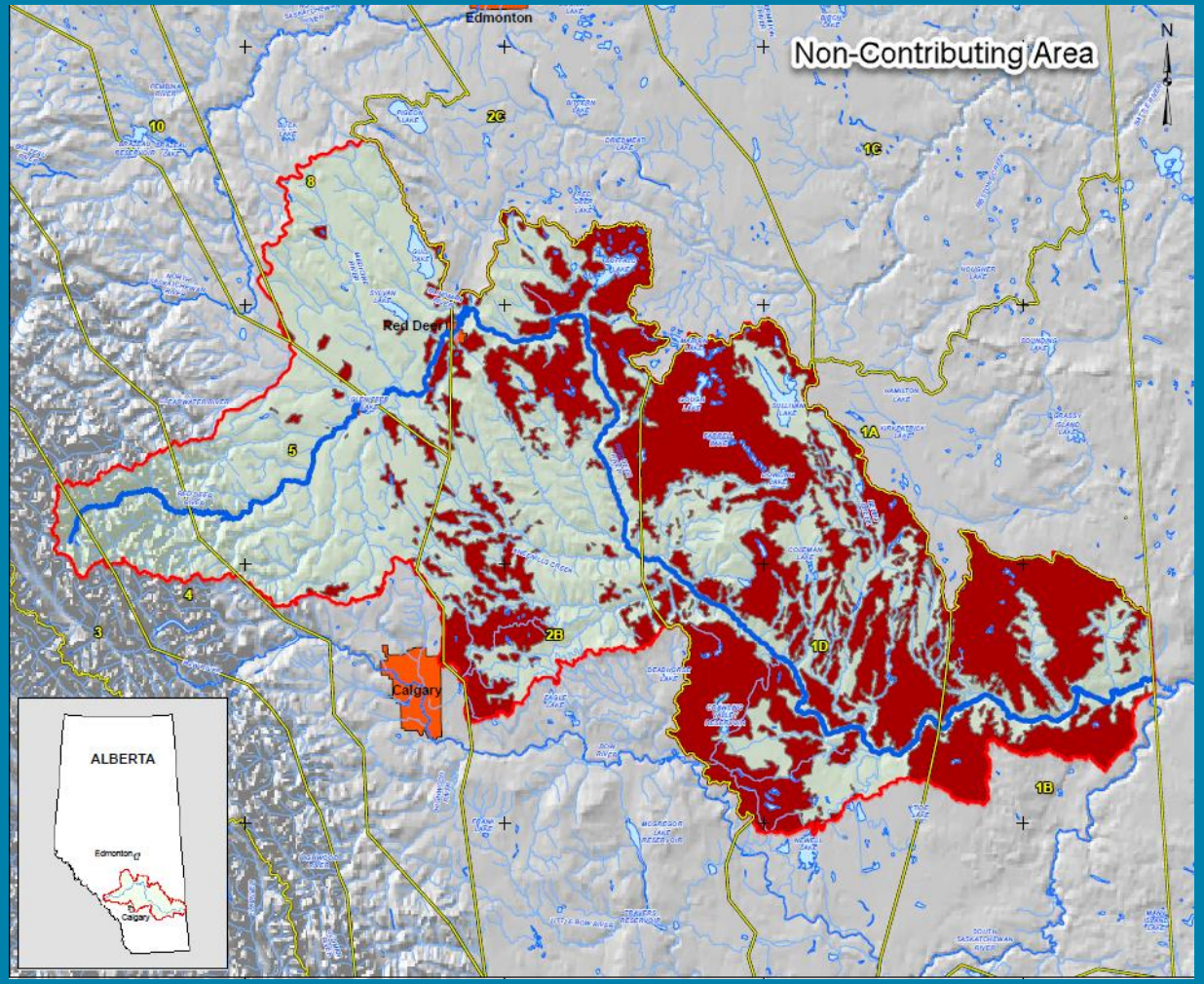

Non-Contributing Drainage Area

Total Area 50,114 sq.km
Effective Area 31, 138 sq.km
Non-Contributing Area 18,976 sq.km

Non-contributing area represents 38% of the total basin

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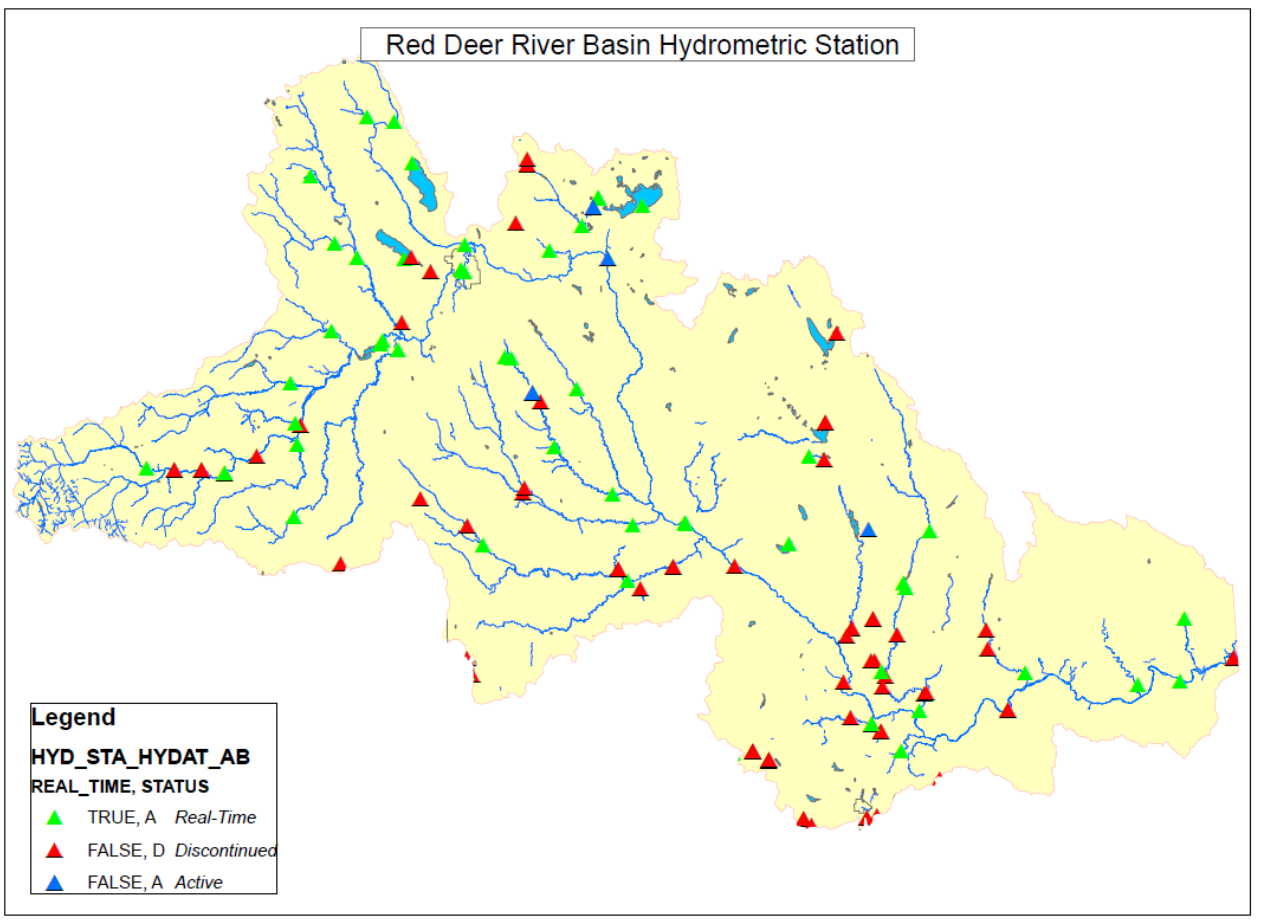
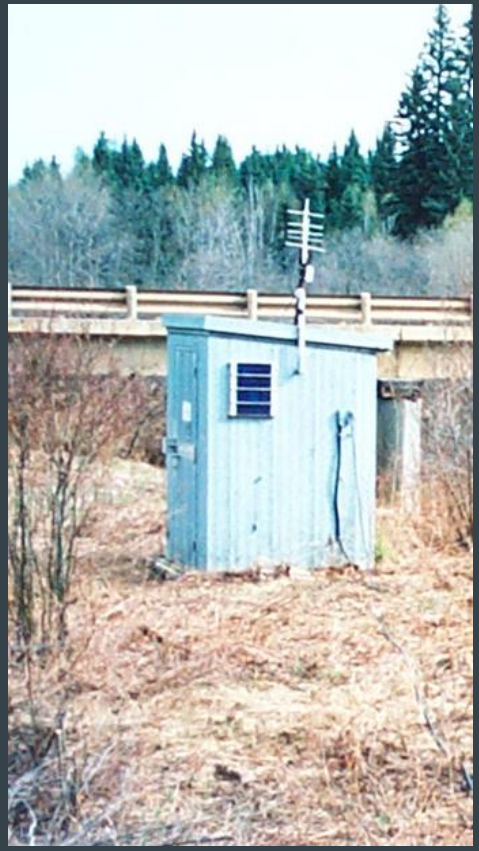
Hydrometric Station Data Collection





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Hydrometric Station Data Collection

Real-Time Hydrometric Stations Summary

Status	**Flow**	**Level**	**Total**
Real-Time	42	7	49
Active	2	1	3
Discontinued	44	6	50
Total	88	14	102
Real-Time Operation			
Continuous	8	1	
Seasonal	34	6	
	42	**7**	49

Red Deer River Basin
8 Real-Time Flow Stations Continuous Operation

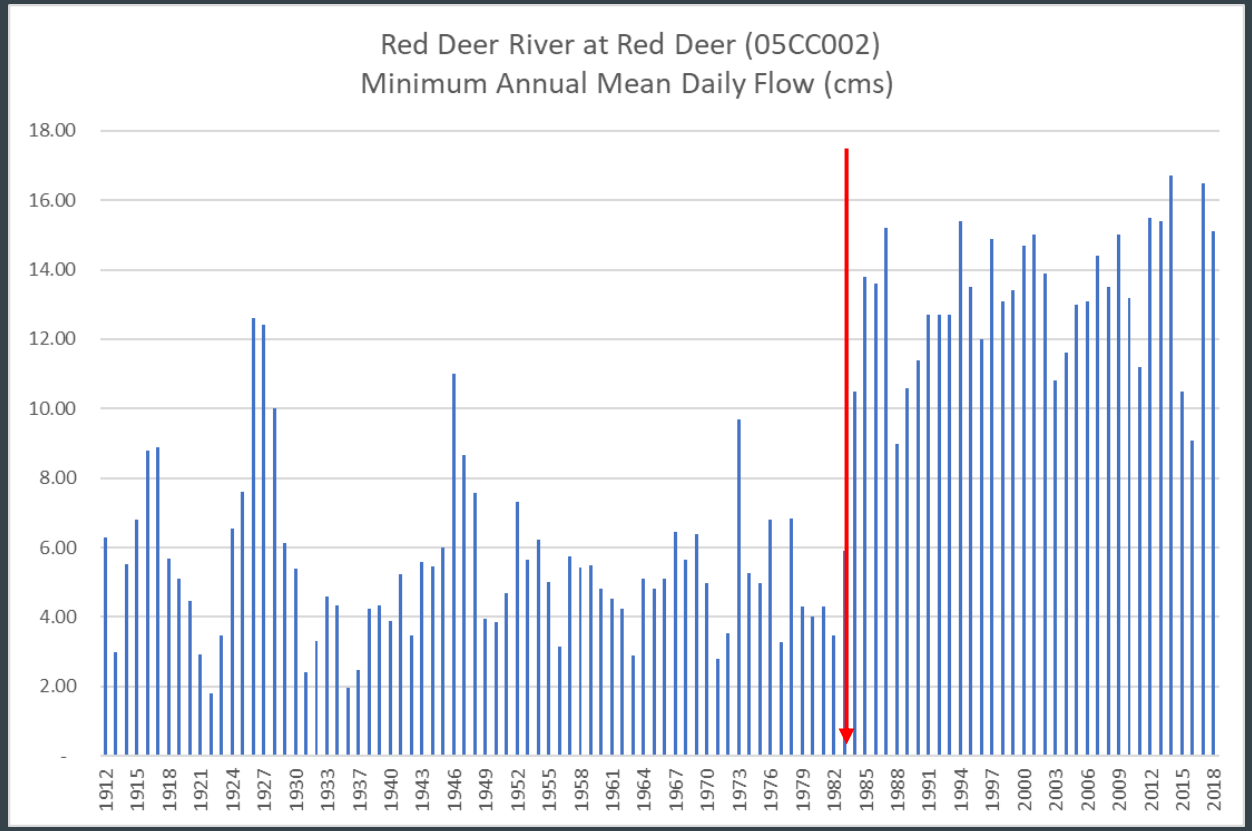
STA_NO	STA_DESC	YEARS	TYPE	OPERATIC
05CC002	RED DEER RIVER AT RED DEER	106	Q	C
05CE001	RED DEER RIVER AT DRUMHELLER	77	Q	C
05CB001	LITTLE RED DEER RIVER NEAR THE MOUTH	59	Q	C
05CC007	MEDICINE RIVER NEAR ECKVILLE	57	Q	C
05CB004	RAVEN RIVER NEAR RAVEN	48	Q	C
05CA009	RED DEER RIVER BELOW BURNT TIMBER CREEK	43	Q	C
05CB007	DICKSON DAM TUNNEL OUTLET	35	Q	C
05CD004	RED DEER RIVER NEAR NEVIS	16	Q	C

