

PROGRESS REPORT ON
THE HYDROLOGIC BALANCE FROM A LARGE PRAIRIE DRAINAGE
BASIN IN CENTRAL ALBERTA, CANADA

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Committee for Alberta Watershed Research

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by

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THE HYDROLOGIC BALANCE FROM A LARGE PRAIRIE DRAINAGE BASIN IN CENTRAL ALBERTA, CANADA

This study area includes representative basins IWB-RB-5-6-7 which are drained by the Kneehills, Threehills, Ghostpine, and Lonepine Creeks. The area is generally bounded by longitude lines $113^{\circ}00'$ and $114^{\circ}00'$ and by latitudes $51^{\circ}21'$ and $52^{\circ}10'$ and covers an area of approximately $4,559 \text{ km}^2$, or $1,767 \text{ miles}^2$. The elevation ranges from 2,500 to 3,300 feet (4,500-5,940 m) above MSL. The area is dominantly prairie parkland — grain is the main farm product. The mean annual amount of precipitation varies from 17 inches over the northern part of the area to 14 inches over the southern part; more than $1/3$ of the precipitation occurs in June and July. Annual runoff approximates $1/2$ inch over the area.

The surficial material consists of a veneer of till, outwash, and/or lake deposits of Pleistocene to post-Pleistocene age, overlying Paskapoo Sandstone of Tertiary age. At the confluence of the basins the main creeks cut through the Paskapoo Formation into the sandstones and shales of the underlying Edmonton Formation (Upper Cretaceous age). Generally the tills and lake deposits have low permeability values, while the permeability values of the Paskapoo Sandstone and outwash deposits are fair to good.

This study is being conducted by D. R. Stevenson for the Groundwater Division, Research Council of Alberta.

Co-operating agencies are the Meteorological Branch, Canada Department of Transport, who supplied and installed the weather instruments at the meteorological sites, two of which have been incorporated into the "National Climat" network, and the Water Survey of Canada, Inland Waters Branch

Department of Energy, Mines and Resources, who are installing the stream-discharge stations.

The objectives of this study are the following:

- a) To establish the hydrologic budget of a prairie watershed under cultivation where natural soil moisture and drainage conditions exist;
- b) to establish relationships among land-use, precipitation, runoff, soil moisture, and water-table fluctuation; and
- c) to establish a relationship between the hydrologic cycle and the physiographic characteristics of the watershed.

The attached maps show the existing meteorological instrumentation, stream-discharge stations, and groundwater instrumentation. The regional groundwater observation well network was initiated in 1962 by Dr. Tóth as part of a separate study. Monthly measurements of water-table fluctuation in 34 of these wells are being recorded. Continuous measurements are being recorded in a seven-well cross section across the upper part of Threehills basin. The presence of existing instrumentation and its central location favored the Threehills basin being selected as the natural model for a water budget study. The hydrologic model derived from the Threehills study will be applied to the Ghostpine and Kneehills basins. In 1966 two small sub-basins drained by tributaries of Threehills Creek were selected for more detailed instrumentation. The Innisfail sub-basin covers 17.6 square miles (45.4 sq. km.) and is characteristic of the rolling, more densely wooded northern part of the area; the Threehills sub-basin covers 21.3 square miles (55.0 sq. km.) and is characteristic of the less hilly, more widely cultivated, arid southern part of the area. Instrumentation in the two sub-basins, as shown on the

respective maps, was started in 1966 and continued in the 1967 field season. The stream-discharge stations will be completed early in the 1968 field season. Soil moisture access tubes will be installed in 1968 at the existing meteorological sites. A comparison of rainfall catch in an aspen grove with that at the adjacent Goldstrom meteorological station will be conducted before the aspen grove is removed. A pump-test analysis on a sandstone aquifer will be carried out in the Innisfail sub-basin during the 1968 field season.

