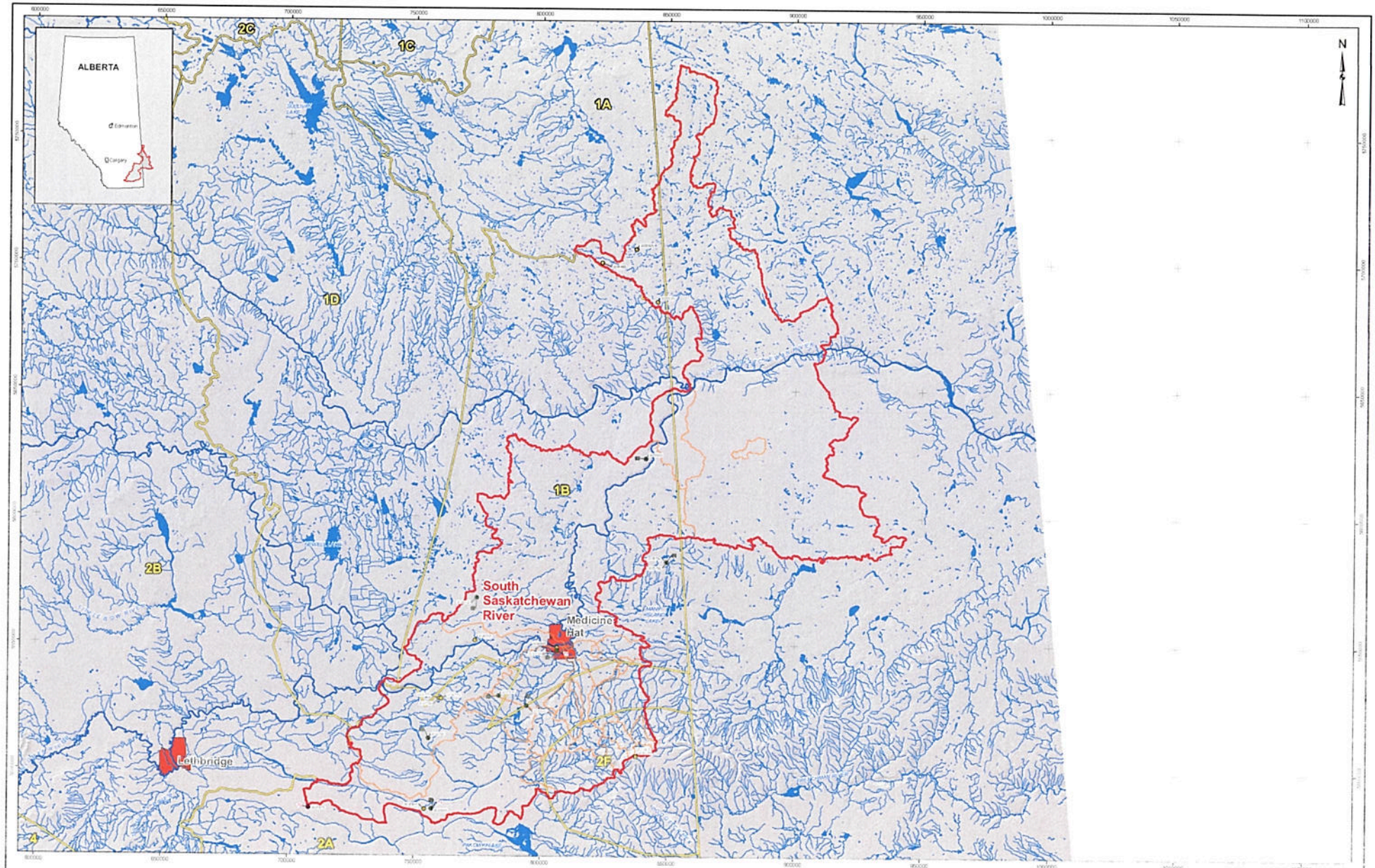
APPENDIX D

South Saskatchewan River 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

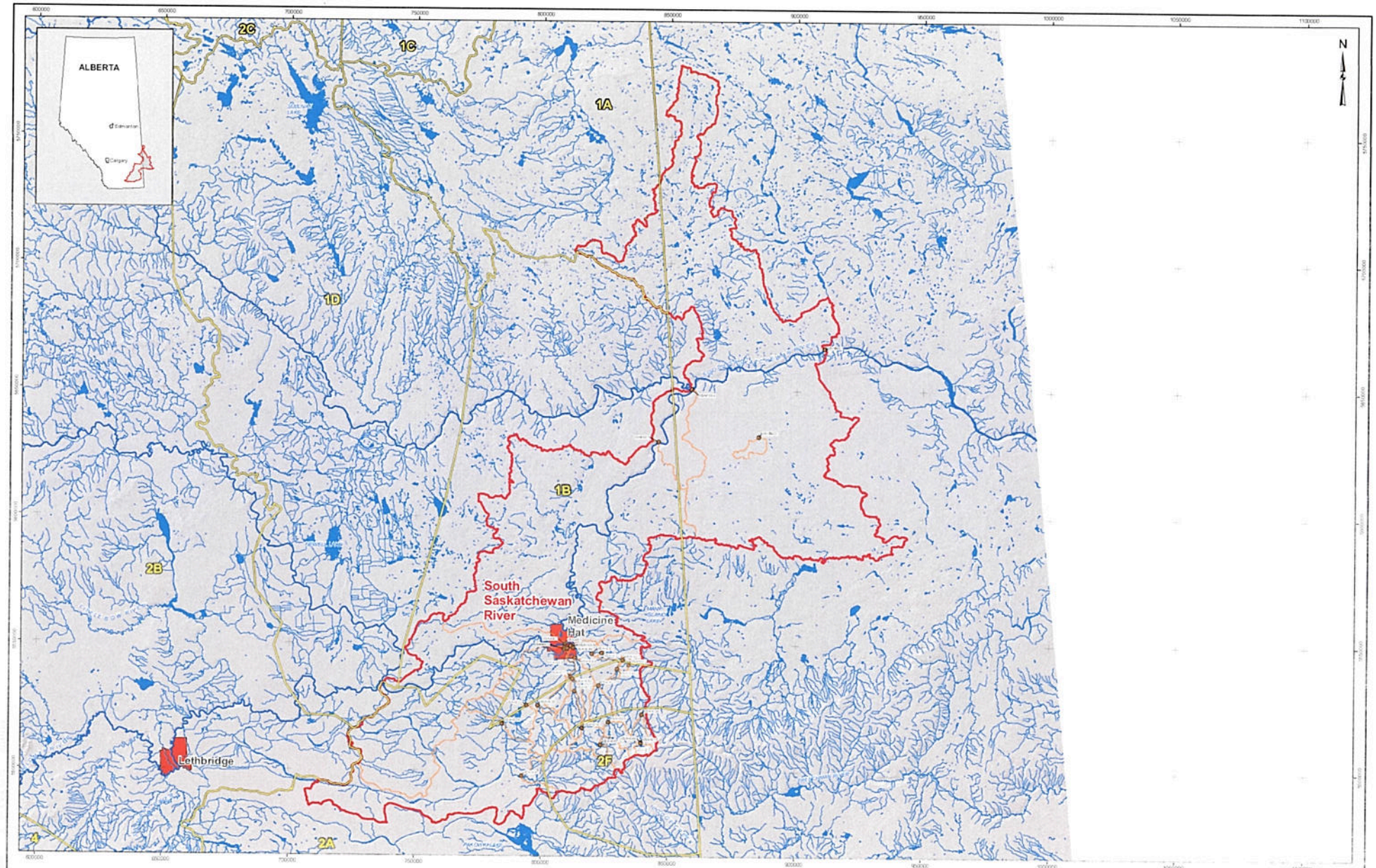
PROJECT
Government of Alberta
Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE
CLIMATE STATIONS
IN THE SOUTH SASKATCHEWAN RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1328-1009		SCALE AS SHOWN	REV. 0
DESIGN	LC	28 Dec 2009	
GIS	AB	25 Mar 2010	
CHECK	AB	25 Jul 2010	
REVIEW	AB	25 Jul 2010	

