

THE SOUTH SASKATCHEWAN - QU'APPELLE DIVERSION:  
HISTORY AND FUTURE PROSPECTS

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ABSTRACT

Diverslon of water from the South Saskatchewan River to the Qu'Appelle River began with a small pump diversion in 1958 designed to augment the water available from Buffalo Pound Lake to supply the municipal requirements of the cities of Regina and Moose Jaw. Development of the South Saskatchewan River Project during the 1960s greatly increased the diversion potential, which is far from full realization twenty years after completion of the project. The primary purpose of the diversion is still municipal water supply, with some consideration given to irrigation and recreation requirements.

This paper traces the history of the South Saskatchewan - Qu'Appelle diversion from its natural origin as a meltwater channel during the retreat of the Wisconsinian Glacier to the controlled operation of the present day diversion works. Current water use in the basin is discussed in relation to the volume of water diverted from the South Saskatchewan River. The paper concludes with a look at possible future directions for basin development which could require additional diverted water from the South Saskatchewan River.

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## INTRODUCTION

The South Saskatchewan-Qu'Appelle River diversion is, as a point of technical fact, an intrabasin transfer rather than an interbasin diversion. Water is released from Lake Diefenbaker, on the South Saskatchewan River, through Qu'Appelle dam to the Qu'Appelle River. The Qu'Appelle is tributary to the Assiniboine River which is tributary to the Red River in Winnipeg. The Red River joins the Saskatchewan River in Lake Winnipeg and the circuit is complete for the diverted water (Figure 1).



Figure 1: Map of Saskatchewan-Nelson Basin

The Qu'Appelle River originates out of a height of land less than 20 km southeast of the sharp northward bend (the Elbow) in the South Saskatchewan River (Figure 2) and flows eastward 770 km to join the Assiniboine River. The Qu'Appelle basin covers 51,000 km<sup>2</sup> and lies entirely in the geographical area known as the Saskatchewan Plain. The basin is predominantly a flat to gently undulating treeless plain sloping from an elevation of 600 m in the highest reaches, to 400 m at the confluence with the Assiniboine. Local relief generally doesn't exceed 5 m which makes the Qu'Appelle Valley and the valleys of its larger tributaries, striking topographical features by contrast.