Red Deer River Basin
34 Real-Time Flow Stations Seasonal Operation

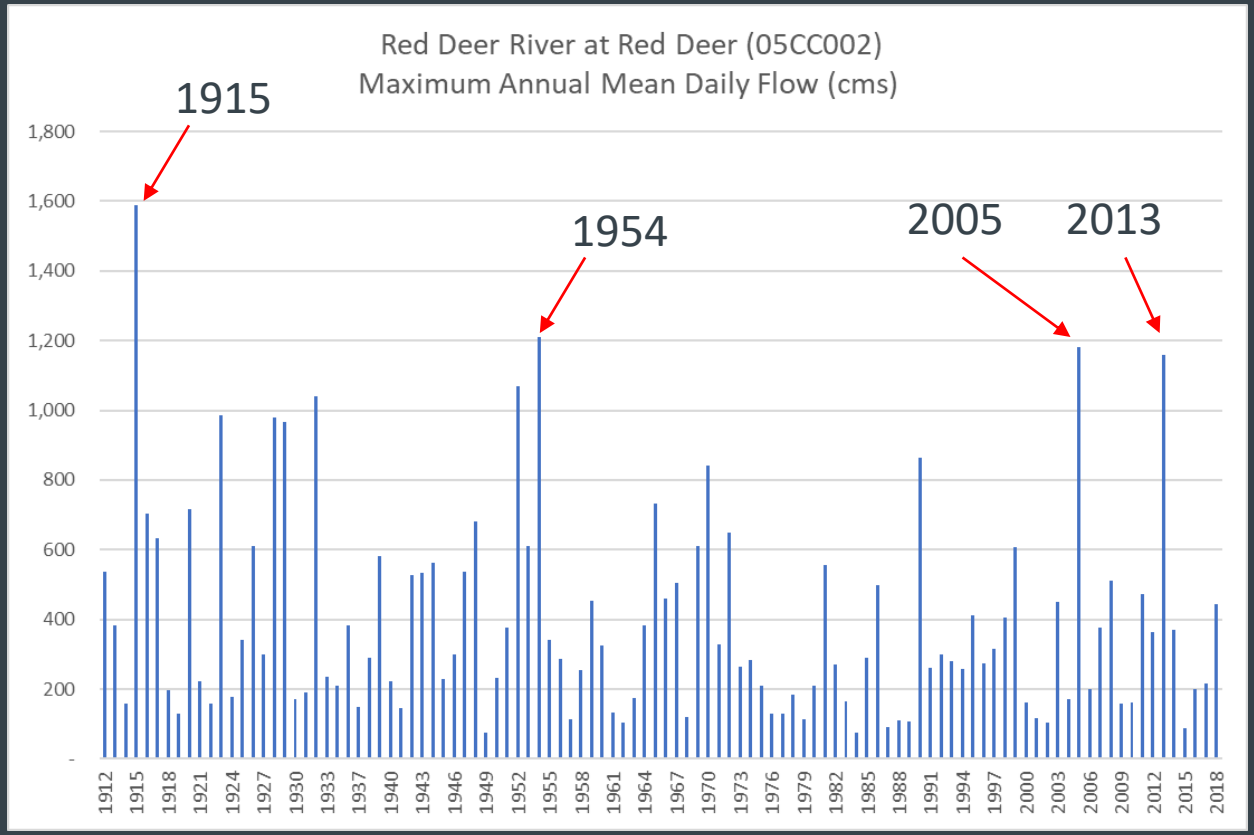
STA_NO	STA_DESC	YEARS
05CE002	KNEEHILLS CREEK NEAR DRUMHELLER	74
05CJ006	ONETREE CREEK NEAR PATRICIA	68
05CE005	ROSEBUD RIVER AT REDLAND	68
05CC001	BLINDMAN RIVER NEAR BLACKFALDS	64
05CE006	ROSEBUD RIVER BELOW CARSTAIRS CREEK	61
05CK004	RED DEER RIVER NEAR BINDLOSS	59
05CB002	LITTLE RED DEER RIVER NEAR WATER VALLEY	57
05CK005	ALKALI CREEK NEAR THE MOUTH	56
05CH007	BERRY CREEK NEAR THE MOUTH	55
05CK001	BLOOD INDIAN CREEK NEAR THE MOUTH	55
05CE007	THREEHILLS CREEK NEAR CARBON	53
05CA002	JAMES RIVER NEAR SUNDRE	52
05CC008	BLINDMAN RIVER NEAR BLUFFTON	51
05CC009	LLOYD CREEK NEAR BLUFFTON	51
05CA004	RED DEER RIVER ABOVE PANTHER RIVER	51
05CH008	BERRY CREEK NEAR ROSE LYNN	48
05CE010	RAY CREEK NEAR INNISFAIL	45
05CE011	RENWICK CREEK NEAR THREE HILLS	45
05CE018	THREEHILLS CREEK BELOW RAY CREEK	45

STA_NO	STA_DESC	YEARS
05CA011	BEARBERRY CREEK NEAR SUNDRE	40
05CC010	BLOCK CREEK NEAR LEEDALE	40
05CD006	HAYNES CREEK NEAR HAYNES	40
05CG004	BULLPOUND CREEK NEAR WATTS	39
05CA012	FALLENTIMBER CREEK NEAR SUNDRE	39
05CD902	PARLBY CREEK NEAR MIRROR	38
05CK006	KENNEDY COULEE NEAR ACADIA VALLEY	37
05CE020	MICHICHI CREEK AT DRUMHELLER	36
05CD007	PARLBY CREEK AT ALIX	35
05CH011	BERRY CREEK RESERVOIR OUTLET	34
05CG006	FISH CREEK ABOVE LITTLE FISH LAKE	33
05CC011	WASKASOO CREEK AT RED DEER	33
05CJ012	MATZHIWIN CREEK BELOW WARE COULEE	30
05CC013	LASTHILL CREEK NEAR ECKVILLE	9
05CE012	GHOSTPINE CREEK NEAR HUXLEY	7

Red Deer River Basin
Red Deer River at Red Deer (05CC002) Minimum Flows



Red Deer River Basin
Red Deer River at Red Deer (05CC002) Maximum Flows

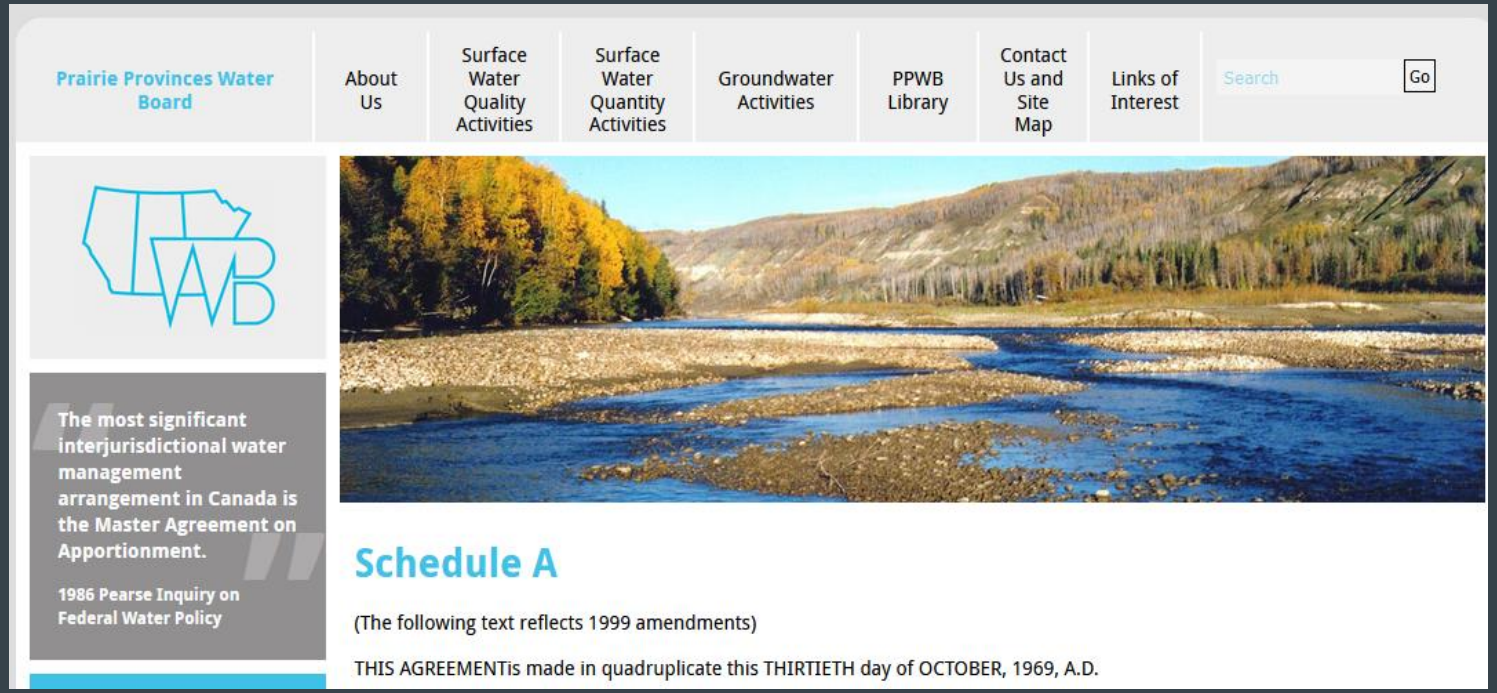


Red Deer River Basin
7 Real-Time Water level Stations

STA_NO	STA_DESC	YEARS	TYPE	OPERATIC
05CC003	SYLVAN LAKE AT SYLVAN LAKE	79	H	S
05CC006	GULL LAKE AT RV HEAVEN MARINA	77	H	S
05CD005	BUFFALO LAKE NEAR ERSKINE	53	H	S
05CB006	GLENIFFER RESERVOIR NEAR DICKSON	36	H	C
05CH013	FORSTER RESERVOIR NEAR CESSFORD	35	H	S
05CH014	BERRY CREEK RESERVOIR NEAR SUNNYNOOK	33	H	S
05CD903	SPOTTED LAKE NEAR MIRROR	28	H	S

Master Agreement on Apportionment

South Saskatchewan River Basin Appointment, which applies to the flows in the Red Deer River. is addressed in Schedule A



Key components of the Apportionment Agreement

3. Alberta shall permit a quantity of water equal to one-half the natural flow of each watercourse to flow into the Province of Saskatchewan, and the actual flow shall be adjusted from time to time on an equitable basis during each calendar year, but this shall not restrict or prohibit Alberta from diverting or consuming any quantity of water from any watercourse provided that Alberta diverts water to which it is entitled of comparable quality from other streams or rivers into such watercourse to meet its commitments to Saskatchewan with respect to each watercourse.

