8. Conclusions

The rate of the water level increase was much faster than any of the major flooding events recorded at Badger since 1916. The mechanism of ice movement that led to the flooding at this point in time also seems to be different. This needs to be further investigated.

In the past, it was believed that once the ice cover was past Three Mile Island for a week or so that the danger of flooding was over in Badger. This event has shown that this is not the case.

As with the past floods, the event occurred after a mild spell was followed by an intense cold snap.

There is no indication in the hourly water level data from the Exploits River below Noel Pauls Brook that a sharp increase in water levels, either natural or due to the operation of Exploits Dam, occurred prior to the flood event.

Water levels on the Exploits River (Exploits River below Noel Pauls Brook) rose from 6.173 m at 8:00 am on February 7 to 6.391 m at 8:00 am on February 15, just before the flood - an increase of only 0.218 metres over the seven days. A stability analysis of the ice cover using mathematical models will be required to determine whether this increase in level contributed to the breakup of the ice cover that resulted in the flood at Badger

The present flood forecasting system was not designed to forecast floods that occurred with the rapidity of the event that occurred on February 15, 2003. Also, improvements are required in the hydrometric network to support an upgraded flood warning system that would have the capability to provide a warning for these types of floods and for the management of the flood response after a flood event.

The information provided by the staff at the Gander Weather Centre has been vital in managing the post flood management of flows in the Exploits River and providing an advance warning of adverse weather conditions.

While the current flood risk mapping is accurate, the flood event was slightly higher than the 1:100 year return interval level used in the map. Further study needs to be carried out to check the validity for the 1:20 and 1:100 year levels. This information will be required to provide the design parameters for any remedial measures that are proposed.

9. Recommendations

A detailed hydrotechnical study needs to be carried out to establish the cause or causes of the flood that occurred on February 15. This study must also review the 1:20 and 1:100 year levels for Badger that were established in the 1985 study to determine if these levels are now reasonable.

Appropriate levels are required so that remedial measures can be designed to protect against an appropriate flood level.

The remedial measures proposed in the 1985 study need to be reevaluated using a new economic analysis based on the flood damages from the February 2003 flood.

An outside consultant should be hired to carry out the two previous recommendations based on a terms of reference to be prepared by the DOE, in consultation with other stake holders.

Improvements need to be made to the flood forecasting system, particularly to improve the flood warning capabilities. The monitoring network needs to be expanded as shown in Figure 18. The gauges upstream of Badger need to be equipped with a real time transmitter that can initiate a warning when the water level changes rapidly. Other improvements to be considered, include:

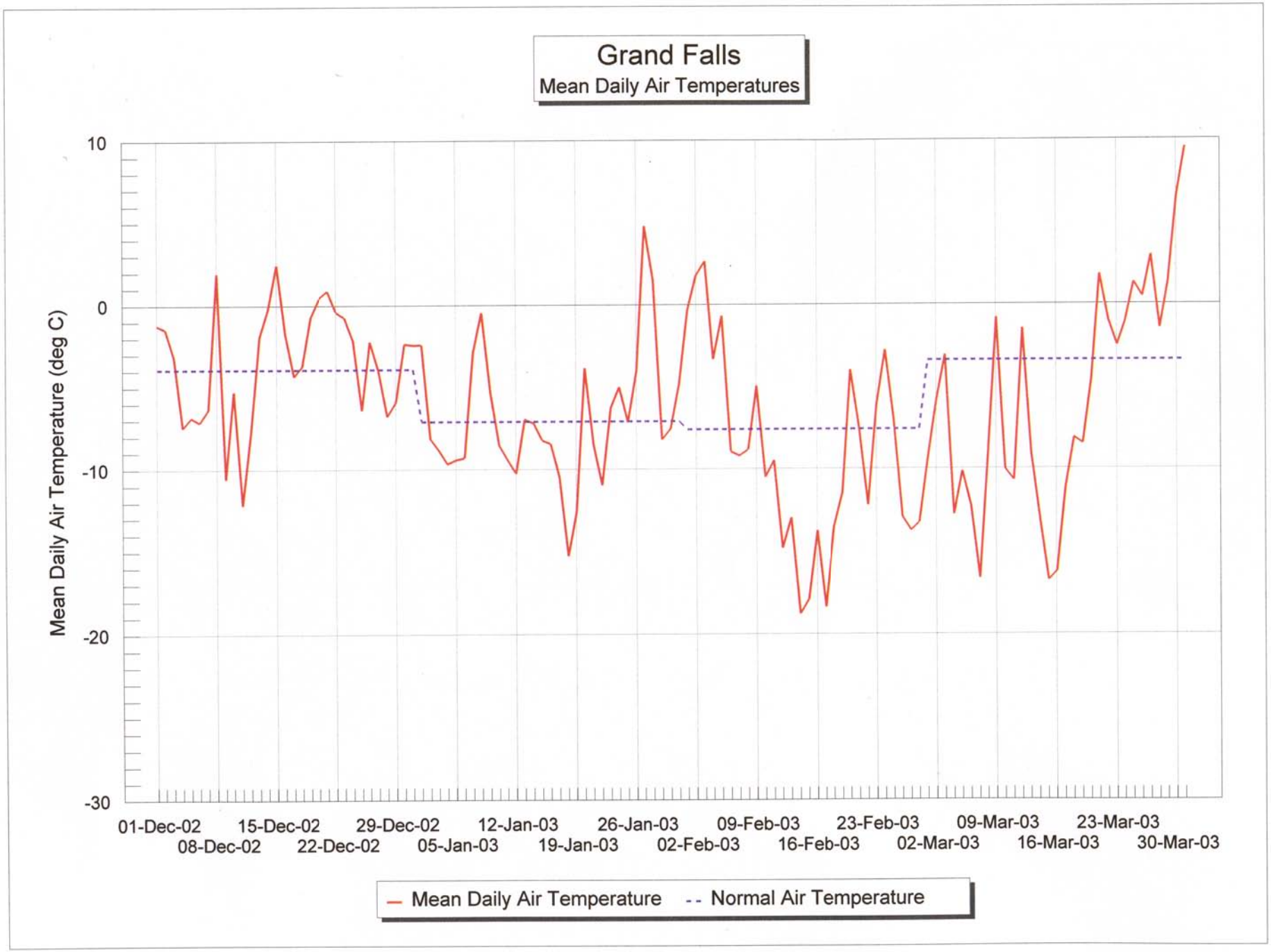
- improve the processing of wind speed, gust and direction from the Noel Pauls Brook wind gauge,
- develop equations for estimating missing data from nearby stations,
- upgrade the equipment at the Badger water level gauge,
- acquire and use realtime satellite imagery (RADARSAT) to monitor ice cover progression,
- purchase previously recorded images for the analysis of this and past events,
- calculate normals for all nearby climate stations, based on available data,
- update ice forecast model more frequently, up to once every 3 hours.