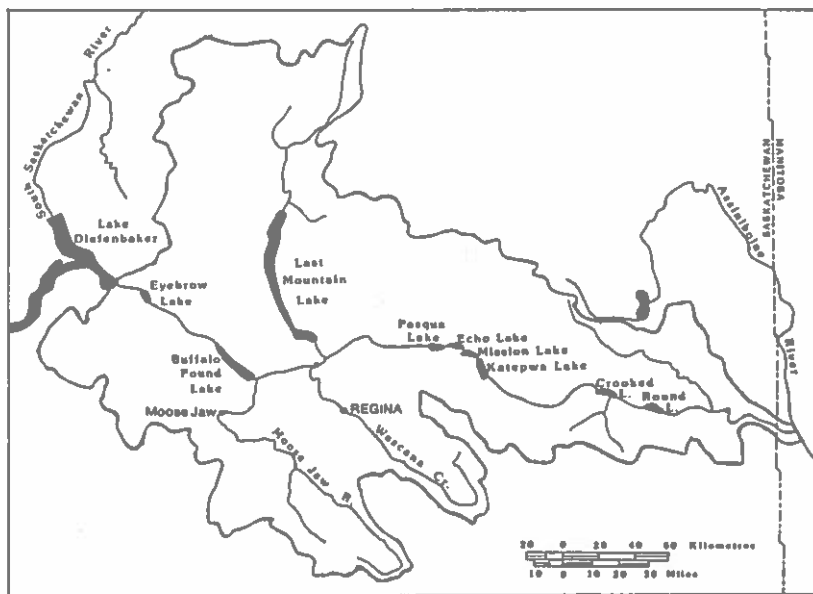


Figure 2: Map of Qu'Appelle River Basin

## History

The Qu'Appelle basin sits on two to three hundred metres of sediment, the product of four periods of glaciation. During the retreat of the last glacier, about 14,000 years ago, the South Saskatchewan River joined the Qu'Appelle near the Elbow of the South Saskatchewan River. They formed one meltwater channel carrying water from the Wisconsinian glacier eastward to Lake Agassiz in Manitoba. Eventually, as the glacier receded further north, the meltwater was diverted at the Elbow to follow the route the South Saskatchewan River travels today. The Qu'Appelle was left as a deep valley, up to 180 metres in places, carrying much lower flows from local runoff. Erosion by wind and water over the several thousand years have partially filled the valley bottom and rounded the hills thus softening the contours as we see them now.

For centuries the valleys of the Qu'Appelle and its tributaries were a welcome refuge for man and beast. An ideal place to live with good hunting and fishing close at hand. Then came the fur traders to whom the river was a means of transportation. In the latter part of the last century the railroad became the mode of transportation and communities sprang up along the ribbon of steel. Settlers began to trickle into the region of the Qu'Appelle in the 1870's. By the 1880's considerable settlement had taken place along the valley and on the surrounding plains.

Commercial fishing in the Qu'Appelle lakes began in 1885 and continued until the 1930's when it was discontinued in favor of recreational fishing (PFRA, Hydrology Report #23, June, 1958). Control of the fishing lake levels was effected in 1888 with dams at the outlets of Echo and Katepwa lakes. A drought in 1889 caused farmers to better appreciate the value of stored water. There followed a flurry of small stockwater dam construction throughout the basin.

The first irrigation in the Craven to Highway #6 reach of the basin began sometime around 1890. Earth plugs were placed in the main channel, temporarily backing the water up onto the hay flats on the valley floor.

The earliest industrial use of Qu'Appelle water would have been directed toward railroad requirements. A subsequent industrial use was cooling water for the power plants of Regina and Moose Jaw.

The lakes of the Qu'Appelle provided the only local location for water based recreation for the centres of Regina and Moose Jaw. This led to the construction of the first control structure at Craven for the purpose of controlling lake levels on Last Mountain Lake. In 1935 the newly formed Prairie Farm Rehabilitation Administration (P.F.R.A., formed by the signing of the Prairie Farm Rehabilitation Act) received petitions to improve the control structures previously built and to construct another below Buffalo Pound Lake.

Municipal water supply for the growing centres of Regina and Moose Jaw was initially supplied locally, predominantly from ground water sources. Quite early in the development of these fast growing communities, however, it was apparent that local water supplies would not always be a sufficient source of supply. In 1911 the Provincial Water Rights Branch granted the cities of Regina and Moose Jaw a reservation to use  $5.7 \text{ m}^3/\text{s}$  (200 cfs) annually from the South Saskatchewan River (P.F.R.A., Hydrology Report #23, June 1958). That represents an annual commitment of  $179,000 \text{ dam}^3$  (145,000 ac. ft.), which is approximately six times the amount drawn from the South Saskatchewan River to satisfy today's level of municipal use. Thus the seeds of a future diversion of water from the South Saskatchewan River to the Qu'Appelle were sown.

#### The Diversion Philosophy

The requirement of a future, supplemental municipal water supply for the cities of Regina and Moose Jaw led to the early recognition of the South Saskatchewan River as a possible source. That fact notwithstanding, the potential for diversion was an inevitable outcome of water resource development and long range planning. As early as 1859, explorer Henry Hind proposed the diversion of South Saskatchewan River water to the Qu'Appelle for irrigation and navigation. Hind proposed that the diversion be effected by building a dam on the South Saskatchewan River north of Elbow.

The design of the South Saskatchewan River Project could not have proceeded very far before it became obvious that another dam would be required to prevent the diversion of the entire flow of the South Saskatchewan River down the Qu'Appelle. The concept of the Qu'Appelle dam was conceived to forestall the river from reverting to its original alignment of some 14,000 years earlier. It follows

that the design of the Qu'Appelle dam would incorporate some form of outlet structure to accommodate the possibility of diversion to the Qu'Appelle at some future date.

