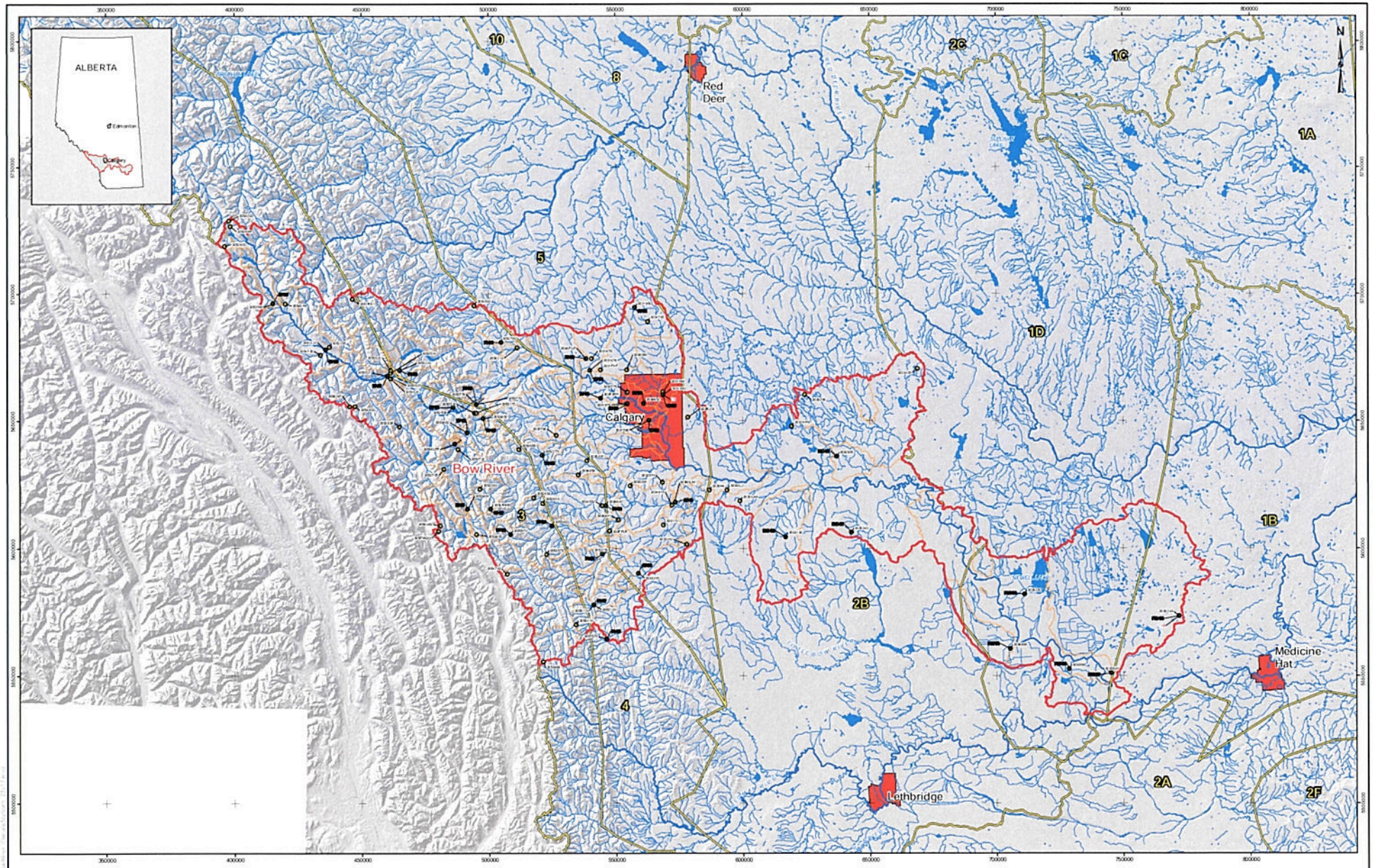
APPENDIX B

Bow River Basin

July 2010
Report No. 09-1326-1006

Golder Associates



LEGEND

- CLIMATE STATION
- INDEX STATION PRECIPITATION
- INDEX STATION TEMPERATURE
- RIVER
- HYDROLOGIC REGION
- LAKE
- MAJOR RIVER BASIN
- PFRA SUB-BASIN

REFERENCE

Hydrography and city data for Canada obtained from Natural Resources Canada. Hydrography for the USA obtained from USGS.
Hydrometric stations, hydrologic regions, basin and sub-basin data obtained from Alberta Environment.
Projection: Alberta 10TM False Easting 500,000 at 115° W. Datum: NAD 83

30 0 30
SCALE 1:1,000,000 KILOMETRES

PROJECT
Government of Alberta
Environment

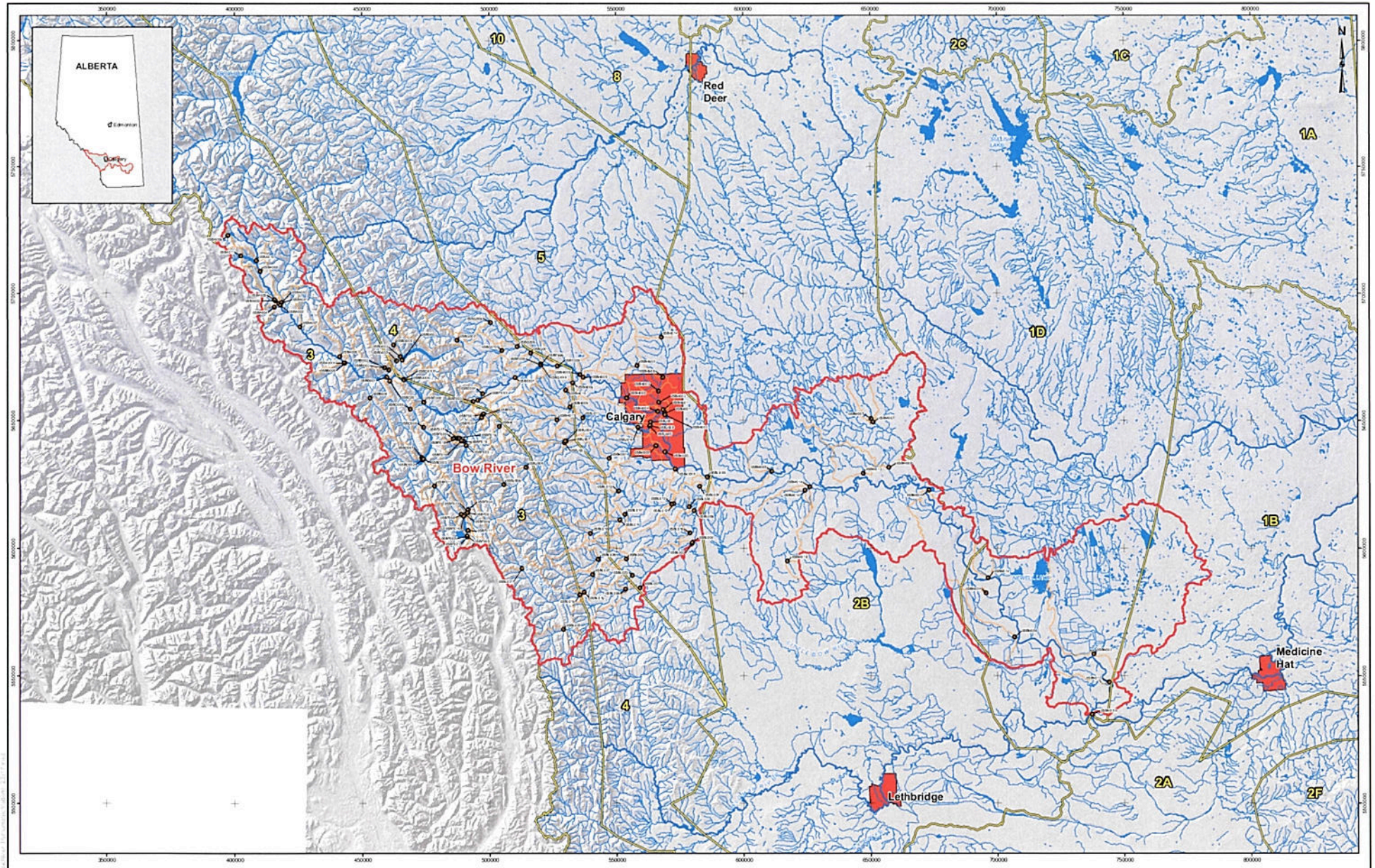
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE

CLIMATE STATIONS IN THE BOW RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1326-1006			SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep. 2008		
GIS	PT	23 Mar. 2010		
CHECK	AB	25 Jul. 2010	FIGURE: B.1	
REVIEW	AB	26 Jul. 2010		



LEGEND

- HYDROMETRIC STATION
- RIVER
- HYDROLOGIC REGION
- LAKE
- MAJOR RIVER BASIN
- PFRA SUB-BASIN

REFERENCE

Hydrography and city data for Canada obtained from Natural Resources Canada. Hydrography for the USA obtained from USGS.
Hydrometric stations, hydrologic regions, basin and sub-basin data obtained from Alberta Environment.
Projection: Alberta 10TM False Easting 500,000 at 115° W. Datum: NAD 83

30 0 30
SCALE 1:1,000,000 KILOMETRES

PROJECT
Government of Alberta
Environment

HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

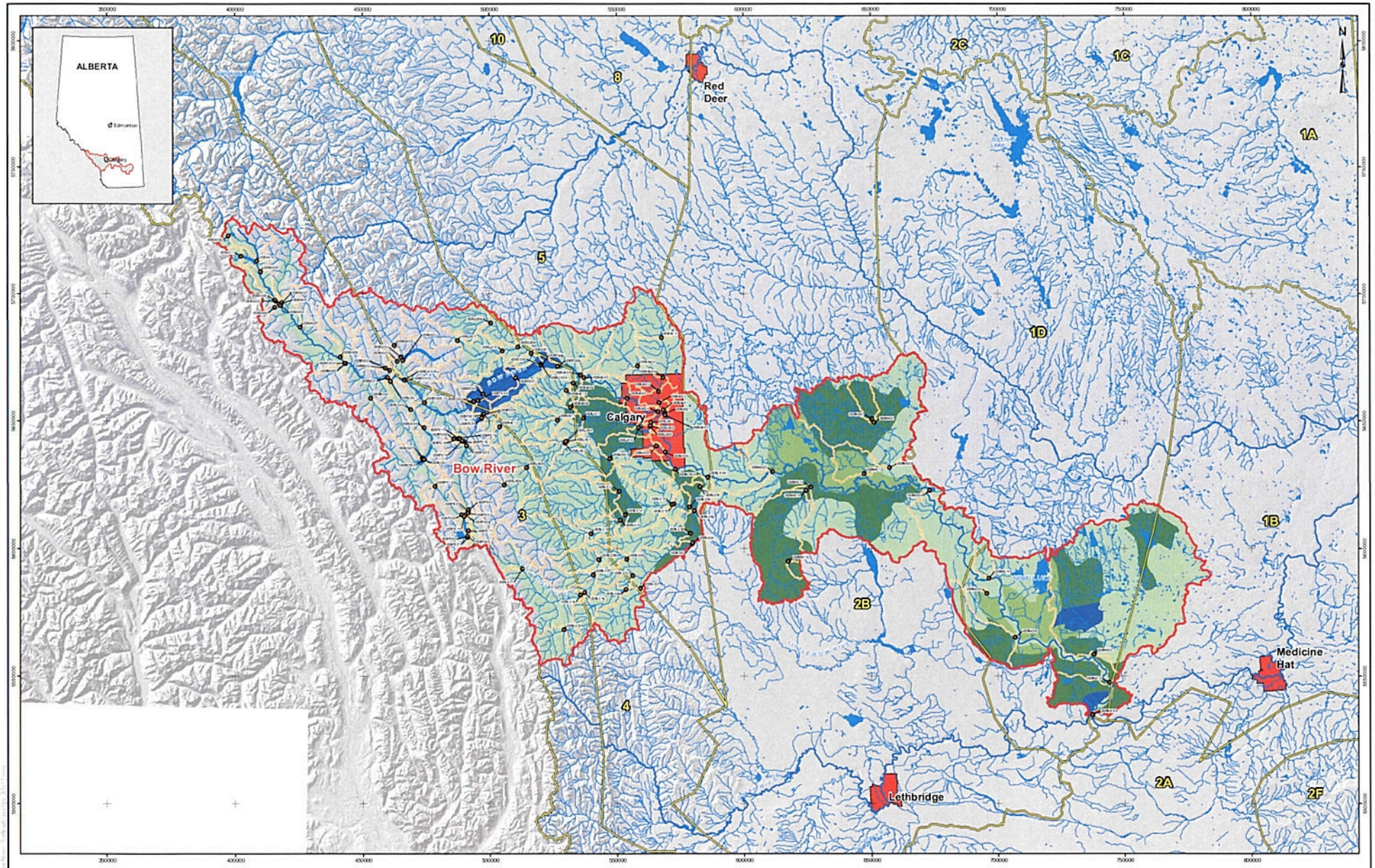
TITLE

HYDROMETRIC STATIONS IN THE BOW RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1336-1004		SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep 2009	
GIS	AB	23 Mar 2010	
CHECK	AB	26 Jul 2010	
REVIEW	AB	26 Jul 2010	

FIGURE: B.2



LEGEND

- HYDROMETRIC STATION
- RIVER
- HYDROLOGIC REGION
- LAKE
- MAJOR RIVER BASIN
- PFRA SUB-BASIN

SOIL TYPE

- IMPERVIOUS
- ORGANIC
- WATER
- POORLY DRAINED CLAY LOAM
- POORLY DRAINED SAND
- POORLY DRAINED TILL
- RAPIDLY DRAINED SAND
- RAPIDLY DRAINED TILL
- WELL DRAINED CLAY LOAM
- WELL DRAINED SAND
- WELL DRAINED TILL
- WELL DRAINED RESIDUAL
- NO DATA

30 0 30
SCALE 1:1,000,000 KILOMETRES

REFERENCE

Hydrography and city data for Canada obtained from Natural Resources Canada. Hydrography for the USA obtained from USGS. Hydrometric stations, hydrologic regions, basin and sub-basin data obtained from Alberta Environment. Surficial Geology for Alberta obtained from Agriculture and Agri-Food Canada. Surficial Geology for Montana obtained from Natural Resources Conservation Service.
Projection: Alberta 10TM False Easting 500,000 at 115° W. Datum: NAD 83