FIGURE: D.1



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

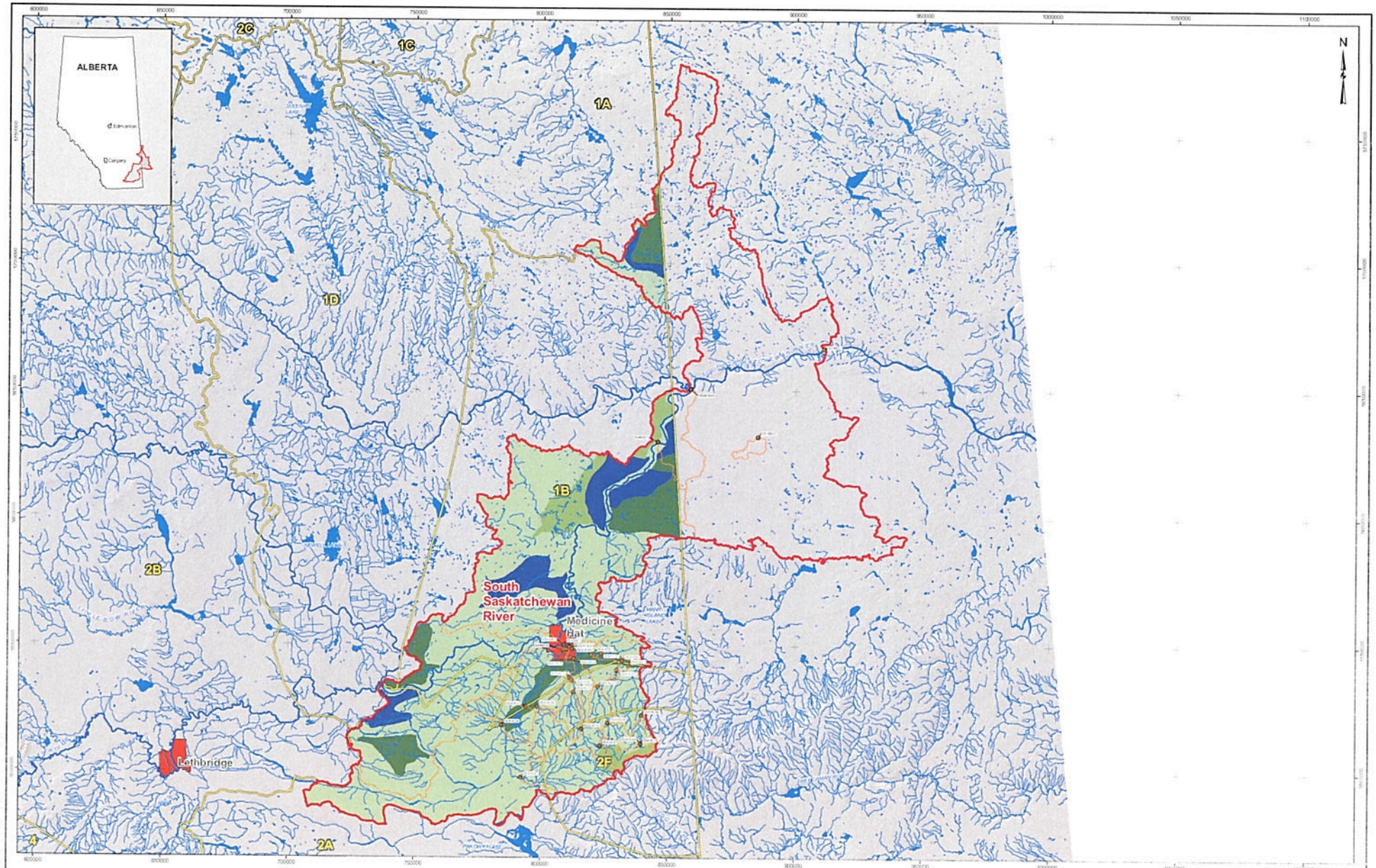
PROJECT
Government of Alberta
Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE
HYDROMETRIC STATIONS
IN THE SOUTH SASKATCHEWAN RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1328-1000		SCALE AS SHOWN	REV. 0
DESIGN	AB	26 Sep 2010	
GIS	AB	29 Mar 2010	
CHECK	AB	26 Jul 2010	
REVIEW	AB	26 Jul 2010	