So it would seem that with or without the cities of Regina and Moose Jaw the diversion of water from the South Saskatchewan River to the Qu'Appelle would be dictated on a basic precept of good planning which is to keep the most options open at least cost.

### Pump Diversion

Although farseeing individuals were aware of the future water supply requirements of Regina shortly after the turn of the century, little was done about it until 1948. The demand of expanding industry and population in the two cities was fast outgrowing the water supply available from local wells. Pipelines from Buffalo Pound Lake to the two centres appeared to be the only possible solution.

In May of 1950 the province received a guarantee from the federal government, responsible for interprovincial waters, that the water supply requirements of the cities of Regina and Moose Jaw would be supplied from the South Saskatchewan River (Proceedings of U of Regina Conference, February 27, 1981).

Studies were conducted with the involvement of the three levels of government. The outlet structure on Buffalo Pound Lake was reconstructed in 1952 providing an additional 0.60 m (2 feet) of storage in the lake. A system of pumps and canals was constructed to convey the water from the South Saskatchewan River to Buffalo Pound Lake.

Pumping to maintain storage levels in Buffalo Pound Lake began in a limited way in 1958 but actually began, in earnest, in 1959. Between 1958 and 1963 an average of 23,000 dam<sup>3</sup> (18,600 ac. ft.) (P.F.R.A., Hydrology Reports 29 and 29A to 29E, 1959-1964) was pumped from the South Saskatchewan annually. During this period two problems became evident. First, conveyance losses from the pump site to the lake were high. This included high evaporation losses in Eyebrow Lake, upstream of Buffalo Pound Lake. Second problem, the high quality of the pumped water deteriorated significantly on passing through Eyebrow Lake (P.F.R.A., Hydrology Report #29, 1959).

The solution was to construct a canal allowing the flow to bypass Eyebrow Lake. This indirectly led to a second use of diverted water, the Nisku waterfowl project established in Eyebrow Lake. Diversion water can now be released from the bypass canal to any one of four cells in the marshy lake to maintain levels for the waterfowl habitat. The quantity of water diverted to Eyebrow Lake annually is relatively small and is a function of the volume of spring runoff and the amount and timing of summer rainfall.

#### Gravity Diversion - Qu'Appelle Dam

On May 27, 1959, Prime Minister Diefenbaker officiated at the ground-breaking ceremonies at the site chosen for the dam on the South Saskatchewan River. The construction agreement was signed in 1958 and contained a clause transferring to the province the 1950 federal commitment to supply the municipal water requirements of Regina and Moose Jaw from the South Saskatchewan River. Although the South Saskatchewan River Project was primarily intended for irrigation, hydro electric development, and regulation of flows, the implementation of the 1958 agreement specifically provided for the exchange of the cumbersome pump scheme for a gravity diversion. Under the terms of the 1958 South Saskatchewan River Agreement an annual allocation of 92,500 dam<sup>3</sup> (75,000 ac. ft.) was licenced to the Qu'Appelle.

Construction of the Qu'Appelle dam began in October of 1963. The site finally chosen was known as the Summit Site, located on the drainage divide between the Qu'Appelle basin and the South Saskatchewan River. Completion of the works took place in November 1967.

The capacity of the outlet structure in the Qu'Appelle dam was designed considerably greater than that of the pump system it was to replace. Sizing of the design discharge capacity of the outlet works was based on studies of projected water demands within the Qu'Appelle basin. The proportion of that demand that could not be supplied by water from within the Qu'Appelle basin would be a measure of the releases that would be required from the Qu'Appelle dam.

The design of the outlet works was based on a minimum flow of 36.8 m<sup>3</sup>/s (1,300 cfs) at a reservoir elevation of 545.6 m (1,790 feet) (P.F.R.A., The Design and Construction of Gardiner dam, 1980). That is the average diversion flow necessary to satisfy projected demands for the year 2000. The reservoir elevation is the minimum likely to occur at the time of maximum diversion. At the reservoir full supply level of 556.9 m (1,827 feet) the discharge capacity of the Qu'Appelle outlet structure is 68 m<sup>3</sup>/s (2,400 cfs).