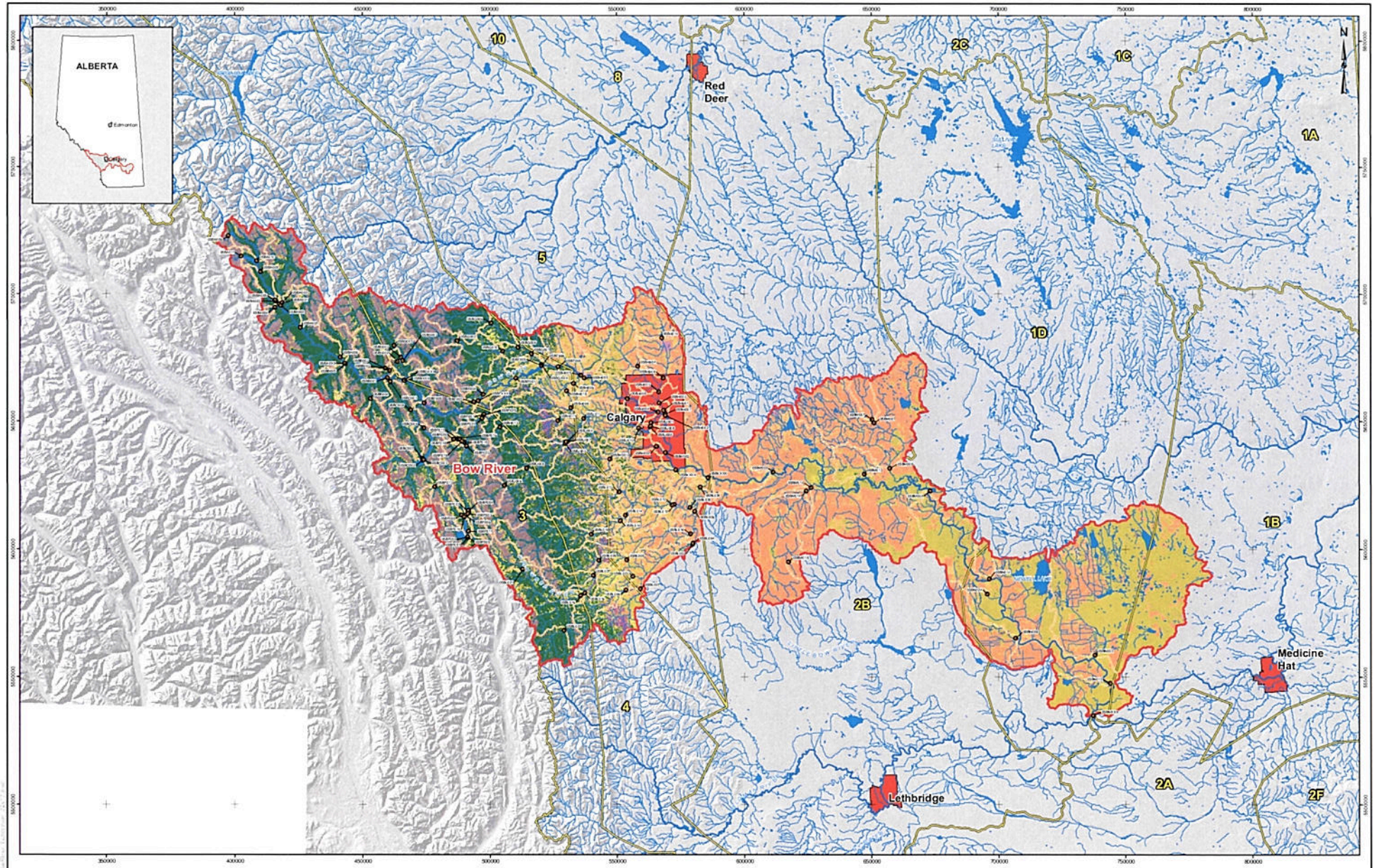
PROJECT
Government of Alberta — Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE
SURFICIAL GEOLOGY IN THE BOW RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1326-1068			SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep 2009	
GIS	AB	25 Mar 2010	
CHECK	AB	25 Jul 2010	
REVIEW	AB	29 Jul 2010	

FIGURE: B.3



REFERENCE

Hydrography and city data for Canada obtained from Natural Resources Canada. Hydrography for the USA obtained from USGS. Hydrometric stations, hydrologic regions, basin and sub-basin data obtained from Alberta Environment. Landcover for Canada obtained from Agriculture and Agri-Food Canada. Landcover for the USA obtained from USGS.
Projection: Alberta 10TM False Easting 500,000 at 115° W. Datum: NAD 83

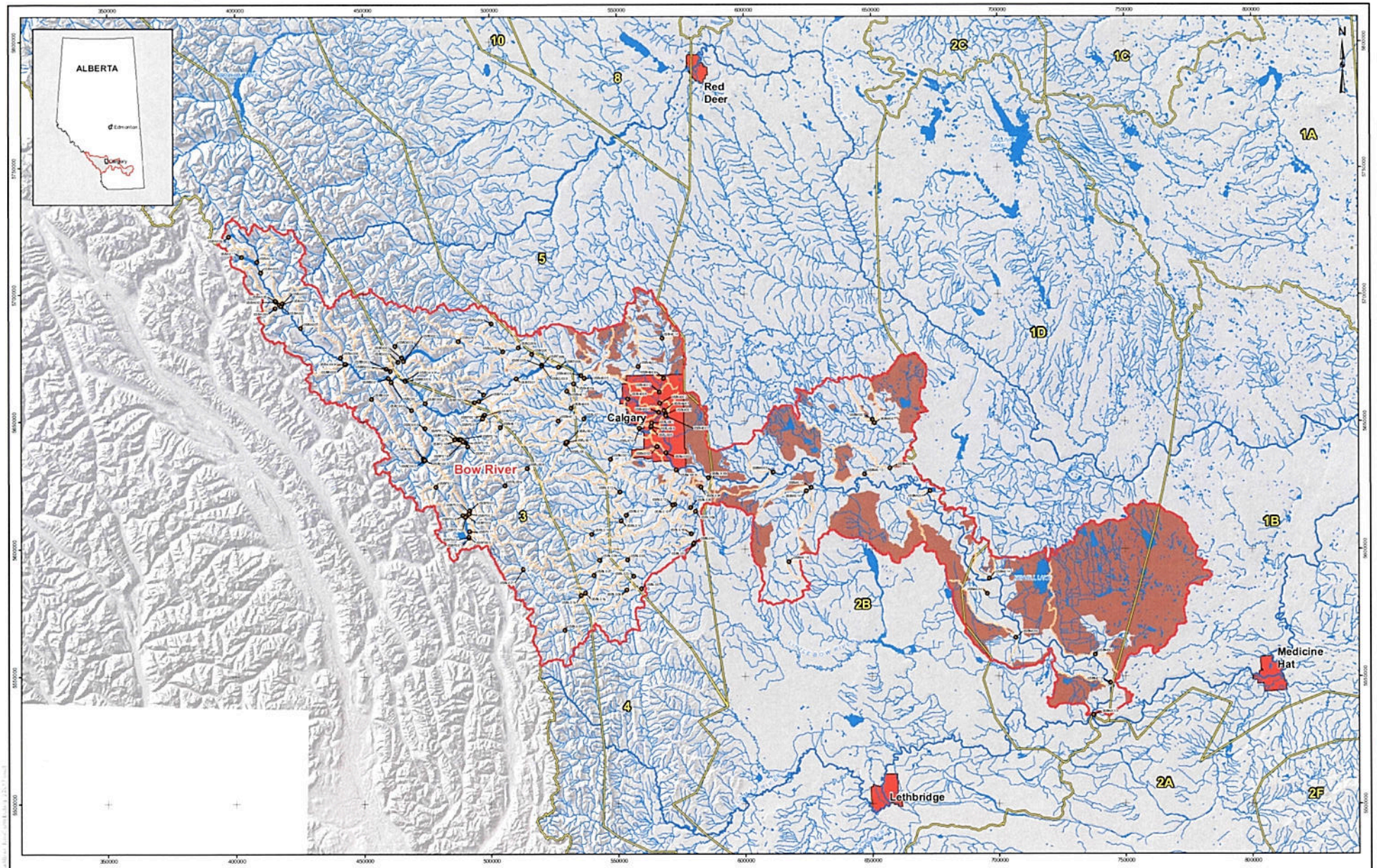
PROJECT
Government of Alberta — Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE
LAND COVER IN THE BOW RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1326-1005		SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep. 2009	
GIS	AB	23 Mar. 2010	
CHECK	AB	25 Jul. 2010	
REVIEW	AB	29 Jul. 2010	