FIGURE: D.2



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

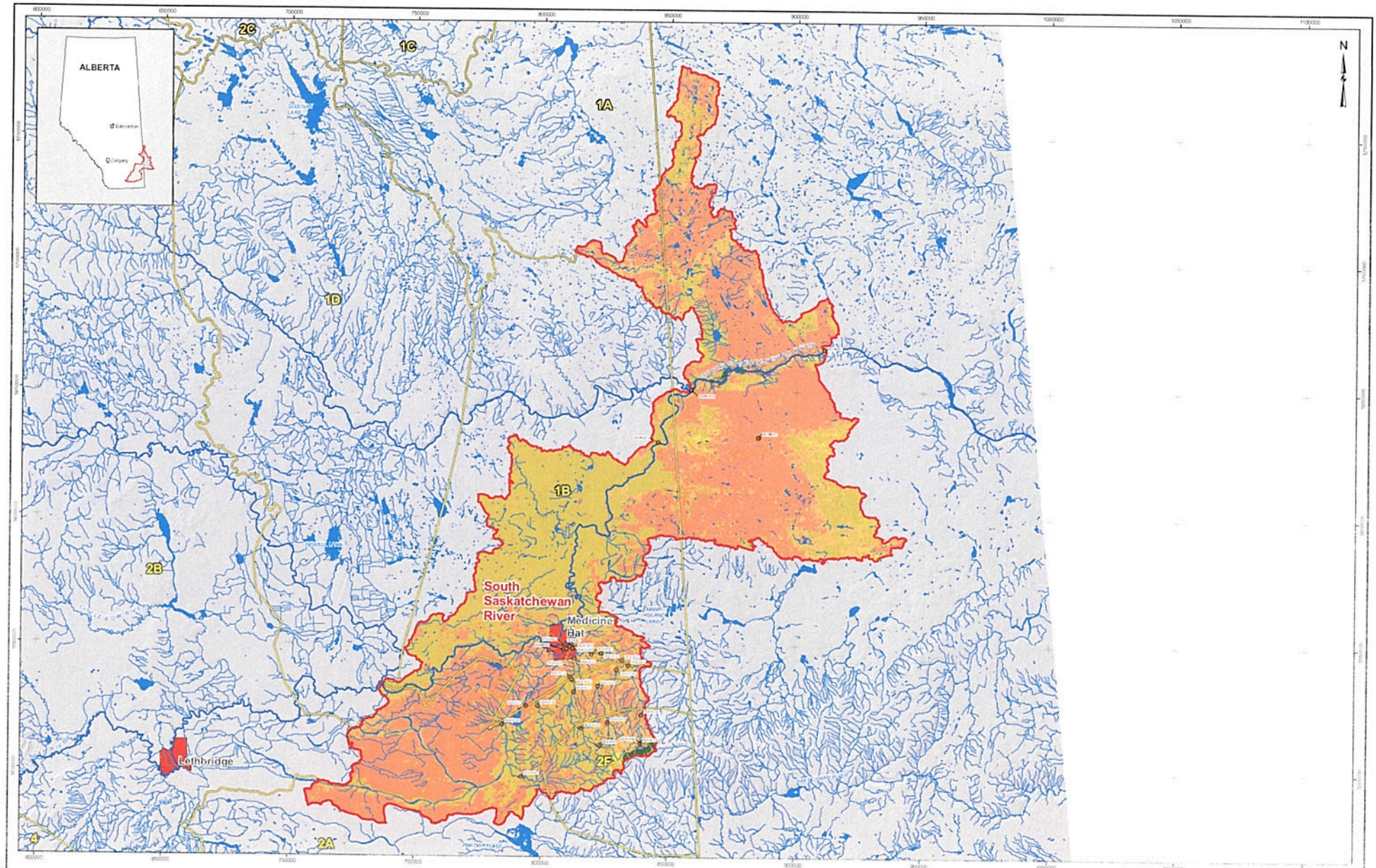
TITLE
SURFICIAL GEOLOGY
IN THE SOUTH SASKATCHEWAN RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1326-1006		SCALE AS SHOWN
DESIGN	AB	24 Sep. 2009
GIS	AB	21 Mar. 2010
CHECK	AB	26 Jul. 2010
REVIEW	AB	26 Jul. 2010