### Diversions Operation

The Qu'Appelle River system today spans almost two thirds of the width of the Province, contains nine lakes and can be regulated at nine control structures. The Qu'Appelle Operation Board was established in 1971 and developed operation procedures designed to provide maximum overall benefit for all purposes including municipal, industrial, agricultural and recreation uses as well as pollution abatement and flood control (Banga, A.B., and Thiele, L., December 1986). An additional consideration is Saskatchewan's commitment to Manitoba under the 1969 Master Agreement on Apportionment\*. Operation of the system includes operation of the Qu'Appelle dam outlet structure to release water to the Qu'Appelle.

Earlier this year, in April 1987, the Board was dissolved and reorganized as the Qu'Appelle Operation Committee. The reorganization was required for administrative reasons, but the membership and purpose essentially remain as before. The purpose of the Operation Committee is to operate the Qu'Appelle River system, including releases from Lake Diefenbaker, impartially to the mutual benefit of all users. Membership on the Committee is from the following federal and provincial agencies:

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\* The Master Agreement on Apportionment, signed in 1969, is administered by the Prairie Provinces Water Board and, in the case of the Qu'Appelle River, assures Manitoba the right to 50% of the natural flow at the provincial boundary.



- Prairie Farm Rehabilitation Administration, Agriculture Canada,
- Saskatchewan Water Corporation,
- Saskatchewan Environment and Public Safety,
- Saskatchewan Parks, Recreation and Culture.

The Operation Committee meets at various times of the year as requests for control dictate. They also meet at specific times of the year as flow conditions dictate such as in the spring, prior to runoff, in the late spring, after runoff is complete, and in the late summer. Based on past and present flows as well as streamflow forecasts, an operating plan is formulated for the pending period. Recommendations of the Committee are turned over to Saskatchewan Water Corporation to implement. Operation of Qu'Appelle dam is the responsibility of the P.F.R.A., while the outlet of Buffalo Pound Lake is controlled by Saskatchewan Agriculture. Both agencies cooperate with the recommendations of the Operation Committee as conveyed to them by Saskatchewan Water Corporation.

Today water is imported from Lake Diefenbaker to the Qu'Appelle River system to meet various water requirements such as:

- Regina and Moose Jaw city water supplies;
- industrial use by Kalium Chemicals mine at Belle Plaine (pumped directly from Buffalo Pound Lake);
- Nisku waterfowl project on Eyebrow Lake;
- fresh water to maintain lake levels during the summer months; and
- maintenance of streamflow for irrigation and stockwatering demands.

Releases through the Qu'Appelle River dam are made by adjusting the control gates to settings obtained from rating curves which relate discharge flows to lake levels and gate openings. Although the structure was designed to release up to  $68 \text{ m}^3/\text{s}$  (2,400 cfs) to meet possible future domestic, industrial, and irrigation demands within the Qu'Appelle, releases to date have been limited to  $11 \text{ m}^3/\text{s}$  (400 cfs). The restriction is due to the limited channel capacity in the upper Qu'Appelle. Often the conveyance capacity is further reduced by weed growth during the summer months. Reductions of as much as 50% to 75% can occur, severely limiting the diversion rate.

## Present Perspective on Basin Water Use

A total of 1,561 surface water projects within the Qu'Appelle basin are registered with the Water Rights Branch, Saskatchewan Water Corporation, to date. Of those, 90% have been authorized, amounting to a total annual allocation of 73,700 dam<sup>3</sup> (60,000 ac. ft.).\* Water is allocated predominantly for such uses as municipal, domestic, irrigation and industrial. The amount allocated to use in the basin is not a measure of mainstem water use because a considerable amount of water is allocated to users along the many tributaries as well as users elsewhere in the basin. Nor is the figure a measure of the volume of water actually used annually. It does, however, give an appreciation of the level of water demand within the basin. The annual allocation is even more significant when compared to Saskatchewan's 50% share (under the 1969 Master Agreement on Apportionment) of the average annual natural flow at the provincial boundary, 125,000 dam<sup>3</sup> (101,500 ac. ft.).\*\*