FIGURE: B.4



LEGEND

- HYDROMETRIC STATION
- RIVER
- HYDROLOGIC REGION
- LAKE
- MAJOR RIVER BASIN
- NON-CONTRIBUTING AREA
- PFRA SUB-BASIN

REFERENCE

Hydrography and city data for Canada obtained from Natural Resources Canada. Hydrography for the USA obtained from USGS.
Hydrometric stations, hydrologic regions, basin and sub-basin data obtained from Alberta Environment.
Projection: Alberta 10TM False Easting 500,000 at 115° W. Datum: NAD 83

30 0 30
SCALE 1:1,000,000 KILOMETRES

PROJECT
Government of Alberta — Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

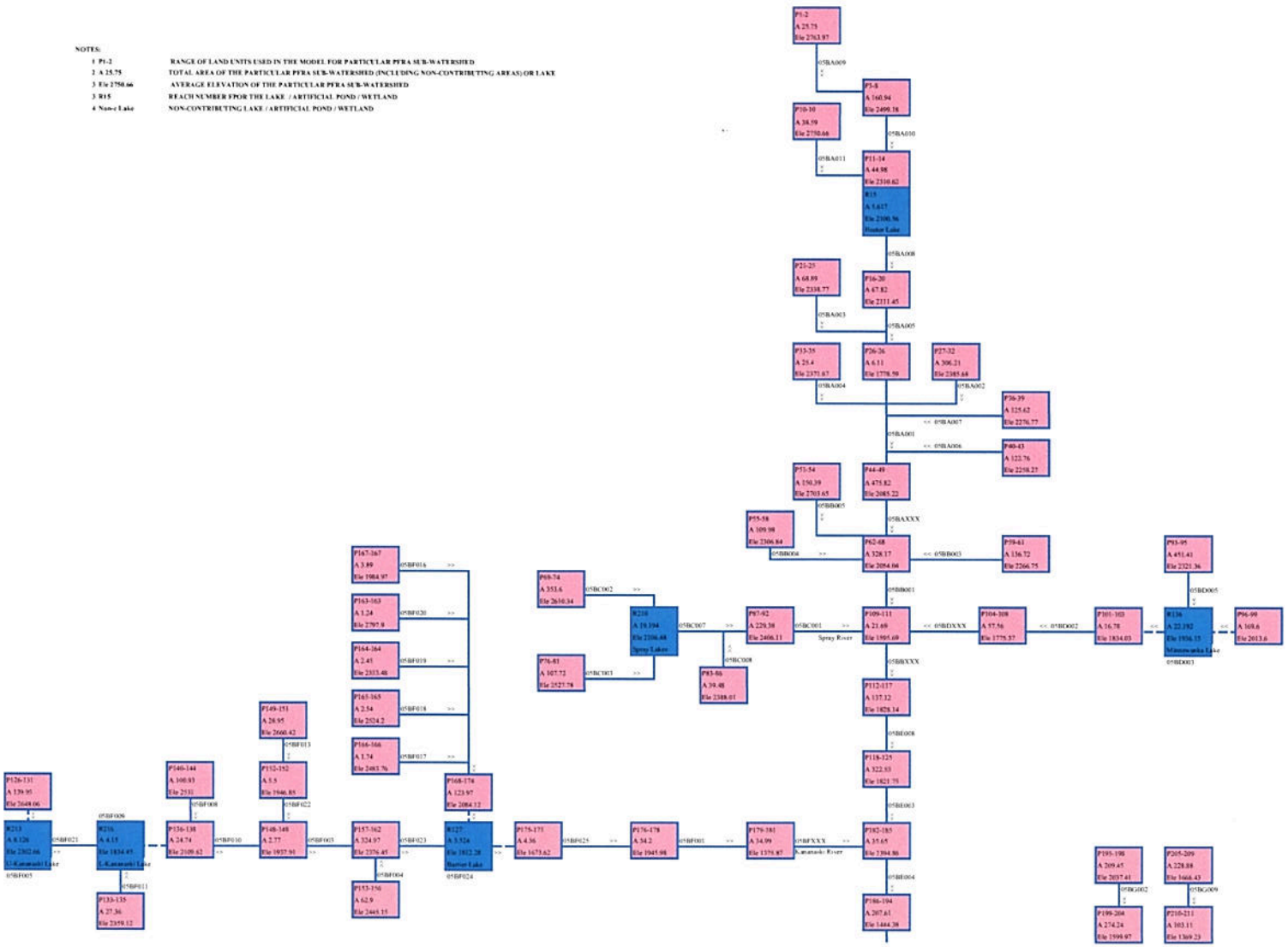
TITLE
NON-CONTRIBUTING AREAS IN THE BOW RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1328-1006		SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep. 2010	
GIS	AB	23 Mar. 2010	
CHECK	AB	25 Jul. 2010	
REVIEW	AB	26 Jul. 2010	

FIGURE: B.5

Figure B.6 HSPF Schematic for the Upper and Lower Portions of the Bow River Basin