References

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Suggested Legend for IHD Research Basins

(NR)	Hydrometric Station: Natural Control; Auto-Recording
(NN)	Hydrometric Station: Natural Control; Non-Recording
(AR)	Hydrometric Station: Artificial Control; Auto-Recording
(AN)	Hydrometric Station: Artificial Control; Non-Recording
(WG)	Water level Gauge
(GR)	Groundwater Well: Auto-Recording
(GN)	Groundwater Well: Non-Recording
(P*)	Piezometer (Replace asterisk by No. of Piezometers in the nest)
(SC)	Snow Course
(SG)	Snow Gauge
(SS)	Snow Stake
(RA)	Auto-Recording Rain Gauge
(RS)	Standard Rain Gauge
(AT)	Air Temperature Station
(WT)	Water Temperature Station
(WQ)	Water Quality Site
(ES)	Evaporation Station
(HT)	Recording Hygrothermograph
(A*)	Anemometer (Asterisk replace by height above ground)
(SR)	Sunshine Recorder
(SM)	Soil Moisture Site
(BM)	Bench Mark
(PN)	Precipitation Storage Gauge
(ST)	Soil Temperature Site

RESEARCH INTO THE HYDROLOGY OF THE THREEHILLS, KNEEHILLS,
LONEPINE, AND GHOSTPINE PRAIRIE DRAINAGE BASINS

Affiliation: IHD, IWR-RB-5, IWR-RC-6, IWB-RB-7

Cooperating agencies: Water Resources Division, Alberta Department of Agriculture; Federal Water Resources, Department of Mines and Technical Surveys; Meteorological Branch, Department of Transport.

Objectives:

To investigate in detail and establish quantitative relationships among the various phases of hydrologic cycle and the physical characteristics of the basins.

To study the distribution of water within the evapotranspiration, soil-moisture and groundwater subcycles under natural drainage conditions in response to various climatic events. These models may subsequently be useful in locating surface water reservoirs, canals, etc., to minimize or increase water movement to and from the soil moisture and groundwater reservoirs.

To study the relationships between stream flow and the consumptive use of potential stream water by phreatophytes lining the stream banks under natural and modified conditions.

Procedure:

Much of the basin inventories have been established on a large scale; where necessary these will be supplemented and/or revised by detailed field mapping.

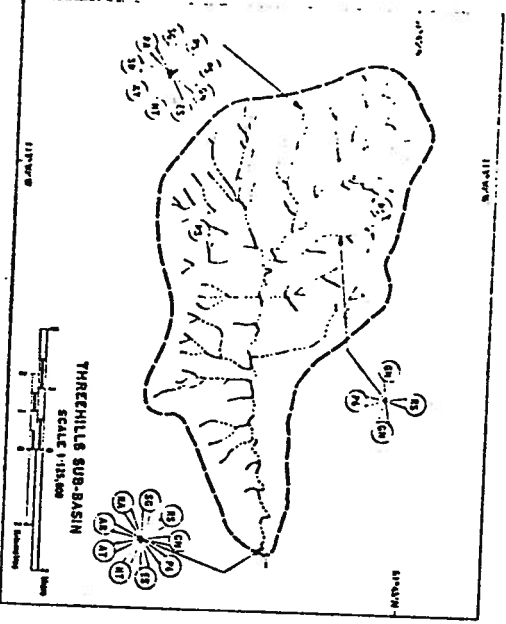
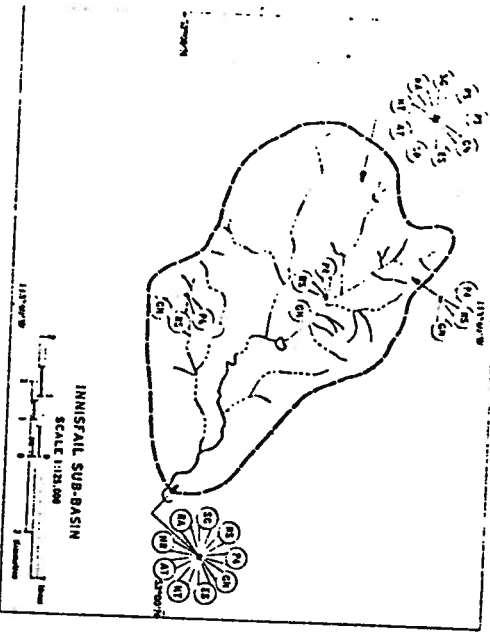
The hydrology of the area will be studied by instrumentation and calibration in as great detail as economically possible. The instrumentation will be confined to two small sub-basins representing the climatic extremes of the centrally located Threehills basin. Each sub-basin is approximately 25 square miles and will contain three hydrometric stations representing the highland recharge area, the confluent discharge area, and the intermediate area which characterizes a large part of the basins. Each site represents an area of six to ten square miles and includes precipitation, temperature, humidity, potential evaporation, air movement, surface runoff, soil moisture, and groundwater instrumentation. There will be no stream gauges at the uppermost sites.