It should be noted that the municipal, surface water requirements of Regina and Moose Jaw are not included in the 73,700 dam<sup>3</sup> of authorized water use in the basin. Regina and Moose Jaw municipal surface water is a water right drawn on the South Saskatchewan River Basin. During the period 1980 to 1983 the average annual quantity pumped from Buffalo Pound to supply the cities of Regina and Moose Jaw was 30,000 dam<sup>3</sup> (24,000 ac. ft.) (Banga, A. B., and Thiele, L., December 1986). An additional 4,200 dam<sup>3</sup> (3,400 ac. ft.) were piped from Buffalo Pound Lake to the Kalium Chemicals solution mine at Belle Plaine.

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\* Information supplied through the courtesy of the Water Rights Branch, Saskatchewan Water Corporation.

\*\* Natural flow figures for the Qu'Appelle River at the provincial boundary for the period 1956-1981 supplied in unpublished form through the courtesy of the Prairie Provinces Water Board. The average annual natural flow for the period is 250,000 dam<sup>3</sup> (203,000 ac. ft.) of which Saskatchewan's share is 50% or 125,000 dam<sup>3</sup> (101,500 ac. ft.).

The greatest single user of water in the Qu'Appelle basin is the atmosphere. The average annual net evaporation from the nine Qu'Appelle lakes alone amounts to 140,000 dam<sup>3</sup> (113,000 ac. ft.)\*, more than Saskatchewan's share of the average annual natural flow at the Manitoba border. The maximum net evaporation loss from the Qu'Appelle lakes occurred in 1980 with 205,000 dam<sup>3</sup> (253,000 ac. ft.) going up in vapor.

Other basin water uses are recreation and wildlife uses. Recreation requires maintaining water levels in the lakes during the summer months. Wildlife use is largely made up of Ducks Unlimited projects as well as the Nisku project in Eyebrow Lake.

### Diversion Releases

Annual releases from Qu'Appelle dam between 1967 and 1983 have averaged 58,000 dam<sup>3</sup> (47,000 ac. ft.). The lowest quantity diverted was 19,000 dam<sup>3</sup> (15,000 ac. ft.) in 1974. 1974 was a record runoff year for the Qu'Appelle basin with major flooding at many points throughout the basin. The largest quantity released to the Qu'Appelle was 142,000 dam<sup>3</sup> (115,000 ac. ft.) during the drought year of 1981. Much of this water was routed through the system to maintain freshwater flow through the lakes.

Of the water released from Qu'Appelle dam, 30,000 dam<sup>3</sup> (24,000 ac. ft.), on the average, goes to supply the annual municipal needs of Regina and Moose Jaw. Another 4,200 dam<sup>3</sup> (3,400 ac. ft.) is pumped from Buffalo Pound Lake to Kalium Chemicals. The Nisku waterfowl project in Eyebrow Lake takes an additional average draft of 4,000 dam<sup>3</sup> (3,200 ac. ft.). The average total annual demand of the three direct users of diversion water is 38,200 dam<sup>3</sup> (31,000 ac. ft.), which is about two-thirds of the annual average quantity of water diverted to the Qu'Appelle from the South Saskatchewan River.

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\* Based on calculations using Saskatchewan-Nelson Basin Board net evaporation figures updated to cover the period 1911-1984. This information was made available in, as yet, unpublished form through the courtesy of the Hydrology Division of P.F.R.A.

## Future Prospects

Obviously as time goes on, developments in the Qu'Appelle basin will require increased quantities of water. Regina and Moose Jaw are not going to go away. They will continue to grow and so will their demand for water. But let's look beyond those ever growing demands to the potential for increased diversion of water.