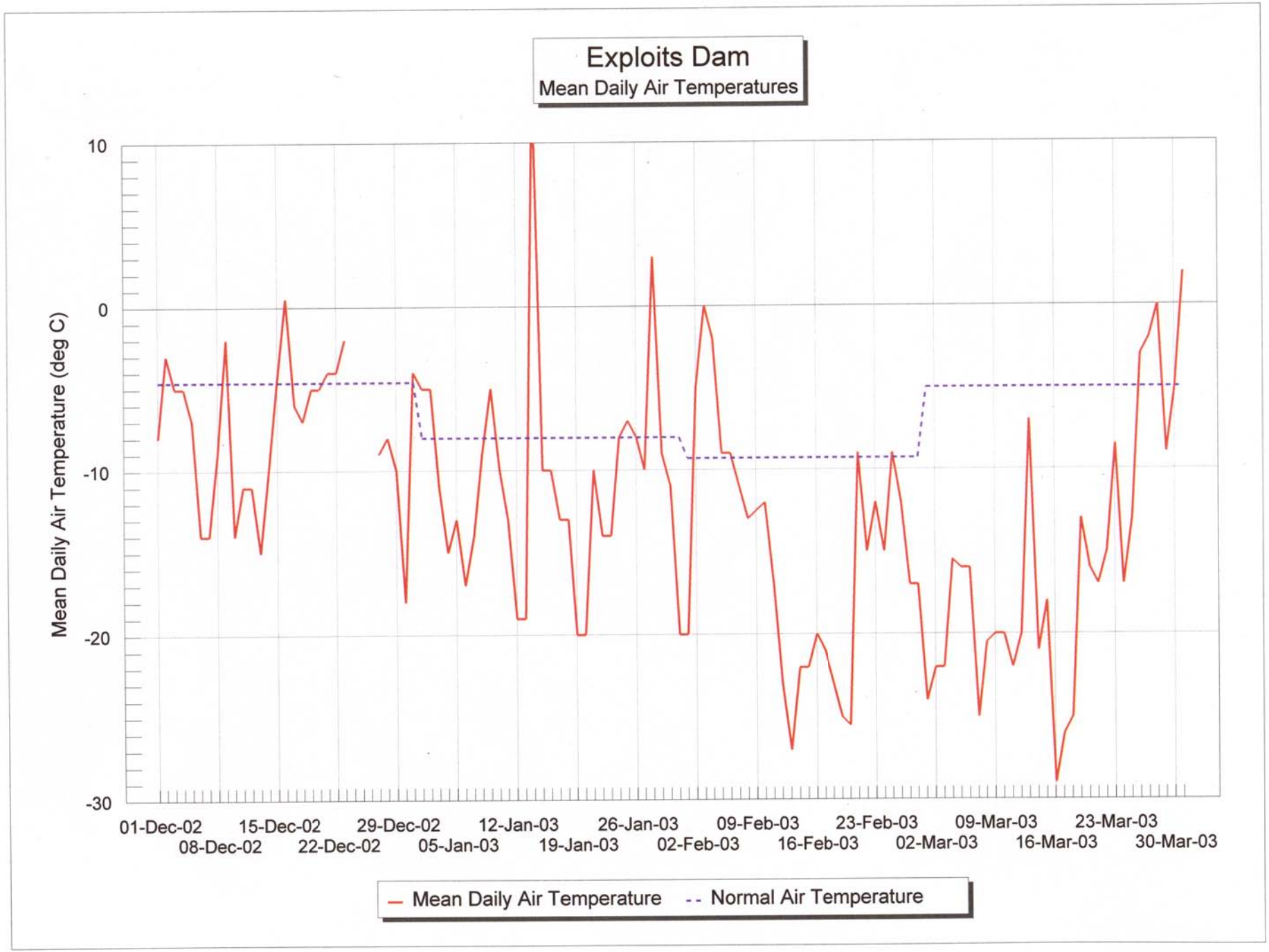
Abitibi should be approached to discuss the cost sharing of the improvements to the flood forecasting system noted above.