The instrumentation will hopefully be completed within the next two to three years, whereby a mathematical model will be constructed and used to calibrate the general area. The validity of this model will be tested in the adjacent basins by the use of existing groundwater and stream control and by the installation of complementary instrumentation where required.

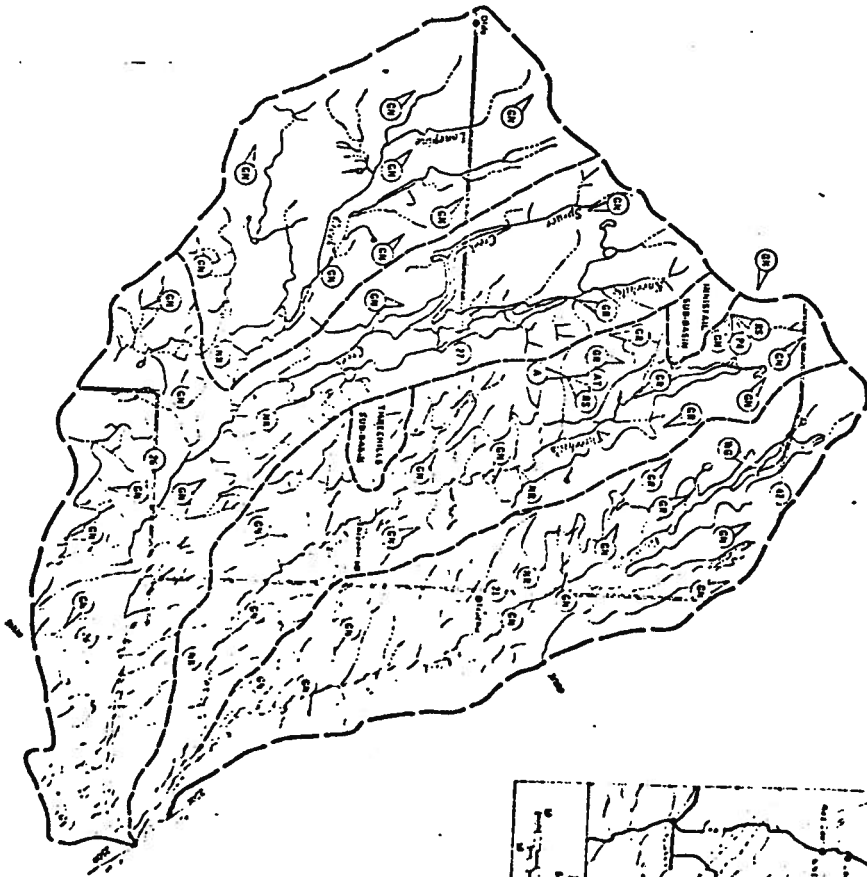
Project Co-ordinator:

D. R. Stevenson, Hydrogeologist,
Research Council of Alberta.

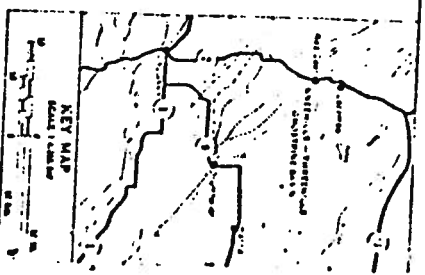
LATITUDE 52°16'00"N



LONGITUDE 115°55'00"W



LATITUDE 51°10'00"N



MAP OF ALBERTA