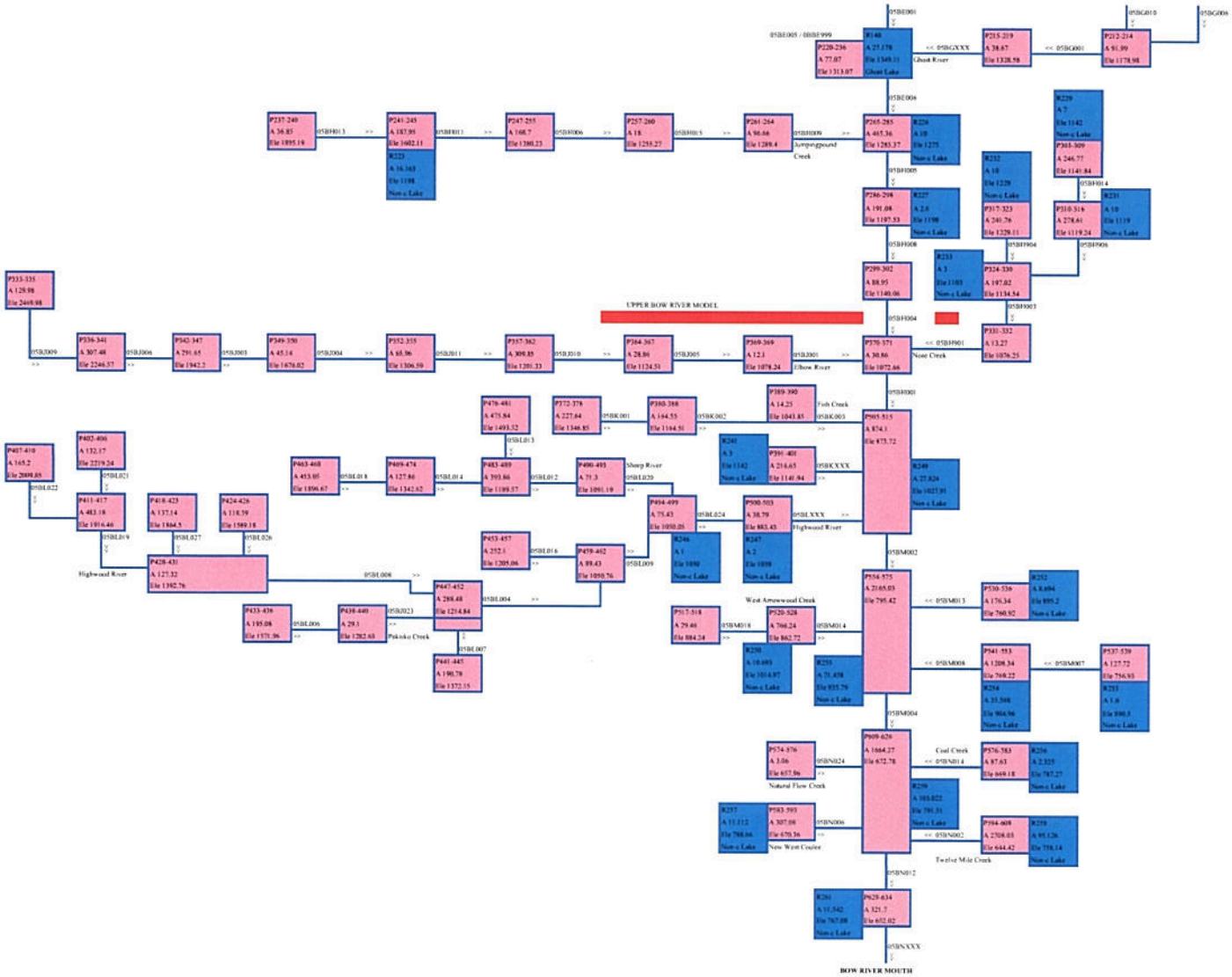

UPPER BOW RIVER MODEL
Ghost River
Jumpingpound Creek
Elbow River
Nose Creek
Fish Creek
Sheep River
Highwood River
West Arrowwood Creek
Pekisko Creek
Cow Creek
Natural Flow Creek
New West Coulee
Twelve Mile Creek
BOW RIVER MOUTH

Table B.1a Calibrated HSPF Parameters for the UPPER Portion of the Bow River Basin

Pervious Land Parameters

Land Type	Parameter	FOREST	LZSN	INFILT	KVARY	AGWRC	PETMAX	PETMIN	INFEXP	INFILD	DEEPFR	BASETP	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
	Description	The fraction of the pervious land segment which is covered by forest	The lower zone nominal storage	An index to the infiltration capacity of the soil	parameter which effects the behavior of groundwater recession flow, enabling it to be non-exponential in its decay with time	The basic groundwater recession rate if KVARY is zero and there is no inflow to groundwater.	The air temperature below which E-T will arbitrarily be reduced below the value obtained from the input time series.	The temperature below which E-T will be zero regardless of the value in the input time series.	Exponent in the infiltration equation.	Ratio between the maximum and mean infiltration capacities	Fraction of groundwater inflow which will enter deep (inactive) groundwater	Fraction of remaining potential E-T which can be satisfied from baseflow (groundwater outflow), if enough is available.	Fraction of remaining potential E-T which can be satisfied from active groundwater storage if enough is available.	Interception storage capacity.	Upper zone nominal storage.	Manning's n for the overland flow plane.	Interflow inflow parameter.	Interflow recession parameter	Lower zone E-T parameter.
	Units	none	in	in/hr	1/in	1/day	degF	degF	none	none	none	none	none	in	in	complex	none	1/day	none
Impervious+Annual Cropland							40	35	2	2				see monthly table					see monthly table
Impervious+Coniferous Forest		0.2	0.1-0.26	0.0194-0.05	0.0123-0.1	0.998	40	35	2	2	0-0.4	0	0	see monthly table	0.083	0.05	1	0.612	see monthly table
Impervious+Deciduous Forest							40	35	2	2				see monthly table					see monthly table
Impervious+Developed							40	35	2	2				see monthly table					see monthly table
Impervious+Exposed Land		0	0.1-0.26	0.0194-0.05	0.0123-0.1	0.998	40	35	2	2	0-0.4	0	0	see monthly table	0.083	0.05	1	0.612	see monthly table
Impervious+Grassland Native Grass		0.2	0.1-0.26	0.05	0.1	0.998	40	35	2	2	0	0	0	see monthly table	0.083	0.05	1	0.612	see monthly table
Impervious+Perennial Crops and Pasture							40	35	2	2				see monthly table					see monthly table
Impervious+Shrubland							40	35	2	2				see monthly table					see monthly table
Poorly Drained Sand+Coniferous Forest							40	35	2	2				see monthly table					see monthly table
Poorly Drained Sand+Grassland Native Grass							40	35	2	2				see monthly table					see monthly table
Poorly Drained Sand+Shrubland							40	35	2	2				see monthly table					see monthly table
Well Drained Clay Loam+Annual Cropland		0.3	0.25-3.3	0.0173-0.15	1.18-1.2	0.938	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1-0.3	0.25	1-2	0.534-0.8	see monthly table
Well Drained Clay Loam+Coniferous Forest		0.8	0.25-3.3	0.0173-0.15	1.18-1.2	0.938	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1-0.3	0.25	1-2	0.534-0.8	see monthly table
Well Drained Clay Loam+Deciduous Forest							40	35	2	2				see monthly table					see monthly table
Well Drained Clay Loam+Developed		0	0.25	0.15	1.2	0.938	40	35	2	2		0.2	0.2	see monthly table	0.1	0.25	2	0.8	see monthly table
Well Drained Clay Loam+Exposed Land							40	35	2	2				see monthly table					see monthly table
Well Drained Clay Loam+Grassland Native Grass		0.3	0.25-3.3	0.0173-0.15	1.18-1.2	0.938	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1-0.3	0.25	1-2	0.534-0.8	see monthly table
Well Drained Clay Loam+Perennial Crops and Pasture		0.3	0.25-3.3	0.0173-0.15	1.18-1.2	0.938	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1-0.3	0.25	1-2	0.534-0.8	see monthly table
Well Drained Clay Loam+Shrubland							40	35	2	2				see monthly table					see monthly table
Well Drained Sand+Annual Cropland		0.3	2	0.5	3	0.995	40	35	2	2	0	0.2	0.2	see monthly table	0.2	0.25	5	0.85	see monthly table
Well Drained Sand+Coniferous Forest		0.8	2	0.5	3	0.993	40	35	2	2		0.005-0.2	0.01-0.2	see monthly table	0.2	0.25	5	0.998	see monthly table
Well Drained Sand+Deciduous Forest		0.8	2	0.5	3	0.993	40	35	2	2		0.2	0.2	see monthly table	0.2	0.25	5	0.998	see monthly table
Well Drained Sand+Developed							40	35	2	2				see monthly table					see monthly table
Well Drained Sand+Exposed Land		0	2	0.5	3	0.993	40	35	2	2		0.2	0.2	see monthly table	0.2	0.25	5	0.998	see monthly table
Well Drained Sand+Grassland Native Grass		0.3	2	0.5	3	0.995	40	35	2	2		0.2	0.2	see monthly table	0.2	0.25	5	0.85	see monthly table
Well Drained Sand+Perennial Crops and Pasture		0.8	2	0.5	3	0.993	40	35	2	2		0.2	0.2	see monthly table	0.2	0.25	5	0.998	see monthly table
Well Drained Sand+Shrubland							40	35	2	2				see monthly table					see monthly table
Well Drained Till+Annual Cropland		0.3	0.3	0.25-0.408	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Coniferous Forest		0.8	0.3	0.25-0.5	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Deciduous Forest		0.8	0.3	0.25-0.5	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Developed							40	35	2	2				see monthly table					see monthly table
Well Drained Till+Exposed Land		0	0.3	0.25-0.403	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Grassland Native Grass		0.3	0.3	0.25-0.408	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Mixed Forest							40	35	2	2				see monthly table					see monthly table
Well Drained Till+Perennial Crops and Pasture		0.8	0.3	0.25-0.5	1.5-5	0.993	40	35	2	2	0-0.4	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84	see monthly table
Well Drained Till+Shrubland							40	35	2	2				see monthly table					see monthly table