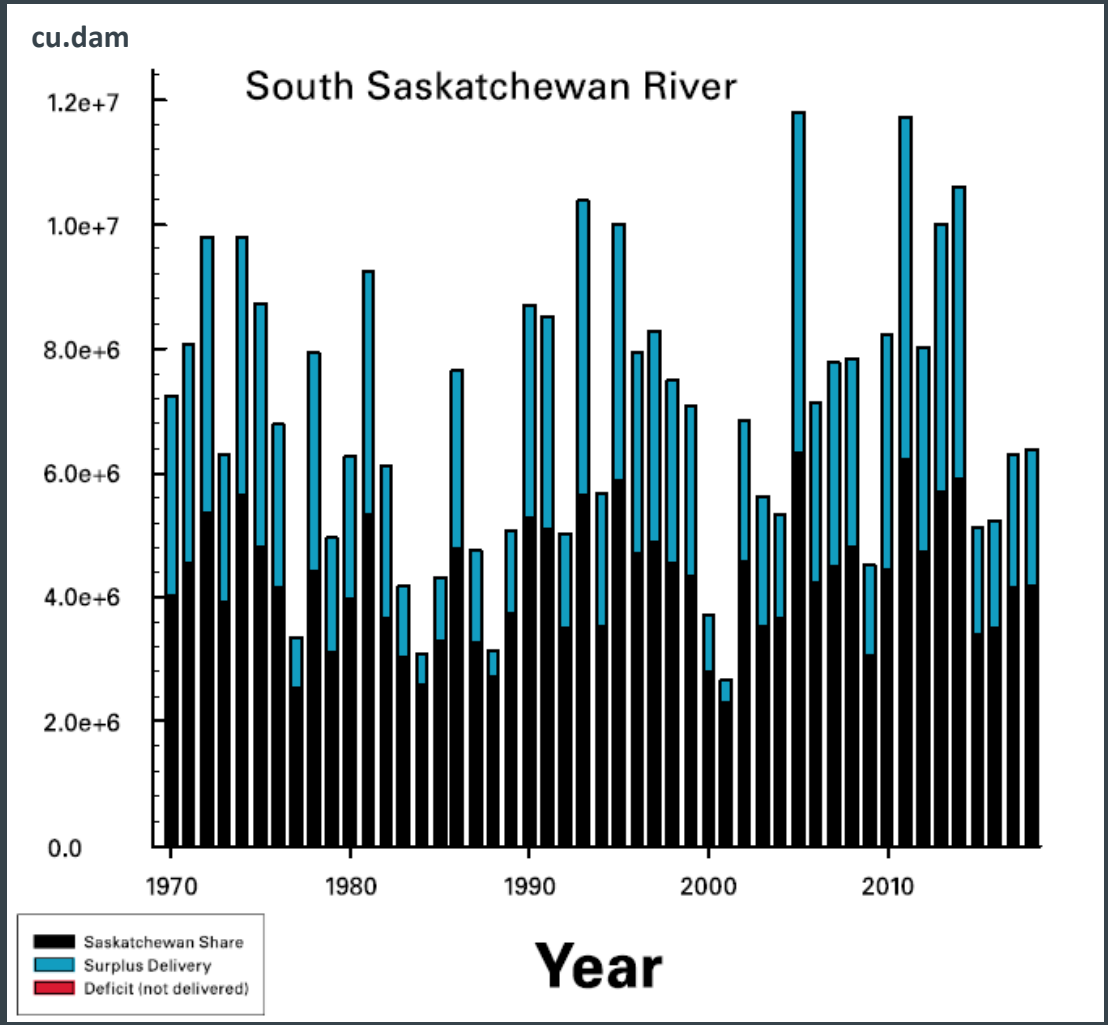
4. Notwithstanding paragraph 3 hereof, the following special provisions shall apply as between the parties hereto with respect to the watercourse known as the South Saskatchewan River.

(a) Alberta shall be entitled in each year to consume, or to divert or store for its consumptive use a minimum of 2,100,000 acre-feet net depletion out of the flow of the watercourse known as the South Saskatchewan River even though its share for the said year, as calculated under paragraph 3 hereof, would be less than 2,100,000 acre-feet net depletion, provided however Alberta shall not be entitled to so consume or divert, or store for its consumptive use, more than one-half the natural flow of the said South Saskatchewan watercourse if the effect thereof at any time would be to reduce the actual flow of the said watercourse at the common boundary of the said Provinces of Saskatchewan and Alberta to less than 1,500 cubic feet per second.

South Sask River Apportionment Agreement
3-key points

- Alberta is allowed to divert ½ of the South Sask natural flow annually
- Alberta may divert a minimum 2.1 million acre-feet (2.59 million dam^3) annually even if its apportionment share would be less
- Alberta shall not divert more than ½ the natural flow if it reduces the flow into Saskatchewan to less than 1,500 cubic fee per second (42.47 cms).

Historic South Sask River Apportionment Annual Volumes



Red Deer River Environmental Flow ‘before’ the WCO was an ‘Instream Objective’

APPENDIX I

ALBERTA ENVIRONMENTAL PROTECTION

WATER MANAGEMENT

LICENSING AND PERMITTING STANDARDS BRANCH

EXISTING WATER DIVERSION RESTRICTIONS WITHIN MAJOR RIVER BASINS AND ASSOCIATED WATER BODIES

WCO applies to any applications received or licences issued **after** May 1, 2005.

IO applies to any applications received or licences issued **before** May 1, 2005.

Red Deer River	8.49 cms 4.24 cms	300.0 cfs minimum flow for non-industrial users 150.0 cfs minimum flow for industrial users

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South Saskatchewan River Basin (SSRB) water management plan

- AENV establish WCOs for the Red Deer River Sub-basin. Any licences issued for applications received after May 1, 2005 be subject to the following WCOs:

  Upstream of the confluence with the Blindman River, to Dickson Dam:

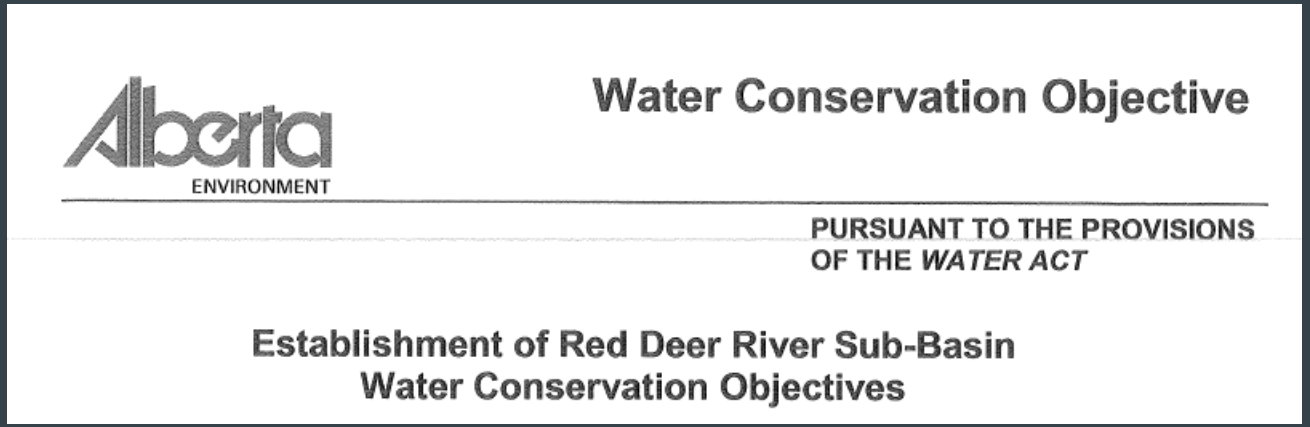
  - For new licences or existing licences with a retrofit provision, a rate of flow that is 45% of the natural rate of flow, or 16 cms, whichever is greater at any point in time.

  Downstream of the confluence with the Blindman River:

  - For future licences that withdraw from November to March inclusive, a rate of flow that is 45% of the natural rate of flow, or 16 cms, whichever is greater at any point in time.
  - For future licences that withdraw from April to October inclusive, a rate of flow that is 45% of the natural rate of flow, or 10 cms, whichever is greater at any point in time.
  - For existing licences with a retrofit provision, a rate of flow that is 45% of the natural rate of flow, or 10 cms, whichever is greater at any point in time.

- When allocations in the Red Deer River Sub-basin reach 550,000 cubic decametres, a thorough review be conducted to identify the maximum allocation limit.

South Saskatchewan River Basin (SSRB) water management plan



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ENVIRONMENT

Water Conservation Objective

PURSUANT TO THE PROVISIONS
OF THE *WATER ACT*

Establishment of Red Deer River Sub-Basin Water Conservation Objectives

Designated Director Under the Act
Andy Lamb

January 16, 2007
Dated

Applies to any applications received or licences issued after May 1, 2005.

