SUMMARY

Author(s) and title (for reference) :

MESSIER, D., 2002. *Suivi environnemental des projets La Grande-2-A et La Grande-1. Le panache de La Grande Rivière.* Rapport synthèse pour la période 1987-2000. Direction Barrages et Environnement, Hydro-Québec Production. 73 p. and appendices.

Abstract :

The hydrological regime of La Grande Rivière is characterized by the doubling of its mean annual flow, from 1 700 m^3/s to 3 400 m^3/s, after the commissioning of the La Grande complex, phase I. With the addition of La Grande-2-A generating station to Robert-Bourassa station, monthly mean flows reach 4 000 m^3/s in November and December and more than 4 500 m^3/s in January and February. La Grande-1 is a run-of-river generating station and its operation is synchronized with that of Robert-Bourassa and La Grande-2-A stations.

Monitoring of the physical characteristics of the north-east coast of James Bay is limited to the monitoring of the freshwater plume of La Grande Rivière in winter. Actually, it is only the winter flows that are the most modified by the addition of La Grande-2-A generating station. Impact predictions were defined by the coastal distance north and south of La Grande Rivière's mouth affected by its plume, as well as the area of the plume limited by the 10 ‰ and 20 ‰ isohalines. The empirical model predicted the plume area to increase to 3 000 km^2 under a flow of 4 300 m^3/s.

Winter surveys were realized in 1987 and 1989 to define more precisely the conditions prevailing before the commissioning of La Grande-2-A generating station, so called the reference period. Monitoring was undertaken in 1993 and 1995, after the commissioning of La Grande-2-A and La Grande-1 stations. The physico-chemical characteristics of the water along the northeast coast of James Bay was also monitored during 1987 survey.

To study the freshwater plume, two approaches were used. First, conductivity-salinity and temperature profiles in the water column were performed at a sufficient number of stations to define the outer limit of the plume (bordered by the 20 ‰ isohaline) and to close the isohalines on shore. Second, instruments were moored at fixed stations to measure temperature, conductivity-salinity and velocity and direction of currents at defined intervals.

During February 1993 and 1995, 101 and 156 salinity-temperature profiles were respectively realized, and two currentmeters mere moored. During winter 1987, 48 water samples were taken for the determination of the concentrations of sestonic matter and nutrients in 4 distinct water masses along the coast.

After commissioning of La Grande-2-A and La Grande-1 generating stations, plume area, as limited by the 20 ‰ isohaline, varied from 3 200 to 3 500 km^2 under 4 600 m^3/s during February 1993, and from 2 100 to 2 800 km^2 under 4 400 m^3/s during February 1995.

For comparison, the area of the plume in 1987 and 1989 surveys is estimated at 2 000 km^2 for flow conditions of 3 700 to 4 000 m^3/s; during 1980 winter survey, the total area of the plume was 1 600 km^2

under a flow of 1 700 m^3/s. Increasing the discharge of La Grande Rivière from 1 700 m^3/s to more than 4 400 m^3/s extends the plume area from 1 600 km^2 to 2 100 km^2 or to 3 500 km^2, whether the extension is minimum or maximum.

A new relationship between under-ice plume area and freshwater discharge of a river was proposed in 1993. This simple model shows a good adequacy between calculated and observed areas for plumes located totally under the ice. It was the case for the 1993 observations. However, the area of the February 1995 plume is from 11 to 33 % smaller than calculated. It seems that river discharge is not the only factor governing the area of the La Grande Rivière plume.

Variability is a characteristic of physical conditions along the northeast coast of James Bay. Differences of more than 700 km^2 in plume area are observed without being related to changes in river discharge. It was not possible to clearly identify the key factors, because they are multiple. Tide is one of the main mixing agent; from neap tide to spring tide, current velocity is doubled, which means that mixing is multiplied by 8, or the cube of the speed. Wind conditions influence the length of open waters, which have a major impact on mixing conditions, and by extension, on the area of the plume.

Finally, it has been shown, for the third time, that La Grande Rivière does not supply significant amount of sestonic matter and nutrients to coastal waters of James Bay. It does not provide nutrients that are always limiting in James Bay, in winter as well as in summer.

Environmental monitoring of the La Grande Rivière winter plume, as realized, has fulfilled the conditions required by the certificates of authorization of the La Grande-2-A and La Grande-1 projects.

In conclusion, for efficient and conclusive monitoring of a winter plume, two conditions must be met. First, the expected changes in the discharge of the river must be larger than its natural range of variations. Second, critical habitats and/or resources must be significantly threatened by these modifications. The monitoring of marine eelgrass showed that this has not been the case along the northeast coast of James Bay.

Key words : James Bay, La Grande Rivière, La Grande complex, environmental monitoring, freshwater plume, temperature, salinity, current, water quality.

Distribution list : Ministère de l'Environnement, James Bay Advisory Committee on the Environment, Review Committee, Cree Regional Authority, Cree communities, Eeyou Corporation, Makivik Corporation, Société de la faune et des parcs du Québec, Société d'énergie de la Baie James, Société de développement de la Baie James, Municipalité de la Baie James, Hunting, Fishing and Trapping Coordinating Committee, Canadian Electrical Association, Environment Canada, Fisheries and Oceans Canada, Unités d'environnements et de relations avec le milieu des divisions d'Hydro-Québec, Documentation centre of Direction Environnement d'Hydro-Québec.

Version : final ***Diffusion code :*** internal / external ***Date :*** December 2002

Call number at Centre de documentation Environnement d'Hydro-Québec : HQ-2002-129