REV. 0

FIGURE: D.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

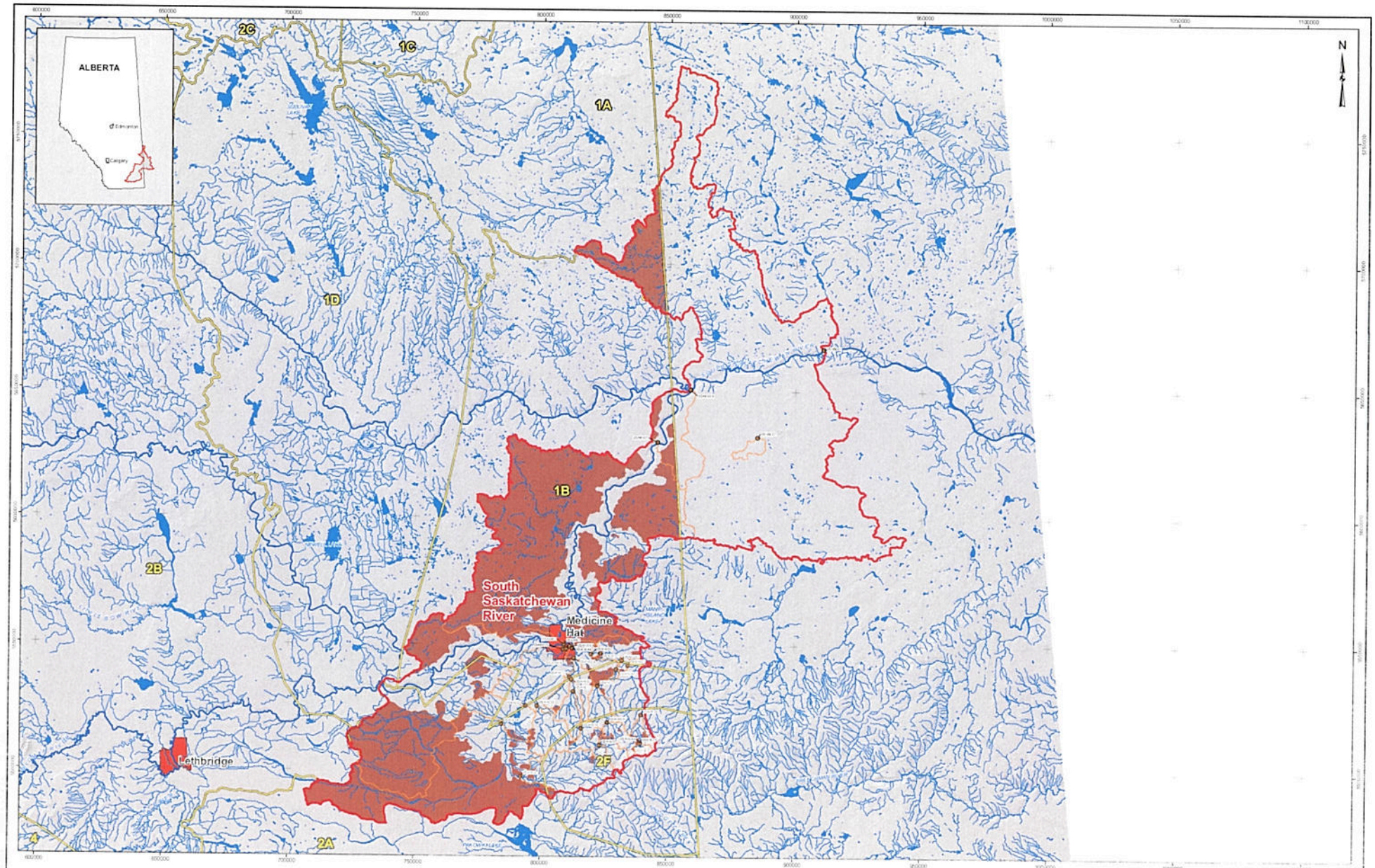
TITLE

LAND COVER
IN THE SOUTH SASKATCHEWAN RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1125-1004			SCALE AS SHOWN	REV. 0
DESIGN	AB	24 Sep 2009	
GIS	AB	21 May 2010	
CHECK	AB	28 Jul 2010	
REVIEW	AB	28 Jul 2010	

FIGURE: D.4



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

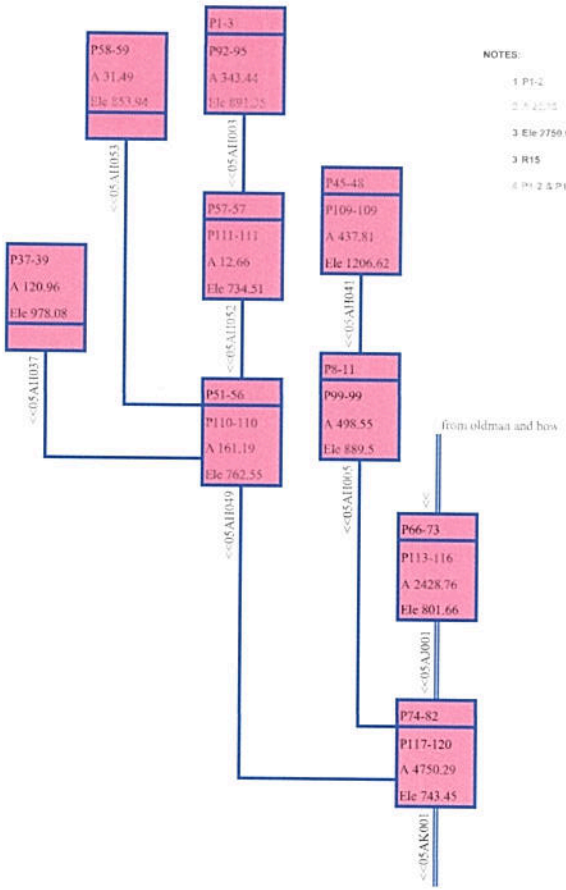
PROJECT
Government of Alberta
Environment
HYDRO-CLIMATE MODELLING OF THE SOUTH SASKATCHEWAN REGIONAL PLANNING AREA

TITLE
NON-CONTRIBUTING AREAS
IN THE SOUTH SASKATCHEWAN RIVER BASIN

Golder Associates
Calgary, Alberta

PROJECT NO. 09-1126-1004			SCALE AS SHOWN	REV. 0
DESIGN	AD	24 Sep. 2009	FIGURE: D.5
GIS	AD	25 Mar. 2010	
CHECK	AD	25 Jul. 2010	
REVIEW	AD	26 Jul. 2010	

Figure D.6 HSPF Schematic for the South Saskatchewan River Basin



NOTES:

1 P1-2 RANGE OF LAND UNITS USED IN THE MODEL FOR PARTICULAR PFRA SUB-WATERSHED

2 A 2275 TOTAL AREA OF THE PARTICULAR PFRA SUB-WATERSHED (INCLUDING NON-CONTRIBUTING AREAS) OR LAKE

3 Ele 2750.66 AVERAGE ELEVATION OF THE PARTICULAR PFRA SUB-WATERSHED

3 R15 REACH NUMBER FOR THE LAKE

4 P1-2 & P180-200 SUB-WATERSHEDS WITH TWO RANGES OF LAND UNITS HAVE NON-CONTRIBUTING AREAS (AND ARTIFICIAL LAKES/PONNDS IN THE MODEL)