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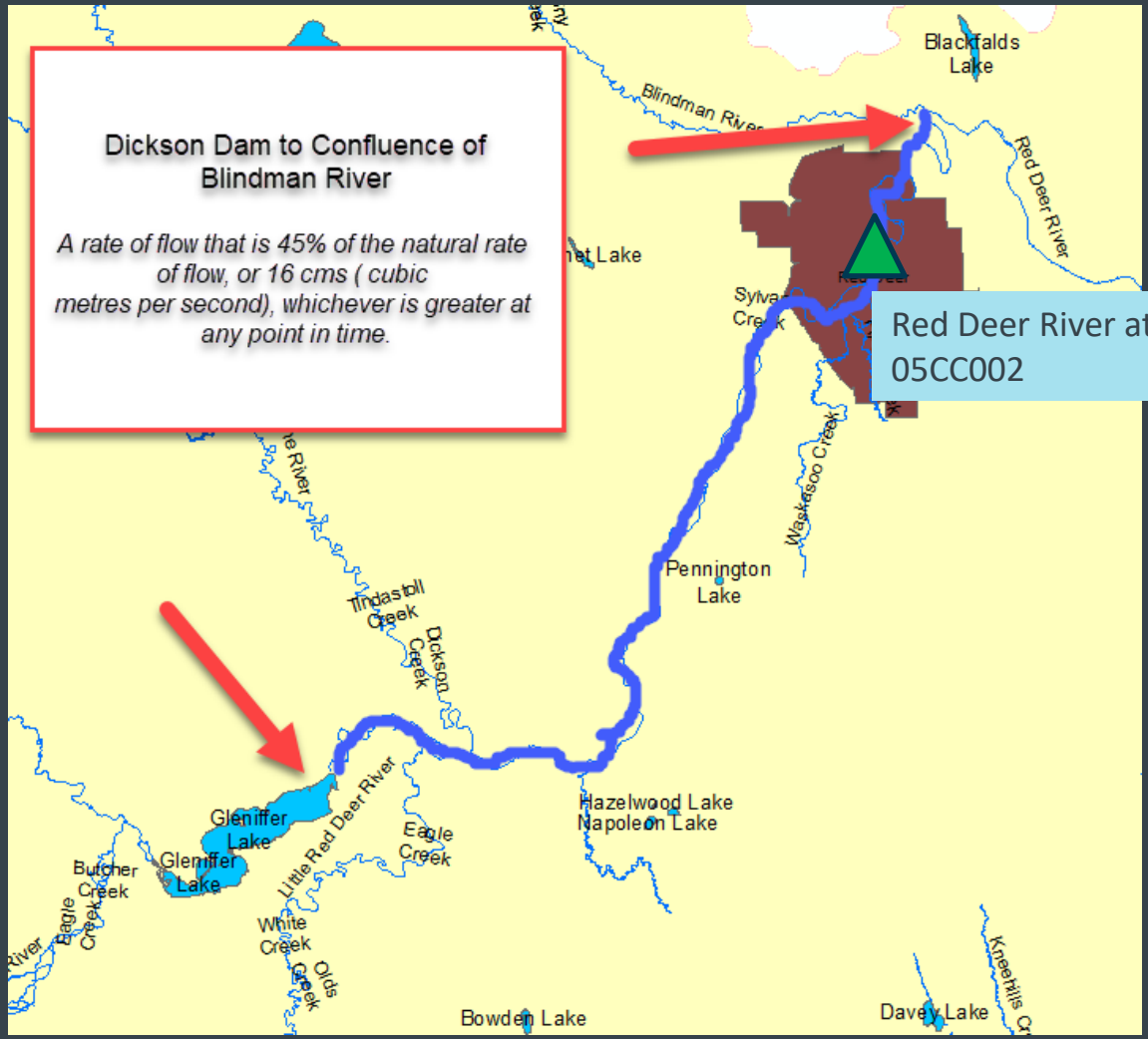
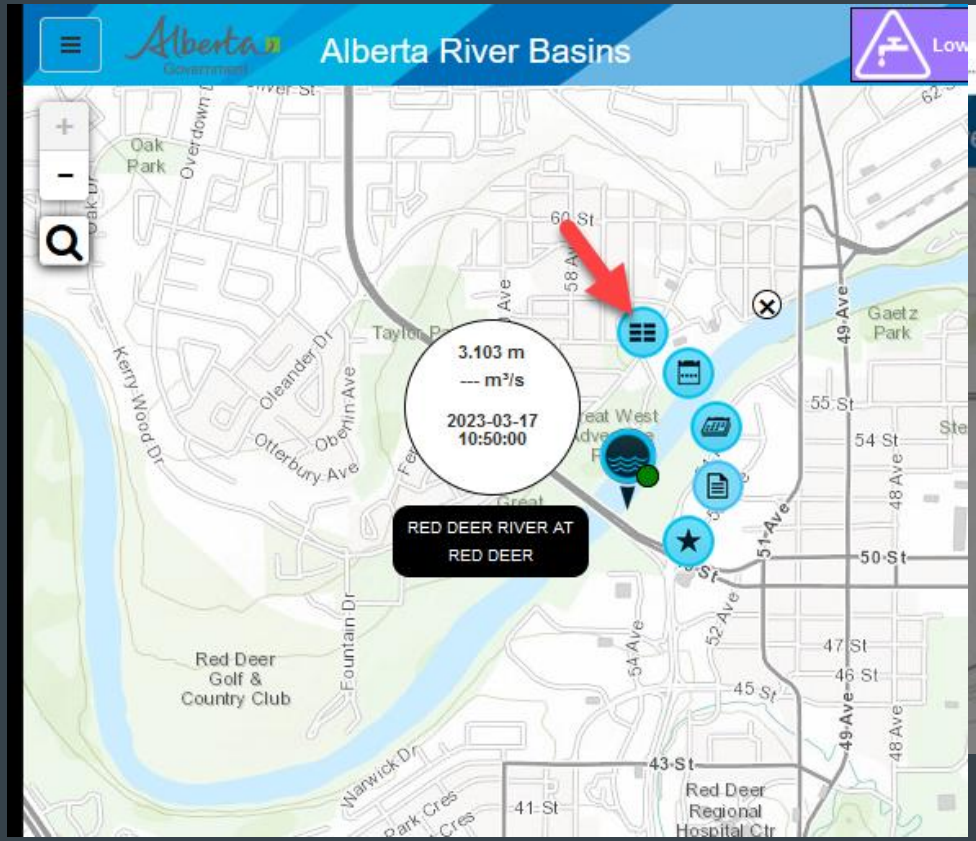
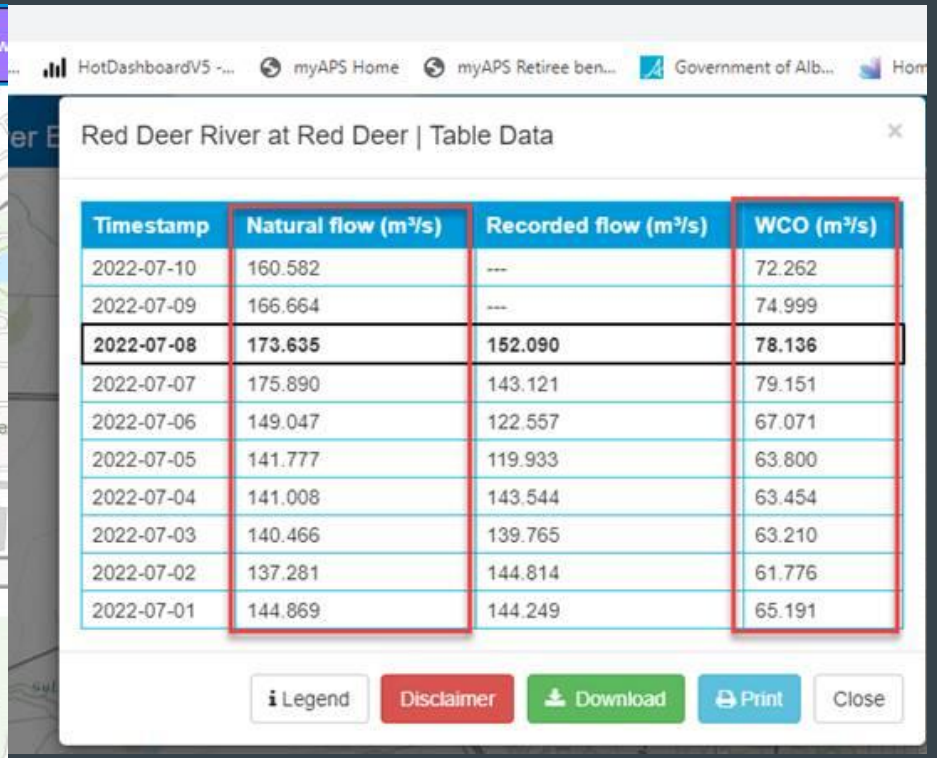
Red Deer River WCO

Dickson Dam to Blindman River



Red Deer River WCO
Real-Time Monitoring

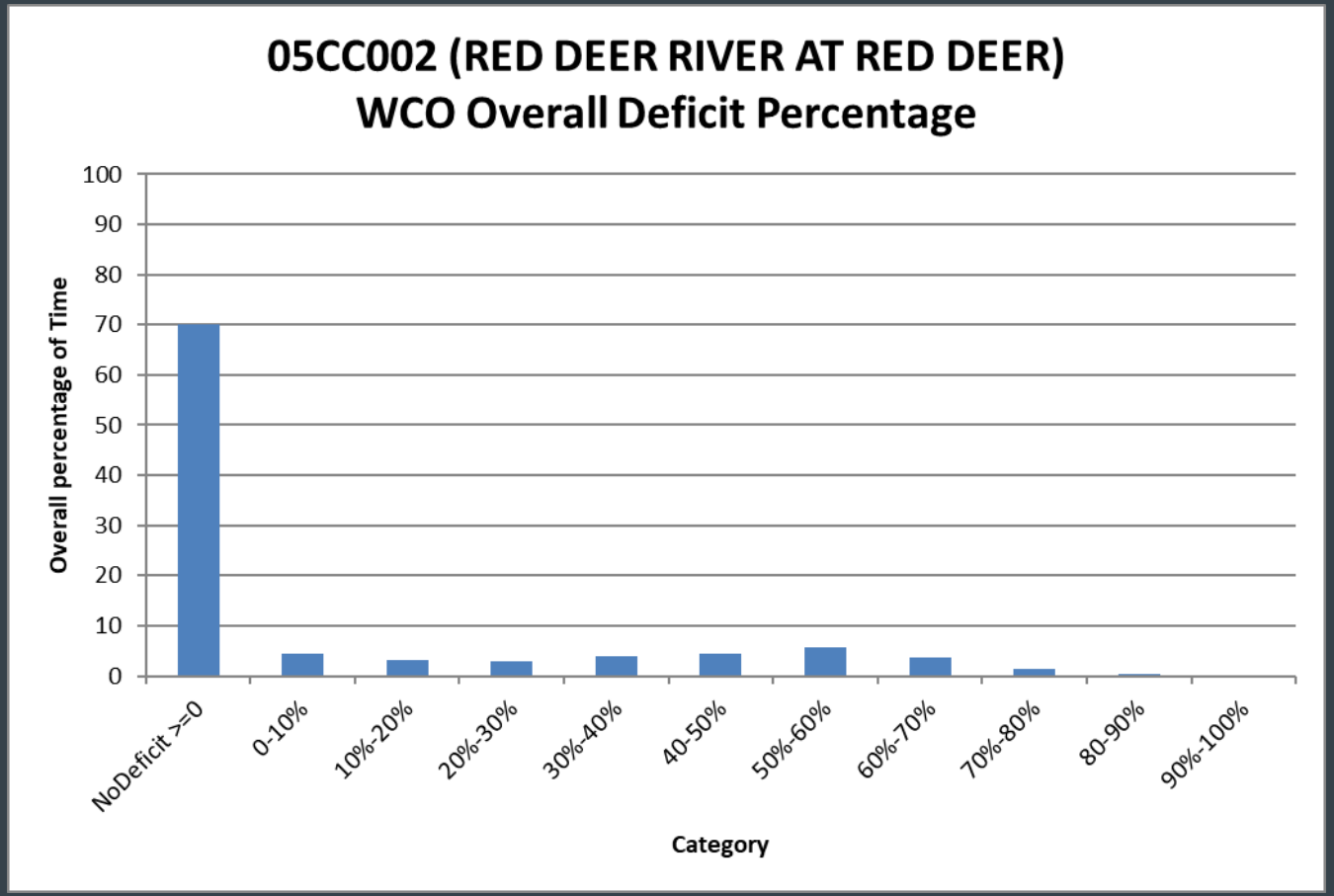




Timestamp	Natural flow (m³/s)	Recorded flow (m³/s)	WCO (m³/s)
2022-07-10	160.582	---	72.262
2022-07-09	166.664	---	74.999
2022-07-08	**173.635**	**152.090**	**78.136**
2022-07-07	175.890	143.121	79.151
2022-07-06	149.047	122.557	67.071
2022-07-05	141.777	119.933	63.800
2022-07-04	141.008	143.544	63.454
2022-07-03	140.466	139.765	63.210
2022-07-02	137.281	144.814	61.776
2022-07-01	144.869	144.249	65.191