Monthly Interception

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Impervious+Annual Cropland												
Impervious+Coniferous Forest	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Impervious+Deciduous Forest												
Impervious+Developed												
Impervious+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Grassland Native Grass	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Impervious+Perennial Crops and Pasture												
Impervious+Shrubland												
Poorly Drained Sand+Coniferous Forest												
Poorly Drained Sand+Grassland Native Grass												
Poorly Drained Sand+Shrubland												
Well Drained Clay Loam+Annual Cropland	0	0	0	0	0.05	0.1	0.05	0.35	0.4	0.4	0	0
Well Drained Clay Loam+Coniferous Forest	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Well Drained Clay Loam+Deciduous Forest												
Well Drained Clay Loam+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Exposed Land												
Well Drained Clay Loam+Grassland Native Grass	0.01	0.01	0.01	0.05	0.1	0.3	0.3	0.3	0.3	0.3	0.05	0.01
Well Drained Clay Loam+Perennial Crops and Pasture	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Well Drained Clay Loam+Shrubland												
Well Drained Sand+Annual Cropland	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Coniferous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Sand+Deciduous Forest	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Developed												
Well Drained Sand+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Grassland Native Grass	0.01	0.01	0.01	0.05	0.1	0.3	0.3	0.3	0.3	0.3	0.05	0.01
Well Drained Sand+Perennial Crops and Pasture	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Shrubland												
Well Drained Till+Annual Cropland	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Till+Coniferous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Deciduous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Developed												
Well Drained Till+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Grassland Native Grass	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.05	0.01
Well Drained Till+Mixed Forest												
Well Drained Till+Perennial Crops and Pasture	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Shrubland												

Lower Zone Evapotranspiration

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Impervious+Annual Cropland	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Impervious+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.3	0.6
Impervious+Deciduous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Impervious+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Grassland Native Grass	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.3	0.6
Impervious+Perennial Crops and Pasture	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Impervious+Shrubland	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Poorly Drained Sand+Coniferous Forest	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Poorly Drained Sand+Grassland Native Grass	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Poorly Drained Sand+Shrubland	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Well Drained Clay Loam+Annual Cropland	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Well Drained Clay Loam+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.3	0.6
Well Drained Clay Loam+Deciduous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Clay Loam+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Grassland Native Grass	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Clay Loam+Perennial Crops and Pasture	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.3	0.6
Well Drained Clay Loam+Shrubland	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Sand+Annual Cropland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Sand+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Sand+Deciduous Forest	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Sand+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Grassland Native Grass	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Sand+Perennial Crops and Pasture	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Sand+Shrubland	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Till+Annual Cropland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Till+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Deciduous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Grassland Native Grass	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Till+Mixed Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Perennial Crops and Pasture	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Shrubland	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1

Snow Parameters

		SHADE	SNOWCF	COVIND	KMELT	TBASE	RDCSN	TSNOW	SNOEVP	CCFACT	MWATER	MGMELT
	Description	The fraction of the land which is shaded from solar radiation by trees	Factor by which the input precipitation data will be multiplied	The maximum snowpack (water equivalent) at which the entire land will be covered with snow	Constant degree-day factor for the temperature index snowmelt method	The reference temperature for the temperature index method	The density of cold, new snow relative to water	The air temperature below which precipitation will be snow	A parameter which adapts the snow evaporation (sublimation) equation to field conditions	A parameter which adapts the snow condensation/convection melt equation to field conditions.	The maximum water content of the snow pack, in depth of water per depth of water	The maximum rate of snowmelt by ground heat, in depth of water per day
	Units	none	none	none	in/day-F	degF	none	degF	none	none	none	in/day
Impervious+Annual Cropland												
Impervious+Coniferous Forest		0.8	1	5	0	32	0.3	33-39	0.3-0.8	0.01-0.1	0.3-0.78	0
Impervious+Deciduous Forest												
Impervious+Developed												
Impervious+Exposed Land		0.5	1	5	0	32	0.3	33-39	0.3-0.8	0.01-0.1	0.3-0.78	0-0.05
Impervious+Grassland Native Grass		0.6	1	6	0	32	0.3	33-39	0.3-0.8	0.01-0.1	0.3-0.7	0
Impervious+Perennial Crops and Pasture												
Impervious+Shrubland												
Poorly Drained Sand+Coniferous Forest												
Poorly Drained Sand+Grassland Native Grass												
Poorly Drained Sand+Shrubland												
Well Drained Clay Loam+Annual Cropland		0.6	1	6	0	32	0.2	33-37	0.4-0.8	0.01	0.8	0
Well Drained Clay Loam+Coniferous Forest		0.8	1	8	0	32	0.2	33-37	0.25-0.45	0.01	0.8	0
Well Drained Clay Loam+Deciduous Forest												
Well Drained Clay Loam+Developed		0.5	1	5	0	32	0.2	33	0.4	0.01	0.8	0.05
Well Drained Clay Loam+Exposed Land												
Well Drained Clay Loam+Grassland Native Grass		0.6	1	6	0	32	0.2	33-37	0.4-0.8	0.01	0.8	0
Well Drained Clay Loam+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	33-37	0.25-0.45	0.01	0.8	0
Well Drained Clay Loam+Shrubland												
Well Drained Sand+Annual Cropland		0.6	1	6	0	32	0.2	33-37	0.4-0.8	0.01	0.8	0
Well Drained Sand+Coniferous Forest		0.8	1	8	0	32	0.2	37	0.25-0.65	0.01	0.8	0
Well Drained Sand+Deciduous Forest		0.8	1	8	0	32	0.2	37	0.65	0.01	0.8	0
Well Drained Sand+Developed												
Well Drained Sand+Exposed Land		0.5	1	5	0	32	0.2	37	0.8	0.01	0.8	0.05
Well Drained Sand+Grassland Native Grass		0.6	1	6	0	32	0.2	33-37	0.4-0.8	0.01	0.8	0
Well Drained Sand+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	33-37	0.25-0.65	0.01	0.8	0
Well Drained Sand+Shrubland												
Well Drained Till+Annual Cropland		0.6	1	6	0	32	0.2	33-39	0.4-0.8	0.01	0.8	0
Well Drained Till+Coniferous Forest		0.8	1	8	0	32	0.2	33-39	0.25-0.65	0.01-0.1	0.8	0
Well Drained Till+Deciduous Forest		0.8	1	8	0	32	0.2	33-37	0.25-0.65	0.01	0.8	0
Well Drained Till+Developed												
Well Drained Till+Exposed Land		0.5	1	5	0	32	0.2	33-39	0.3-0.8	0.01-0.1	0.8	0-0.05
Well Drained Till+Grassland Native Grass		0.6	1	6	0	32	0.2	33-39	0.3-0.8	0.01-0.1	0.8	0
Well Drained Till+Mixed Forest												
Well Drained Till+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	33-37	0.25-0.65	0.01	0.8	0
Well Drained Till+Shrubland												