Three proposals are to be described here and are all well documented in Appendix 3 of the 1972 Report of the Saskatchewan-Nelson Basin Board. All three schemes would require an enlarged outlet structure in Qu'Appelle dam as well as a much improved conveyance capacity in the Qu'Appelle River channel.

The first proposal is the Lake Diefenbaker to Upper Assiniboine River diversion. Releases from Qu'Appelle dam would be carried by the Qu'Appelle to Valeport where a pump station would facilitate the raising the water 65.5 m (215 ft.) to a canal. The water would then flow under the influence of gravity, north along highway 20 and then east, passing south of the Quill Lakes. After passing through a number of drop structures, lowering the water some 56 m (184 ft.), the flow would join the Assiniboine River entering the reservoir of the proposed Kamsack dam.

The second proposal is known as the Qu'Appelle River Conveyance Channel. This proposal simply requires increasing the conveyance capacity of the Qu'Appelle River channel to carry the proposed design flows. Four flow volumes have been suggested between 14.2 m<sup>3</sup>/s (500 cfs) and the 1:50 flood flow, which varies from reach to reach. Besides the channel conveyance improvements a number of drop structures would be required as well. Finally, Victor dam would be built on the Qu'Appelle River in Saskatchewan a few miles upstream of the Manitoba boundary.

The third glimpse into possible future developments is known as the Qu'Appelle River to Souris River diversion. A pump station would be located below the Craven Control structure. The diverted water would be lifted 119 m (380 ft.) to a canal which would convey the water over 145 km (90 mi.) in a southeasterly direction to flow into the proposed Rafferty Reservoir. Turnouts along the route would allow releases of diversion water to the proposed Boggy Creek reservoir, to the Wascana Creek immediately upstream of Regina, to Wascana Creek above the proposed Sedley Reservoir and to Moose Jaw Creek via a canal.

At Glen Ewen the water can once again be pumped a further 18 m (59 ft.) to a canal carrying it 29 km (18 mi) to enter a proposed Antler River reservoir. The flow would pass down the Antler River into Manitoba, bypassing a short reach into North Dakota, ending up in a proposed reservoir behind Coulter dam just above the confluence of the Antler and Souris Rivers.

In brief, these are the possible future diversion developments which will impact upon the Saskatchewan-Qu'Appelle diversion. The concept of such megaprojects as the three proposals just described makes today's modest diversion volumes pale by comparison. Water is a valuable commodity in the southern prairies and becoming more valuable all the time. The time may come when the economic realities may well see one or more of those farsighted proposals come into fruition. The report of the study now in progress under the Canada-Saskatchewan South Saskatchewan River Basin Study Agreement will give a clearer picture of future directions for water resource planning in the South Saskatchewan River Basin as well as diversions from the basin.

### Conclusion

The South Saskatchewan-Qu'Appelle River diversion has not begun to realize its potential as a water resource alternative. In the almost 20 years of operation the volume of water diverted is slightly more than one half of one percent of the natural flow of the South Saskatchewan River entering the Province of Saskatchewan. An insignificant quantity, well within the confidence band surrounding the best hydrometric records available.

Considerable more water resource development could take place within the Qu'Appelle basin before the diversion quantities would become appreciable. As previously described, there are some very ambitious water resource schemes on the drawing board which would, if implemented, use large quantities of diversion water and have very far reaching effects on the environment and economy of southeastern Saskatchewan as well as Manitoba.

The purpose of this paper is not to promote greater diversion development on the premise that if a little is good, more will be

better. However, increased diversion does appear to be inevitable. A Saskatchewan Environment report (Water Management in Saskatchewan, Volume 1, September 1980) states, "The concept (Interbasin transfer from the South Saskatchewan River to the Qu'Appelle River) will become more and more necessary with time. Consideration must be given to the two major costs associated with water transfer, the cost of benefits foregone on the Saskatchewan River system, and the cost to manage the water once it enters the Qu'Appelle." It is to be hoped that before any large scale diversion projects are launched, with possibly irreversible consequences, water resource planners avail themselves of the lessons to be gained by past experience and consider more than economics alone.

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