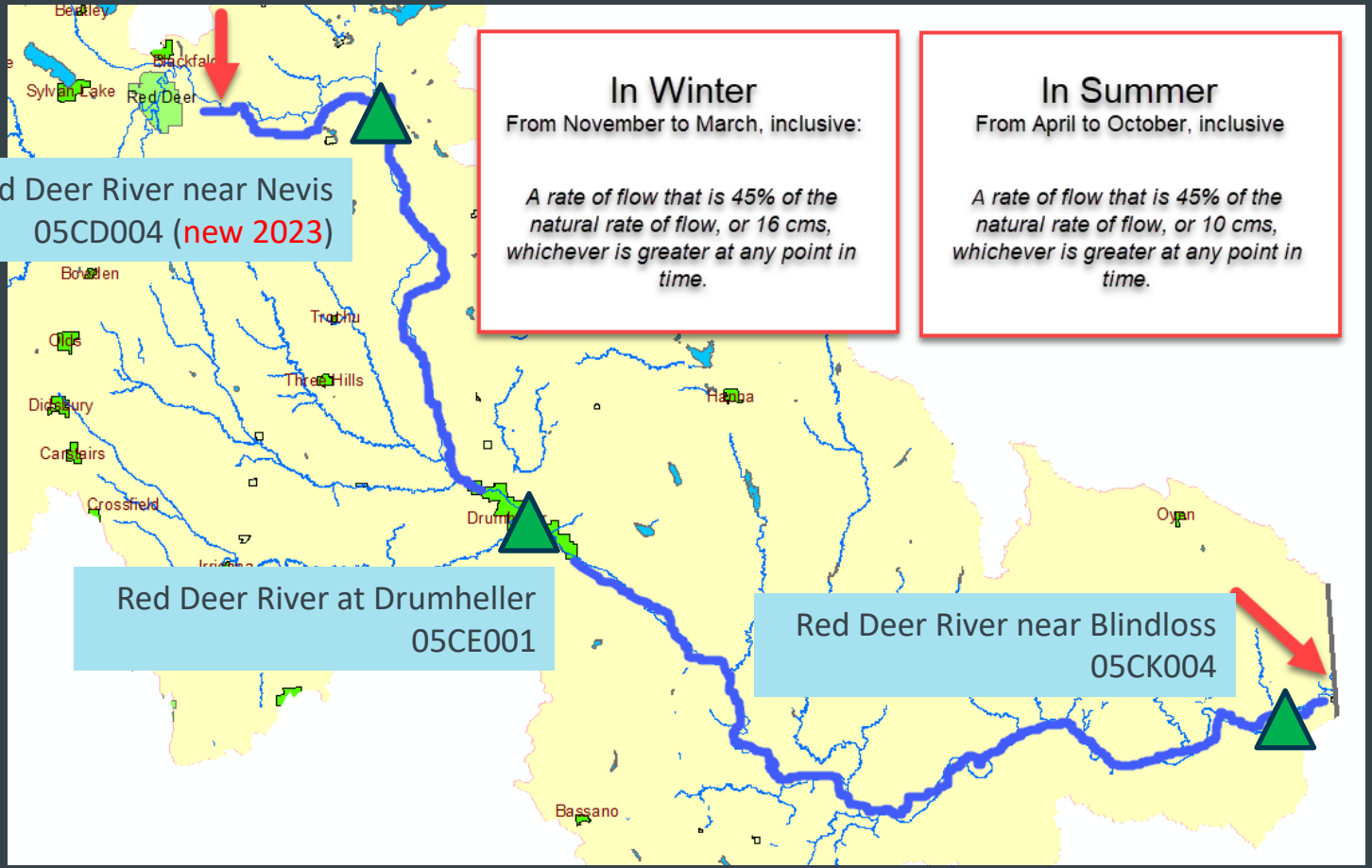
Red Deer River WCO

Dickson Dam to Blindman River



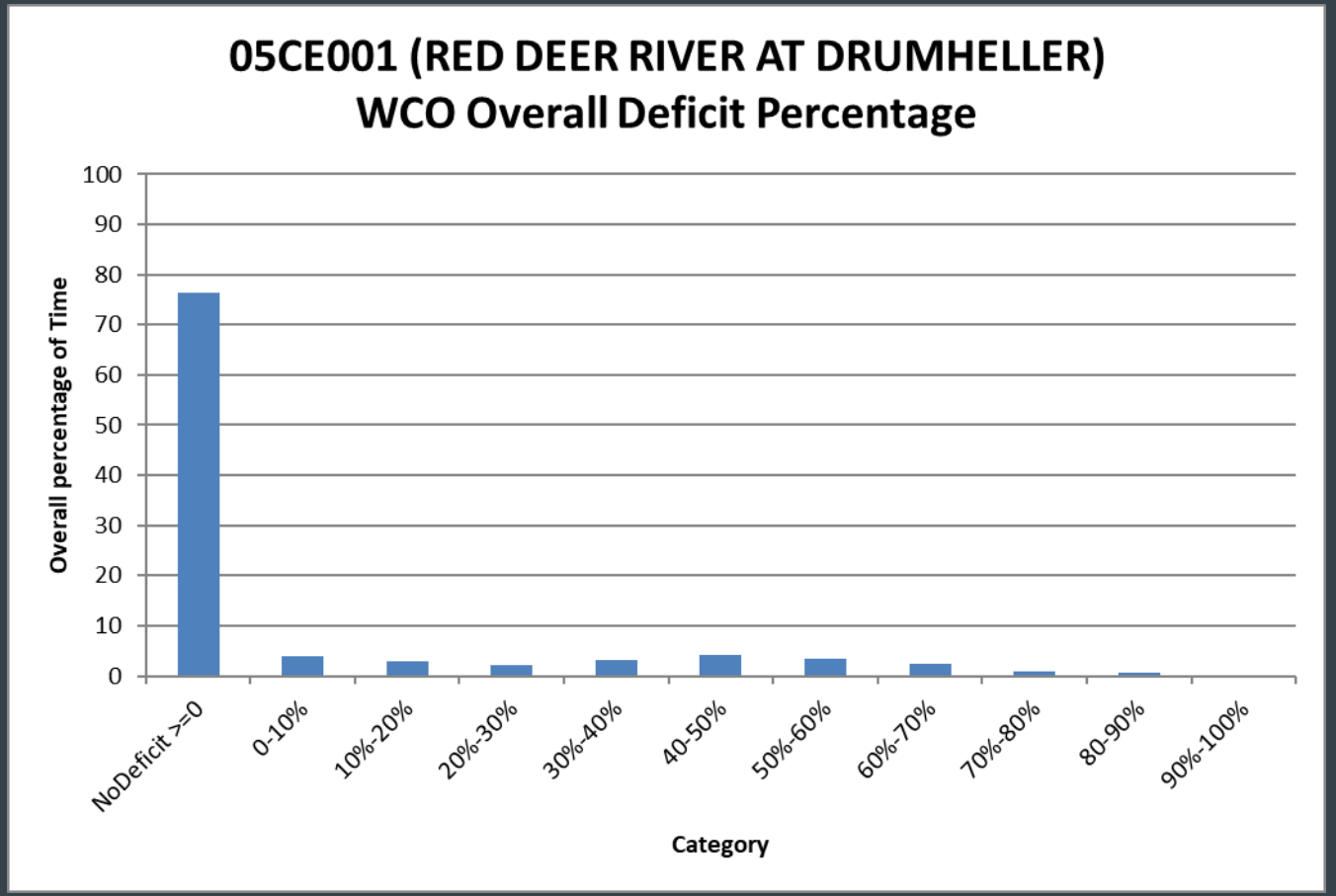
Red Deer River WCO

Confluence Blindman River to Sask Border



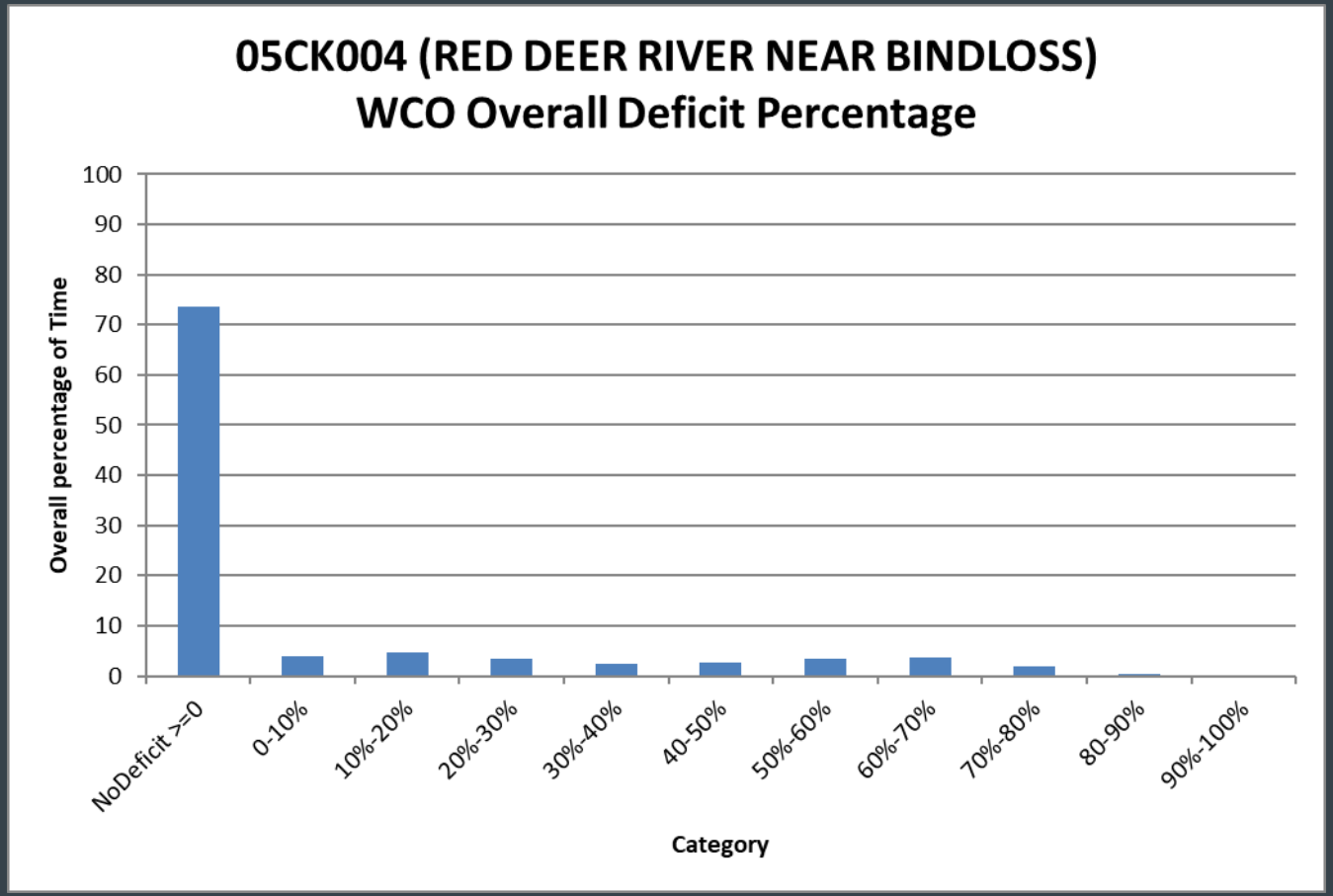
Red Deer River WCO

Blindman River to Sask Border



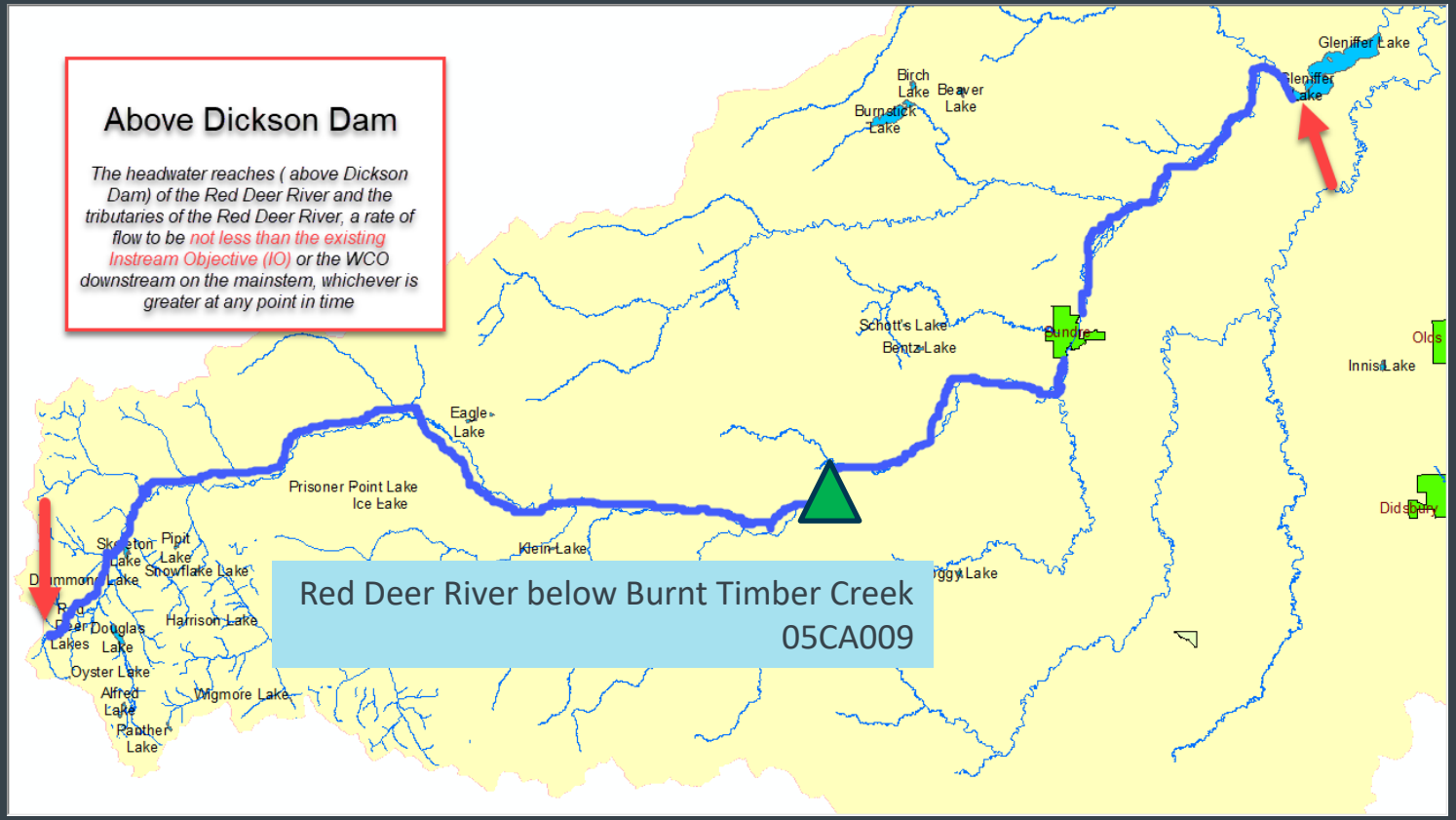
Red Deer River WCO

Blindman River to Sask Border



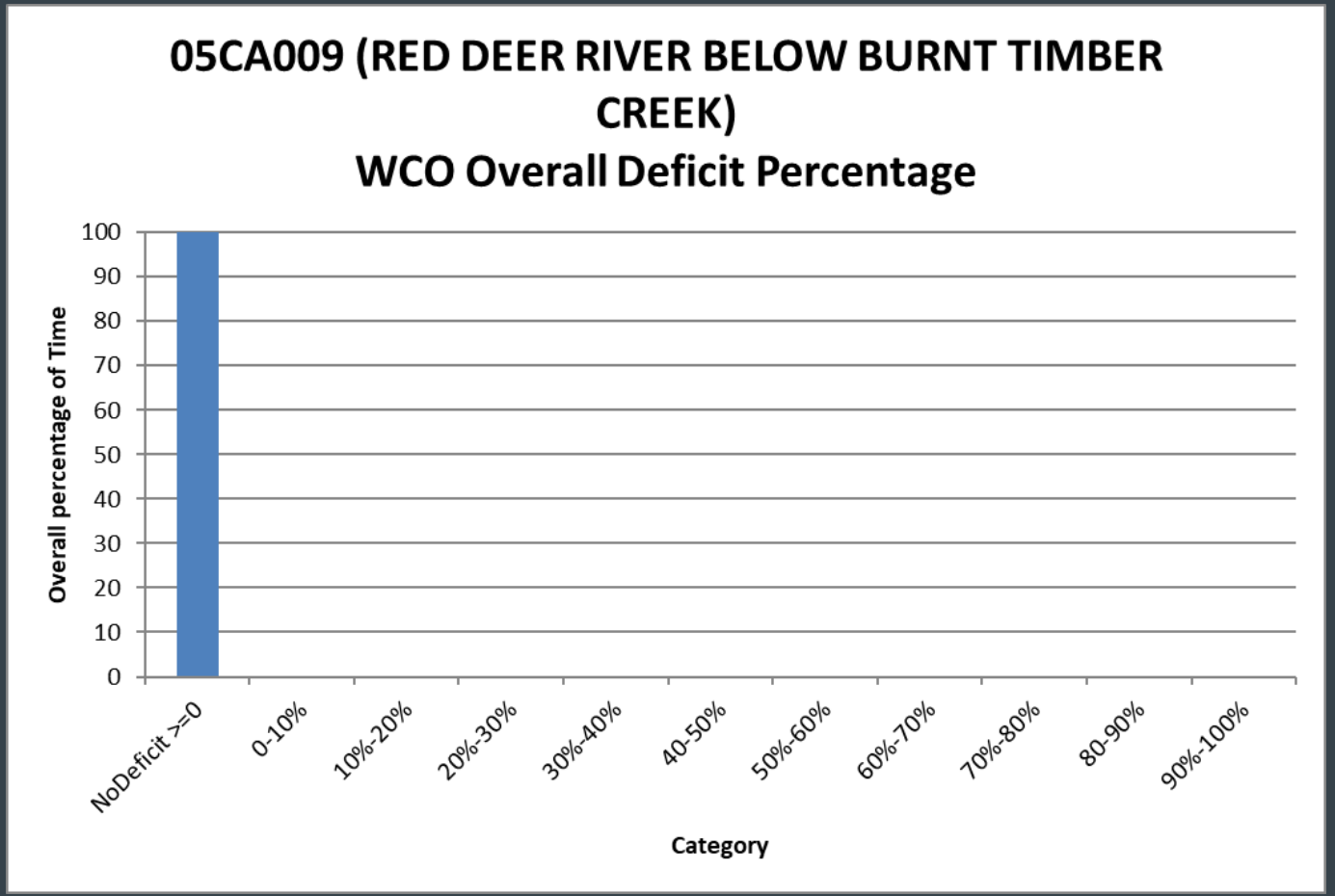
Red Deer River WCO

Dickson Dam to Blindman River

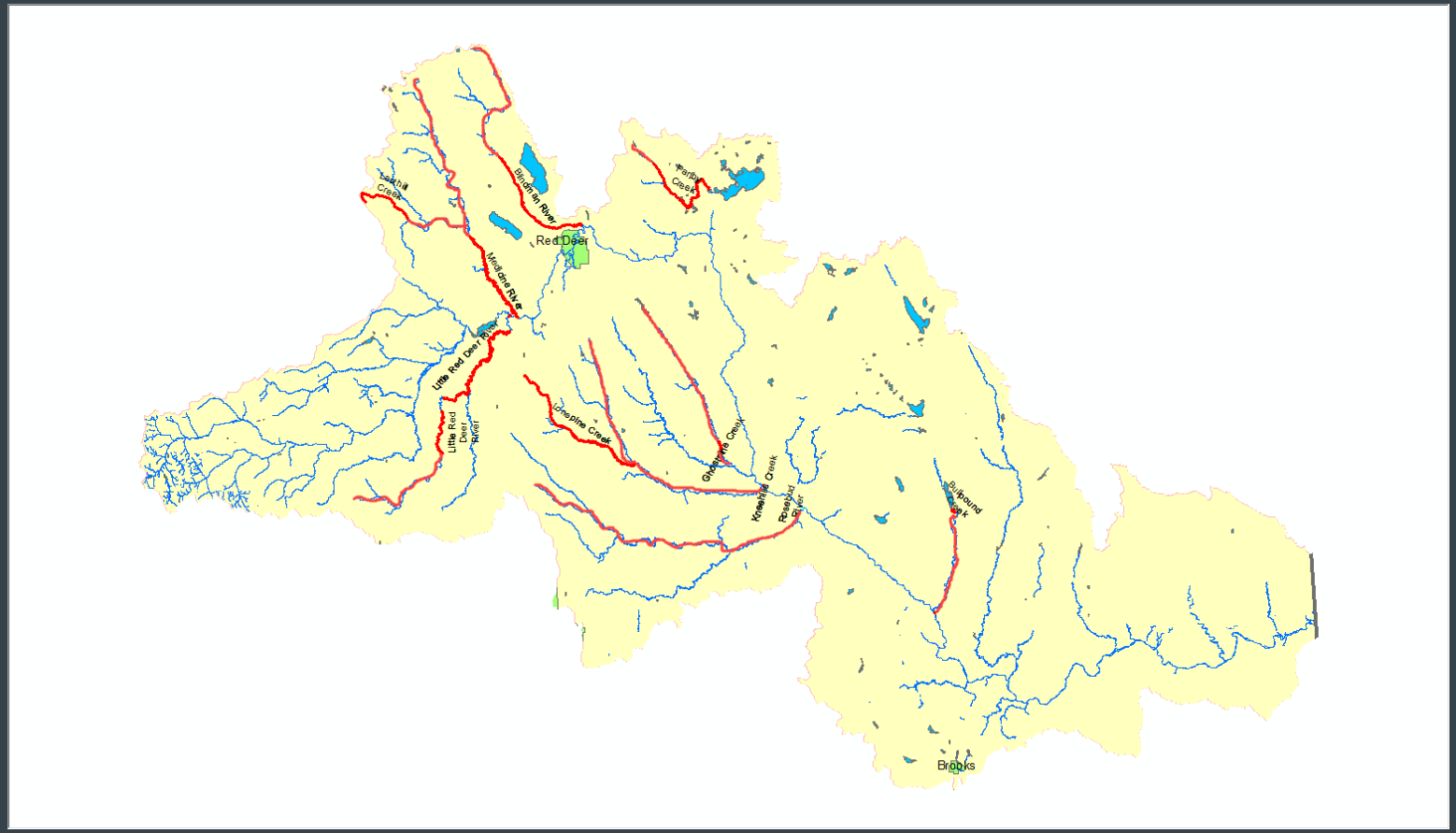


Red Deer River WCO

Upstream of Dickson Dam



Red Deer River Tributary Instream Objectives (IO's)



Red Deer River Tributary Instream Objectives (IO's)

Red Deer River Basin Tributary IO's based upon provincial 449 document			
Basin	**Description**	**Hydrometric Station**	**IO** *(cms)*
Rivers (cms)			
	Blindman River	05CC001	0.156
	Bowden Creek	No Gauge	0.093
	Bullpound Creek	05CG004	0.093
	Ghostpine Creek	05CE012	0.093
	Kneehills Creek	05CE002	0.311