Table B.1b Calibrated HSPF Parameters for the LOWER Portion of the Bow River Basin

Pervious Land Parameters

Land Type	Parameter	FOREST	LZSN	INFILT	KVARY	AGWRC	PETMAX	PETMIN	INFEXP	INFILD	DEEPFR	BASETP	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC
	Description	The fraction of the pervious land segment which is covered by forest	The lower zone nominal storage	An index to the infiltration capacity of the soil	parameter which affects the behavior of groundwater recession flow, enabling it to be non-exponential in its decay with time	The basic groundwater recession rate if KVARY is zero and there is no inflow to groundwater	The air temperature below which E-T will arbitrarily be reduced below the value obtained from the input time series.	The temperature below which E-T will be zero regardless of the value in the input time series.	Exponent in the infiltration equation	Ratio between the maximum and mean infiltration capacities	Fraction of groundwater inflow which will enter deep (inactive) groundwater	Fraction of remaining potential E-T which can be satisfied from baseflow (groundwater outflow), if enough is available.	Fraction of remaining potential E-T which can be satisfied from active groundwater storage if enough is available.	Interception storage capacity.	Upper zone nominal storage.	Manning's n for the overland flow plane.	Interflow inflow parameter.	Interflow recession parameter
	Units	none	in	in/hr	1/in	1/day	degF	degF	none	none	none	none	none	in	in	complex	none	1/day
Impervious+Annual Cropland														see monthly table				
Impervious+Coniferous Forest		0.2	0.1	0.05	0.1	0.998	40	35	2	2	0	0	0	see monthly table	0.083	0.05	1	0.412
Impervious+Deciduous Forest														see monthly table				
Impervious+Developed														see monthly table				
Impervious+Exposed Land		0	0.1	0.05	0.1	0.998	40	35	2	2	0	0	0	see monthly table	0.083	0.05	1	0.412
Impervious+Grassland Native Grass		0.2	0.1	0.05	0.1	0.998	40	35	2	2	0	0	0	see monthly table	0.083	0.05	1	0.412
Impervious+Perrenial Crops and Pasture														see monthly table				
Impervious+Shrubland		0.2	0.1	0.05	0.1	0.998	40	35	2	2	0	0	0	see monthly table	0.083	0.05	1	0.412
Poorly Drained Sand+Coniferous Forest														see monthly table				
Poorly Drained Sand+Grassland Native Grass														see monthly table				
Poorly Drained Sand+Shrubland														see monthly table				
Well Drained Clay Loam+Annual Cropland		0.3	0.25-3.25	0.15-0.35	1.2	0.738-0.938	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Coniferous Forest		0.8	0.25	0.15	1.2	0.738-0.938	40	35	2	2	0.5-0.6	0.005	0.01	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Deciduous Forest		0.8	0.25	0.15	1.2	0.738-0.938	40	35	2	2	0.5-0.6	0.005	0.01	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Developed		0	0.25-3.25	0.15-0.35	1.2	0.738-0.938	40	35	2	2	0-0.6	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Exposed Land														see monthly table				
Well Drained Clay Loam+Grassland Native Grass		0.3	0.25-3.25	0.15-0.35	1.2	0.738-0.938	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Perrenial Crops and Pasture		0.8	0.25-3.25	0.15-0.35	1.2	0.738-0.938	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	2	0.8
Well Drained Clay Loam+Shrubland														see monthly table				
Well Drained Sand+Annual Cropland		0.3	5	0.5	3	0.855-0.995	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.2	0.25	5	0.85
Well Drained Sand+Coniferous Forest														see monthly table				
Well Drained Sand+Deciduous Forest		0.8	5	0.5	3	0.85	40	35	2	2	1	0.2	0.2	see monthly table	0.2	0.25	5	0.998
Well Drained Sand+Developed		0	5	0.5	3	0.85	40	35	2	2	1	0.2	0.2	see monthly table	0.2	0.25	5	0.998
Well Drained Sand+Exposed Land														see monthly table				
Well Drained Sand+Grassland Native Grass		0.3	5	0.5	3	0.855-0.995	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.2	0.25	5	0.85
Well Drained Sand+Perrenial Crops and Pasture		0.8	5	0.5	3	0.85-0.993	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.2	0.25	5	0.998
Well Drained Sand+Shrubland														see monthly table				
Well Drained Till+Annual Cropland		0.3	0.3-3.3	0.25-0.45	1.5	0.85-0.999	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Coniferous Forest		0.8	0.3	0.25	1.5	0.97-0.999	40	35	2	2	0-0.6	0.005-0.16	0.01-0.16	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Deciduous Forest		0.8	0.3	0.25	1.5	0.97-0.993	40	35	2	2	0-0.5	0.005	0.01	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Developed		0	0.3-3.3	0.25-0.45	1.5	0.85-0.993	40	35	2	2	0-0.5	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Exposed Land		0	0.3-3.3	0.25-0.45	1.5	0.853-0.999	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Grassland Native Grass		0.3	0.3-3.3	0.25-0.45	1.5	0.85-0.999	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Mixed Forest														see monthly table				
Well Drained Till+Perrenial Crops and Pasture		0.8	0.3-3.3	0.25-0.45	1.5	0.85-0.999	40	35	2	2	0-1	0.005-0.2	0.01-0.2	see monthly table	0.1	0.25	3.3	0.84
Well Drained Till+Shrubland		0.3	0.3	0.25	1.5	0.97-0.979	40	35	2	2	0	0.005	0.01	see monthly table	0.1	0.25	3.3	0.84