Table D.1 Calibrated HSPF Parameters for the South Saskatchewan 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	A parameter which affects the behavior of groundwater recession flow, enabling it to decay 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 theoretically 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 outflow 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/day	1/day	degF	degF	none	none	none	none	none	in	in	complex	none	1/day
Well Drained Clay Loam + Annual Cropland		0.1	3.5	0.0173	1.18	0.938	40	35	2	2	0	0.05-0.1	0.05-0.1	see monthly table	0.3	0.25	1	0.934
Well Drained Clay Loam + Developed		0	3.5	0.0173	1.18	0.938	40	35	2	2	0	0.05	0.1	see monthly table	0.3	0.25	1	0.934
Well Drained Clay Loam + Perrenial Crops and Pasture		0.3	3.5	0.0173	1.18	0.938	40	35	2	2	0-0.5	0.05-0.1	0.05-0.1	see monthly table	0.3	0.25	1	0.934
Well Drained Clay Loam+ Grassland Native Grass		0.3	3.5	0.0173	1.18	0.938	40	35	2	2	0-0.5	0.05	0.05	see monthly table	0.3	0.25	1	0.934
Well Drained Sand + Annual Cropland		0.3	2	0.5	5	0.995	40	35	2	2	0.5	0.05	0.05	see monthly table	0.2	0.25	5	0.95
Well Drained Sand + Coniferous Forest		0.8	2	0.5	5	0.999	40	35	2	2	0.5	0.05	0.05	see monthly table	0.2	0.25	5	0.95
Well Drained Sand + Grassland Native Grass		0.3	2	0.5	5	0.995	40	35	2	2	0-0.5	0.05	0.05	see monthly table	0.2	0.25	5	0.998
Well Drained Sand + Perrenial Crops and Pasture		0.3	2	0.5	0	0.995	40	35	2	2	0.5	0.05	0.05	see monthly table	0.2	0.25	5	0.95
Well Drained Sand + Shrubland		0.3	2	0.5	0	0.995	40	35	2	2	0.5	0.05	0.05	see monthly table	0.2	0.25	5	0.95
Well Drained Till + Annual Cropland		0.1	0.3	0.408	5	0.993-0.999	40	35	2	2	0-0.5	0.05-0.1	0.05-0.1	see monthly table	0.1	0.25	3.3	0.94
Well Drained Till + Exposed Land		0	0.3	0.401	5	0.993	40	35	2	2	0.5	0.1	0.1	see monthly table	0.1	0.25	3.3	0.94
Well Drained Till + Grassland Native Grass		0.3	0.3	0.408	5	0.993-0.999	40	35	2	2	0-0.5	0.05-0.1	0.05-0.1	see monthly table	0.1	0.25	3.3	0.94
Well Drained Till + Perrenial Crops and Pasture		0.8	0.3	0.5	5	0.993-0.999	40	35	2	2	0-0.5	0.05-0.1	0.05-0.1	see monthly table	0.1	0.25	3.3	0.94

Monthly Interception

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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 + Developed	0	0	0	0	0	0	0	0	0	0	0	0
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+ 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 + 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 + 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	0.01	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 + 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 + 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 + 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

Lower Zone Evapotranspiration

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Well Drained Clay Loam + Annual Cropland	0	0	0	0	0.3	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 + Perrenial 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+ 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 + 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 + 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 + Perrenial Crops and Pasture	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 + 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 + 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 + Perrenial 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

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/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
Well Drained Clay Loam + Annual Cropland		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Clay Loam + Developed		0.5	1	5	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Clay Loam + Perrenial Crops and Pasture		0.3	1	5	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Clay Loam+ Grassland Native Grass		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Sand + Annual Cropland		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Sand + Coniferous Forest		0.8	1	8	0	32	0.2	40	0.65	0.01	1.0	0.00
Well Drained Sand + Grassland Native Grass		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Sand + Perrenial Crops and Pasture		0.3	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Sand + Shrubland		0.3	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Till + Annual Cropland		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Till + Exposed Land		0.5	1	5	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Till + Grassland Native Grass		0.6	1	6	0	32	0.2	40	0.3	0.01	1.0	0.00
Well Drained Till + Perrenial Crops and Pasture		0.8	1	8	0	32	0.2	40	0.65	0.01	1.0	0.00