	Lasthill Creek	05CC013	0.093
	Little Red Deer River	05CB001	0.467
	Lonepine Creek	No Gauge	0.187
	Medicine River (above Lasthill Creek)	05CC007, 05CC013	0.093
	Medicine River (below Lasthill Creek)	05CC007	0.187
	Parlby Creek	05CD902	0.047
Lake (m)			*(m)*
	Gabriel Lake	No Gauge	944.148
	Shooting Lake	No Gauge	826.953

Legacy 'outdated' Tennant and Tessmann derived environmental minimum flow that are still being used.

10 Streams

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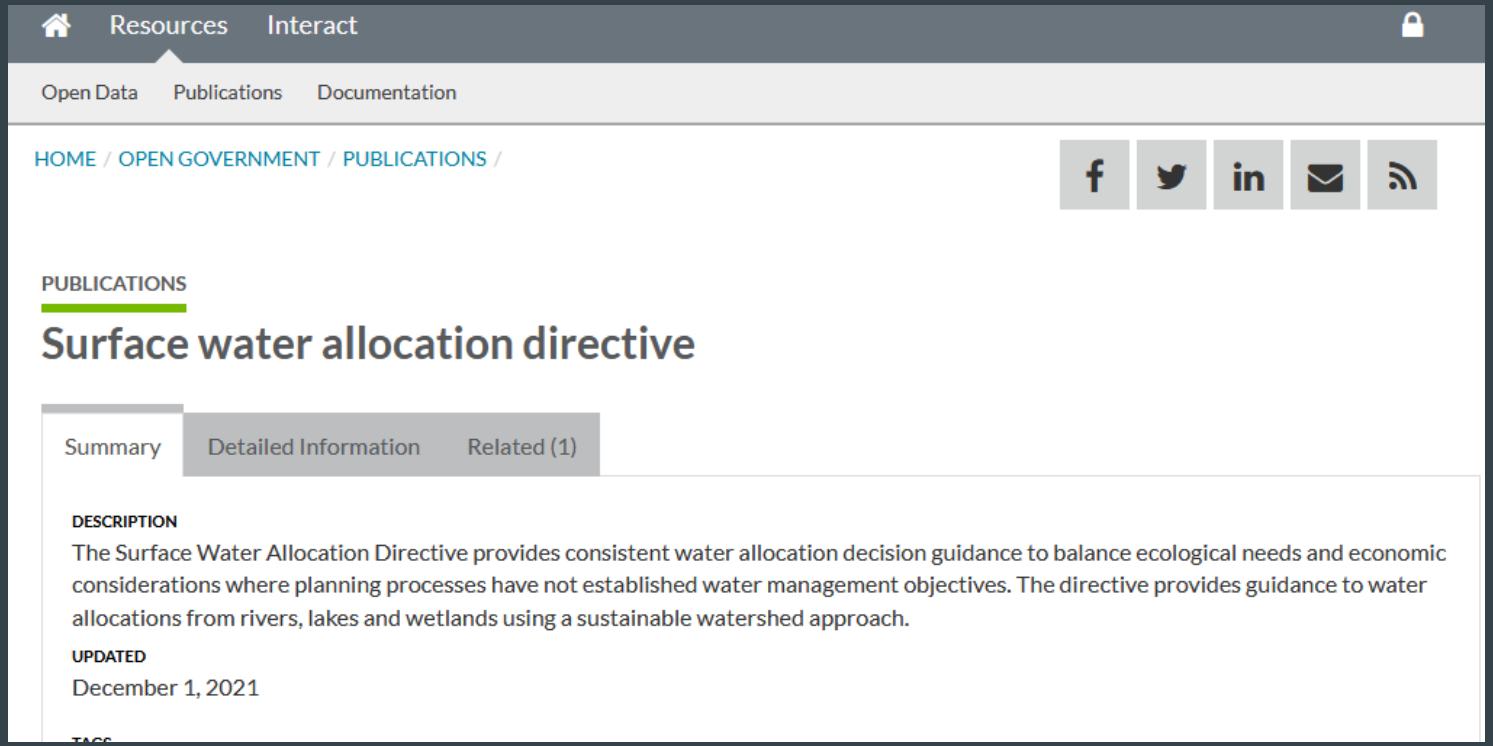
Provincial Environmental Stream Flows
Surface Water Allocation Directive (SWAD)



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Surface Water Allocation Directive

Table 3. River and stream cumulative percent allocation limits based on natural instantaneous discharge f w eekly exceedance data as determined by mean annual discharge and/or stream order. Mean annual discharge is the primary criteria; stream order is to be used only as a secondary option.