Monthly Interception

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Impervious+Annual Cropland	0	0	0	0	0.05	0.1	0.05	0.35	0.4	0.4	0	0
Impervious+Coniferous Forest	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Impervious+Deciduous Forest	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Impervious+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Grassland Native Grass	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.05	0.01
Impervious+Perrenial Crops and Pasture	0	0	0	0	0.05	0.1	0.05	0.35	0.4	0.4	0.4	0
Impervious+Shrubland	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.05	0.01
Poorly Drained Sand+Coniferous Forest	0.05	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0.05
Poorly Drained Sand+Grassland Native Grass	0.05	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0.05
Poorly Drained Sand+Shrubland	0.05	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0.05
Well Drained Clay Loam+Annual Cropland	0	0	0	0	0.05	0.1	0.05	0.35	0.4	0.4	0	0
Well Drained Clay Loam+Coniferous Forest	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Well Drained Clay Loam+Deciduous Forest	0	0	0	0	0.05	0.1	0.05	0.35	0.4	0.4	0	0
Well Drained Clay Loam+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Grassland Native Grass	0.01	0.01	0.01	0.05	0.1	0.3	0.3	0.3	0.3	0.3	0.05	0.01
Well Drained Clay Loam+Perrenial Crops and Pasture	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Well Drained Clay Loam+Shrubland	1.8	1.5	1.2	0.4	0.05	0.1	0.05	0.35	0.4	0.4	0.4	1.5
Well Drained Sand+Annual Cropland	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Coniferous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Sand+Deciduous Forest	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Grassland Native Grass	0.01	0.01	0.01	0.05	0.1	0.3	0.3	0.3	0.3	0.3	0.05	0.01
Well Drained Sand+Perrenial Crops and Pasture	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Sand+Shrubland	0.01	0.01	0.01	0.05	0.1	0.3	0.3	0.3	0.3	0.3	0.05	0.01
Well Drained Till+Annual Cropland	0	0	0	0	0.05	0.3	0.3	0.3	0.1	0.1	0.05	0
Well Drained Till+Coniferous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Deciduous Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Grassland Native Grass	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.05	0.01
Well Drained Till+Mixed Forest	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Perrenial Crops and Pasture	0.5	0.5	0.1	0.1	0.05	0.05	0.05	0.35	0.4	0.4	0.4	0.4
Well Drained Till+Shrubland	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.3	0.3	0.3	0.05	0.01

Lower Zone Evapotranspiration

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Impervious+Annual Cropland	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Impervious+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Impervious+Deciduous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Impervious+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Impervious+Grassland Native Grass	0	0	0	0	0.2	0.43	0.45	0.45	0.2	0.1	0	0
Impervious+Perennial Crops and Pasture	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Impervious+Shrubland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Poorly Drained Sand+Coniferous Forest	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Poorly Drained Sand+Grassland Native Grass	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Poorly Drained Sand+Shrubland	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Well Drained Clay Loam+Annual Cropland	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Well Drained Clay Loam+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.3	0.6
Well Drained Clay Loam+Deciduous Forest	0	0	0	0	0.2	0.2	0.2	0.4	0.5	0.5	0	0
Well Drained Clay Loam+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Clay Loam+Grassland Native Grass	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Clay Loam+Perennial Crops and Pasture	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Clay Loam+Shrubland	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Sand+Annual Cropland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Sand+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Sand+Deciduous Forest	0	0	0	0	0.2	0.45	0.43	0.45	0.2	0.1	0	0
Well Drained Sand+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Sand+Grassland Native Grass	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Sand+Perennial Crops and Pasture	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Sand+Shrubland	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1
Well Drained Till+Annual Cropland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Till+Coniferous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Deciduous Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Developed	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Exposed Land	0	0	0	0	0	0	0	0	0	0	0	0
Well Drained Till+Grassland Native Grass	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0
Well Drained Till+Mixed Forest	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Perennial Crops and Pasture	0.3	0.5	0.6	0.8	0.2	0.2	0.2	0.4	0.5	0.5	0.5	0.6
Well Drained Till+Shrubland	0	0	0	0	0.2	0.45	0.45	0.45	0.2	0.1	0	0

Snow Parameters

	Description	SHADE	SNOWCF	COVIND	KMELT	TBASE	RDCSN	TSNOW	SNOEVP	CCFACT	MWATER	MGMELT
		The fraction of the land which is shaded from solar radiation by trees	Factor by which the input precipitation data will be multiplied	The maximum snowpack (water equivalent) at which the entire land will be covered with snow	Constant degree-day factor for the temperature index snowmelt method	The reference temperature for the temperature index method	The density of cold, new snow relative to water	The air temperature below which precipitation will be snow	A parameter which adapts the snow evaporation (sublimation) equation to field conditions	A parameter which adapts the snow condensation (advection melt) equation to field conditions.	The maximum water content of the snow pack, in depth of water (per depth) of water	The maximum rate of snowmelt by ground heat, in depth of water per day
	Units	none	none	none	in/day F	degF	none	degF	none	none	none	in/day
Impervious+Annual Cropland												
Impervious+Coniferous Forest		0.8	1	5	0	32	0.3	37-38	0.5-0.8	0.01	0.7	0
Impervious+Deciduous Forest												
Impervious+Developed												
Impervious+Exposed Land		0.5	1	5	0	32	0.3	37-38	0.5-0.8	0.01	0.7	0-0.1
Impervious+Grassland Native Grass		0.6	1	6	0	32	0.3	37	0.5	0.01	0.7	0
Impervious+Perennial Crops and Pasture												
Impervious+Shrubland		0.6	1	6	0	32	0.3	37-38	0.8	0.01	0.7	0
Poorly Drained Sand+Coniferous Forest												
Poorly Drained Sand+Grassland Native Grass												
Poorly Drained Sand+Shrubland												
Well Drained Clay Loam+Annual Cropland		0.6	1	6	0	32	0.2	37-40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Clay Loam+Coniferous Forest		0.8	1	8	0	32	0.2	37	0.25-0.35	0.01-0.1	0.8	0
Well Drained Clay Loam+Deciduous Forest		0.8	1	8	0	32						
Well Drained Clay Loam+Developed		0.5	1	5	0	32	0.2	37-40	0.3-0.8	0.01-0.1	0.8	0-0.02
Well Drained Clay Loam+Exposed Land												
Well Drained Clay Loam+Grassland Native Grass		0.6	1	6	0	32	0.2	37-40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Clay Loam+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	37-40	0.25-0.75	0.01-0.1	0.8	0
Well Drained Clay Loam+Shrubland												
Well Drained Sand+Annual Cropland		0.6	1	6	0	32	0.2	40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Sand+Coniferous Forest												
Well Drained Sand+Deciduous Forest		0.8	1	8	0	32	0.2	40	0.75	0.1	0.8	0
Well Drained Sand+Developed		0.5	1	5	0	32	0.2	40	0.8	0.1	0.8	0
Well Drained Sand+Exposed Land												
Well Drained Sand+Grassland Native Grass		0.6	1	6	0	32	0.2	40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Sand+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	40	0.25-0.75	0.01-0.1	0.8	0
Well Drained Sand+Shrubland												
Well Drained Till+Annual Cropland		0.6	1	6	0	32	0.2	37-40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Till+Coniferous Forest		0.8	1	8	0	32	0.2	37-38	0.25-0.75	0.01-0.1	0.8	0
Well Drained Till+Deciduous Forest		0.8	1	8	0	32	0.2	37-38	0.35-0.75	0.01	0.8	0
Well Drained Till+Developed		0.5	1	5	0	32	0.2	37-40	0.4-0.8	0.01-0.1	0.8	0-0.02
Well Drained Till+Exposed Land		0.5	1	5	0	32	0.2	37-40	0.5-0.8	0.01-0.1	0.8	0-0.1
Well Drained Till+Grassland Native Grass		0.6	1	6	0	32	0.2	37-40	0.3-0.8	0.01-0.1	0.8	0
Well Drained Till+Mixed Forest												
Well Drained Till+Perennial Crops and Pasture		0.8	1	8	0	32	0.2	37-40	0.25-0.75	0.01-0.1	0.8	0
Well Drained Till+Shrubland		0.6	1	6	0	32	0.2	37-38	0.8	0.01	0.8	0