Mean Annual Discharge [4] (m^3/s)	Stream Order [5]	Natural/Naturalized Weekly Flow (% exceedance)*		
primary criteria	secondary	$>Q_{80}$	$\leq Q_{80}$ - $>Q_{95}$	$\leq Q_{95}$
≥10	≥7	15%	5%	5%
≥2 - <10	5 or 6	15%	5%	0%
< 2	≤4	10%	0%	0%

* Measured (recorded) flow s may not provide the natural flow of a river or stream and further analysis is done to naturalize the flow data by removing significant human impacts on observed flow.

Modern Scientifically Defendable Stream Allocation Limit Methodology

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Surface Water Allocation Directive Applicability to the Red Deer River Tributaries

1.2 Policy Context and Scope

The primary legislative basis for this policy is the *Water Act*. This policy does not exempt a proponent from any regulatory requirements under other provincial and federal legislation. This directive does not replace or override requirements specified in other guidelines, directives, regulations, policies or legislation in effect at the time of application for a licence under the *Water Act*.

This directive is applicable where the following are absent and where the following do not already provide guidance on water allocation, principally:

- a Ministerial Order or decision of the Lieutenant Governor in Council;
- a water management plan or water conservation objective (*Water Act)*;
- a Land-use Framework regional plan or environmental management framework (*Alberta Land Stewardship Act)*.

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RDRB Surface Water Licenses

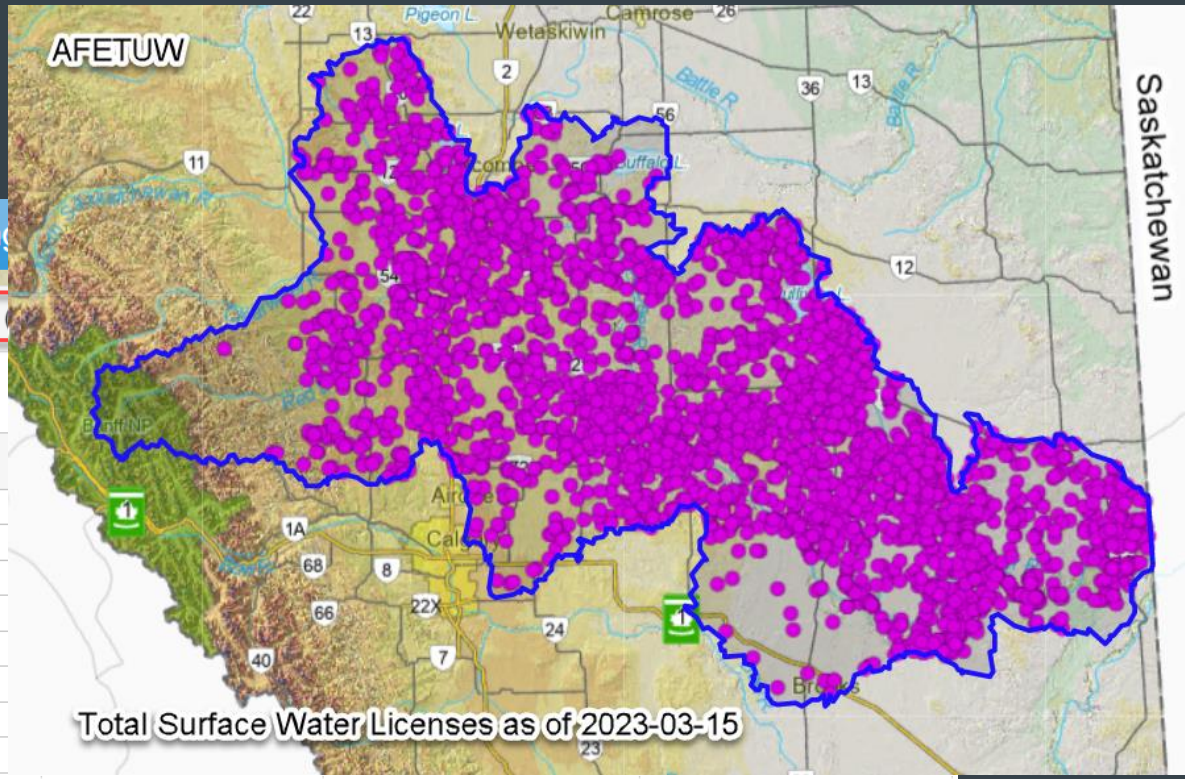
Red Deer River Basin Surface Water Licence Allocations			
	Current Allocations	331,572,612.00	*cu.m*
	Threshold	550,000,000.00	*cu.m*
	Percent Allocated	60.3%	
	Available	218,427,388.00	*cu.m*

Alberta Government — Alberta Flow Estimation Tool for Un

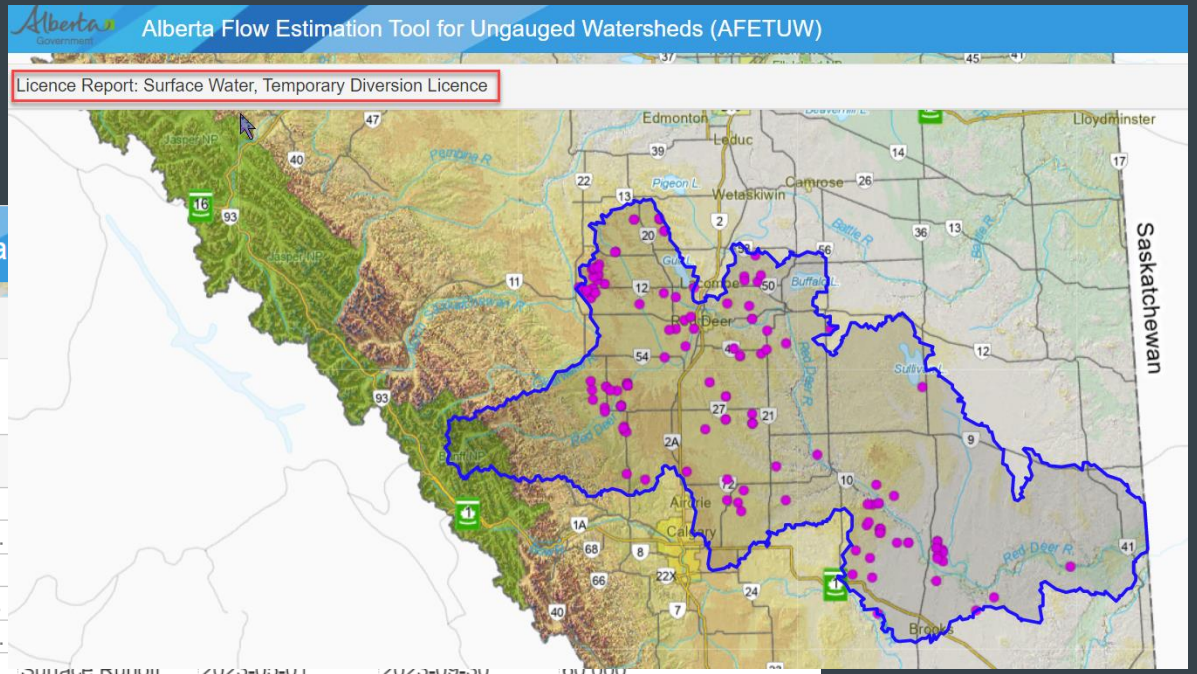
Licence Report: Surface Water, Permanent Licences including

Export to Excel | Export to TXT | Red Deer River Basin

	Effective Date	Expiry Date	Licence Volume [3]
Sev…	1976-09-27		2,460
	1992-08-24	2039-01-01	0
Na…	1993-11-10	2039-01-01	0
Nol…	1968-11-05		117,180
Sulli…	1975-11-04		37,010
ver	1990-06-12		308,370
ver	1996-08-15		57,970
Jnn…	2007-04-04	2032-04-03	3,531
Red…	1985-01-08		3.700
			2.470
			0
			1.230
			331,572,612.15 (m^3/year)
			92,921,911.47 (m^3/year)
			58,008,128.98 (m^3/year)
			180,642,571.7 (m^3/year)



RDRB Temporary Diversion Licenses



Alberta Flow Estimation Tool for Unga

Licence Report: Surface Water, Temporary Diversion Licence

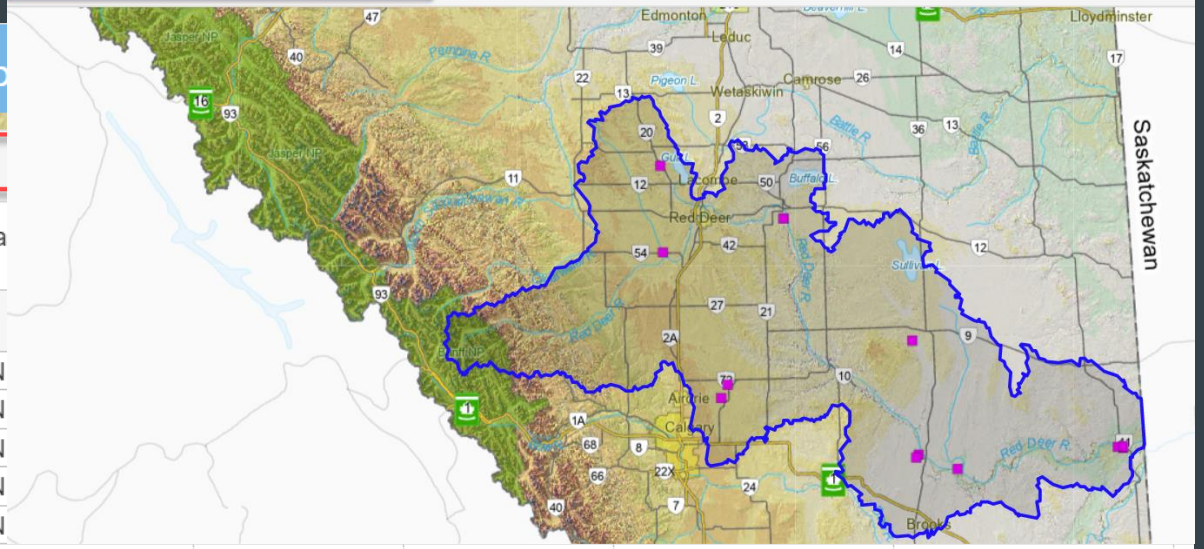
Export to Excel | Export to TXT | Red Deer River Basin

Approval Id	Priority [1]	Licensee				
488508		VESTA ENERGY LTD.				
492938		BONAVISTA ENERGY CORPO…				
491622		BAYTEX ENERGY LTD.				
490255		TRANSGLOBE ENERGY COR…				
492938		BONAVISTA ENERGY CORPO…				
492938		BONAVISTA ENERGY CORPO…	Surface Runoff	2023-03-01	2023-09-30	60,000
490373		TAQA NORTH LTD.	Surface Runoff	2022-12-02	2023-04-30	60,000
492647		WHITECAP RESOURCES INC.	Surface Runoff	2023-02-06	2023-05-31	52,500
491622		BAYTEX ENERGY LTD.	Surface Runoff	2023-01-01	2023-12-31	50.000
						2,784,095.53 (m^3/year)

RDRB Surface Water Licence Applications

Alberta Flow Estimation Tool for Ungauged Watersheds (AFETUW)

Licence Report: Surface Water, Licence Application



Alberta Flow Estimation Too

Licence Report: Surface Water, Licence Application

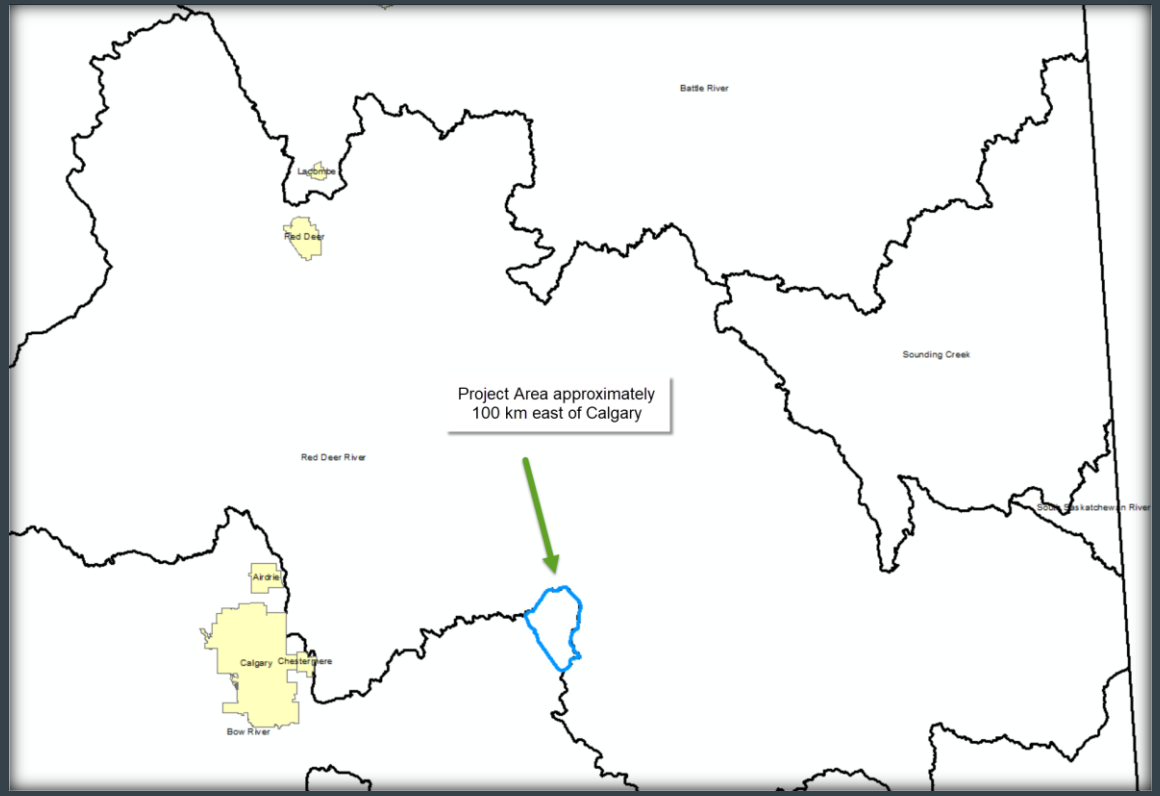
Export to Excel | Export to TXT | Red Deer River Ba

Approval Id	Priority [1]	Licensee						
	20030411006	SPECIAL AREA…	N			53,100	0	0
	20210430001	YESTER YEAR…	N			40,076	0	0
		CHRISTOPHE…	N			34,320	0	0
	20180716001	BOGI, CHESTER	N			21.000	0	0
	20180615003	BOGI, CHESTER	N					
	20220722002	COLEGRAVE, …	N					
		EDWARD MILE…	N					
		MCNAIR SAND…	N					
	20190227001	HOWELL'S EX…	N					
						64,720,590 (m^3/year)	240,410 (m^3/year)	0

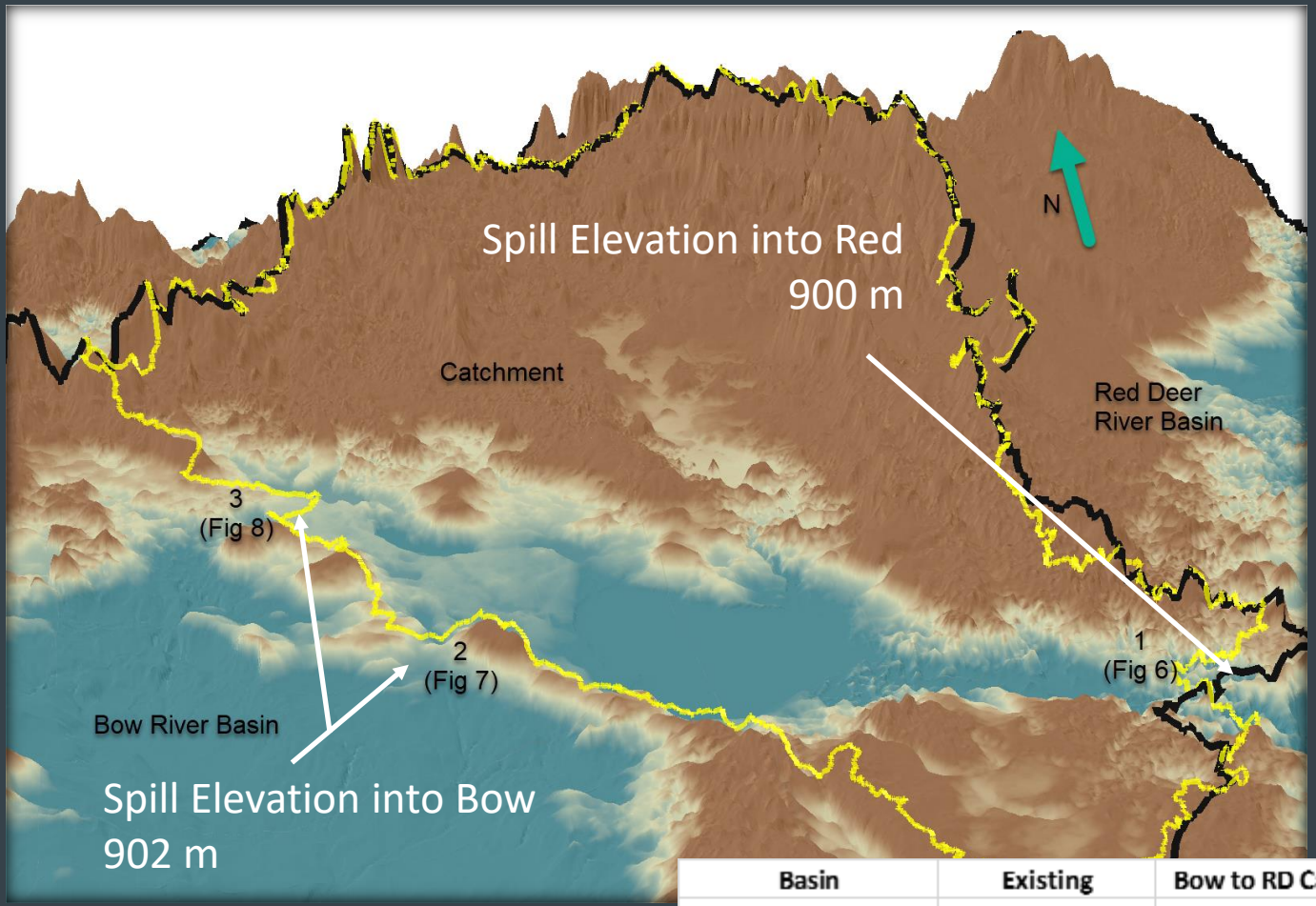
Regional Hydrologist Functions

- Conduct surface water hydraulic/hydrologic analysis
- Evaluate applications under the Water Act for RAD
- Evaluate surface water impacts for Compliance
- Naturalize flows
- Undertake modelling studies
- Incorporate spatial data into hydrologic analysis
- Provide hydrology SME end-user support
- Improve current methodology in hydrology

Something New

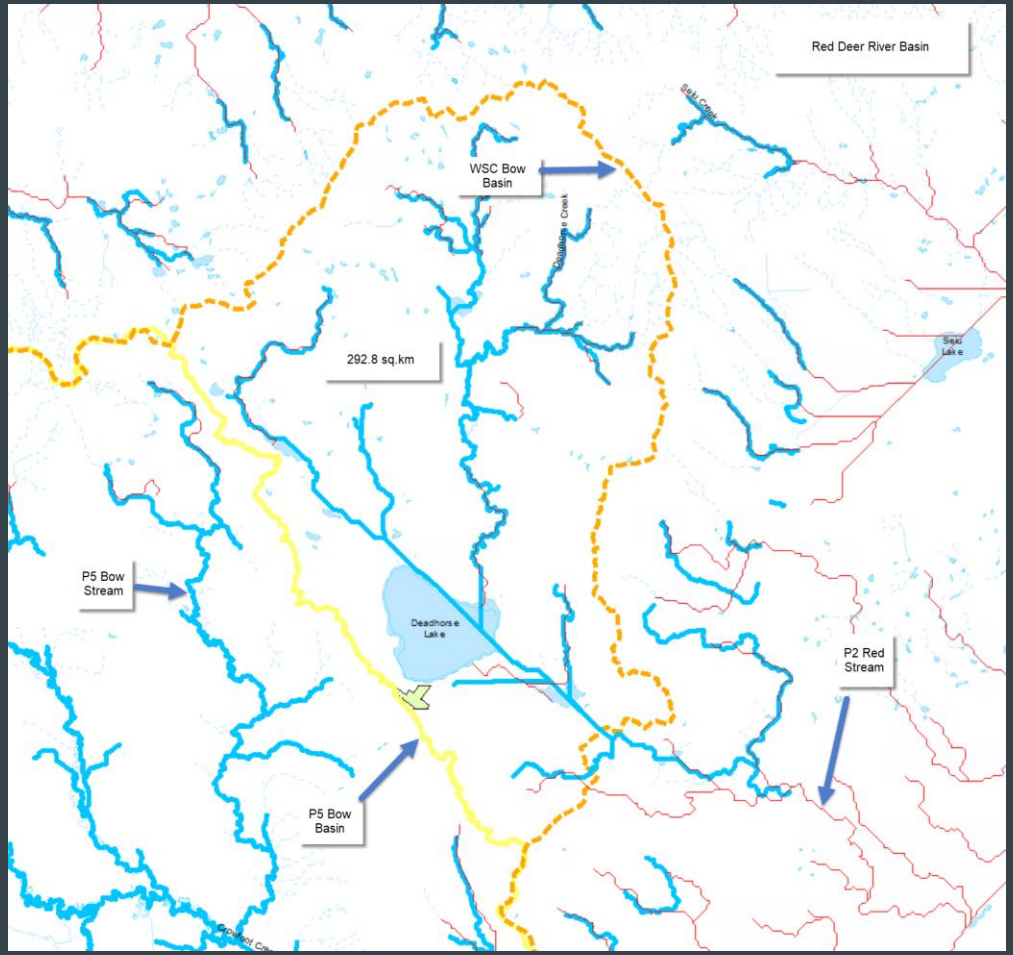


Something New



Basin	Existing	Bow to RD Catchment	Corrected	Change in Area
	(sq.km)	*(sq.km)*	*(sq.km)*	*(%)*
Bow River Basin	25,593.44	-292.8	25,300.64	-1.1%
Red Deer River Basin	50,113.89	292.8	50,406.69	0.6%

Revised Drainage Network



The End