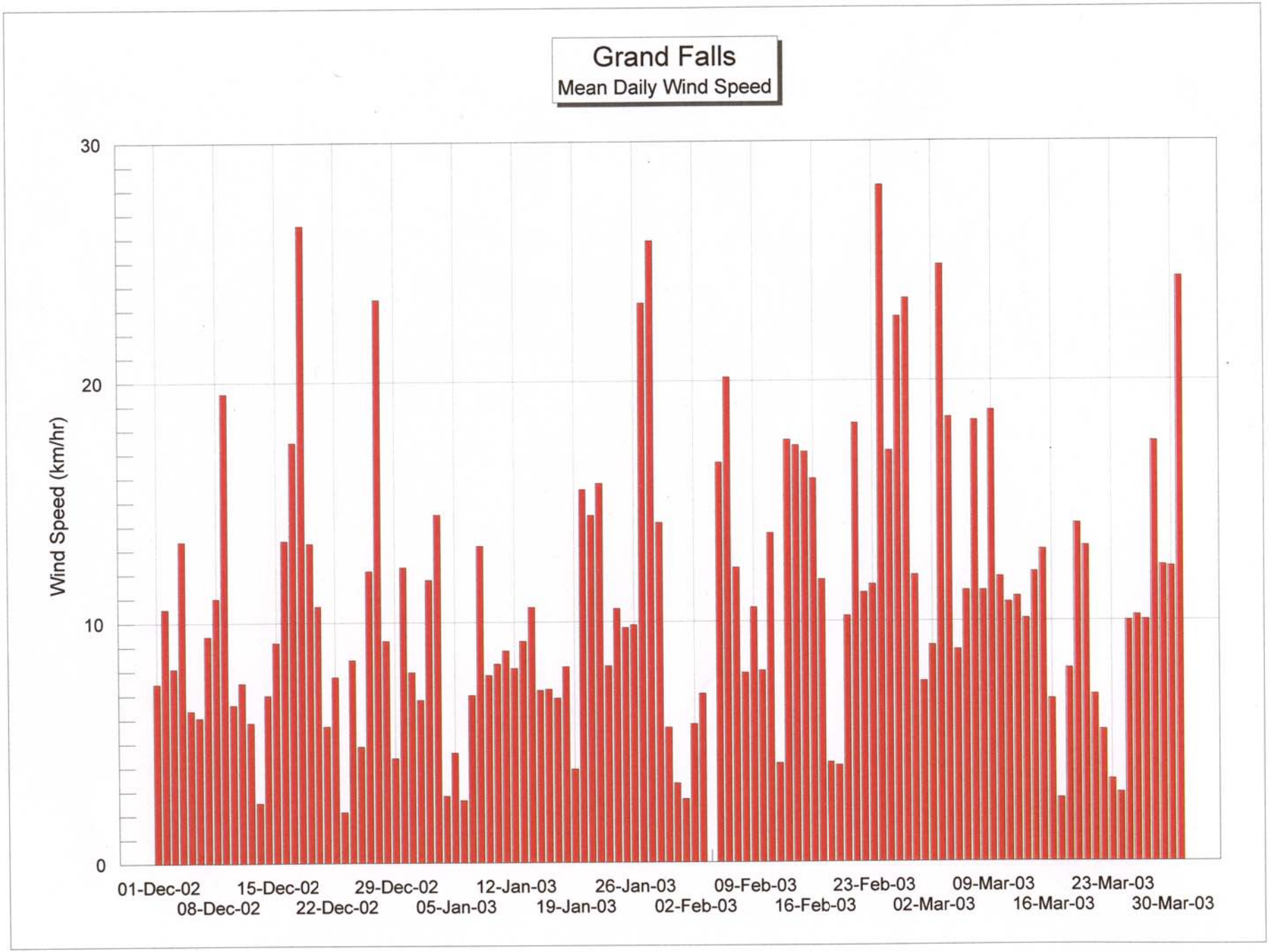
The recommendations above are based on the current situation in Badger and may be subject to revision depending on the remedial measures that are implemented

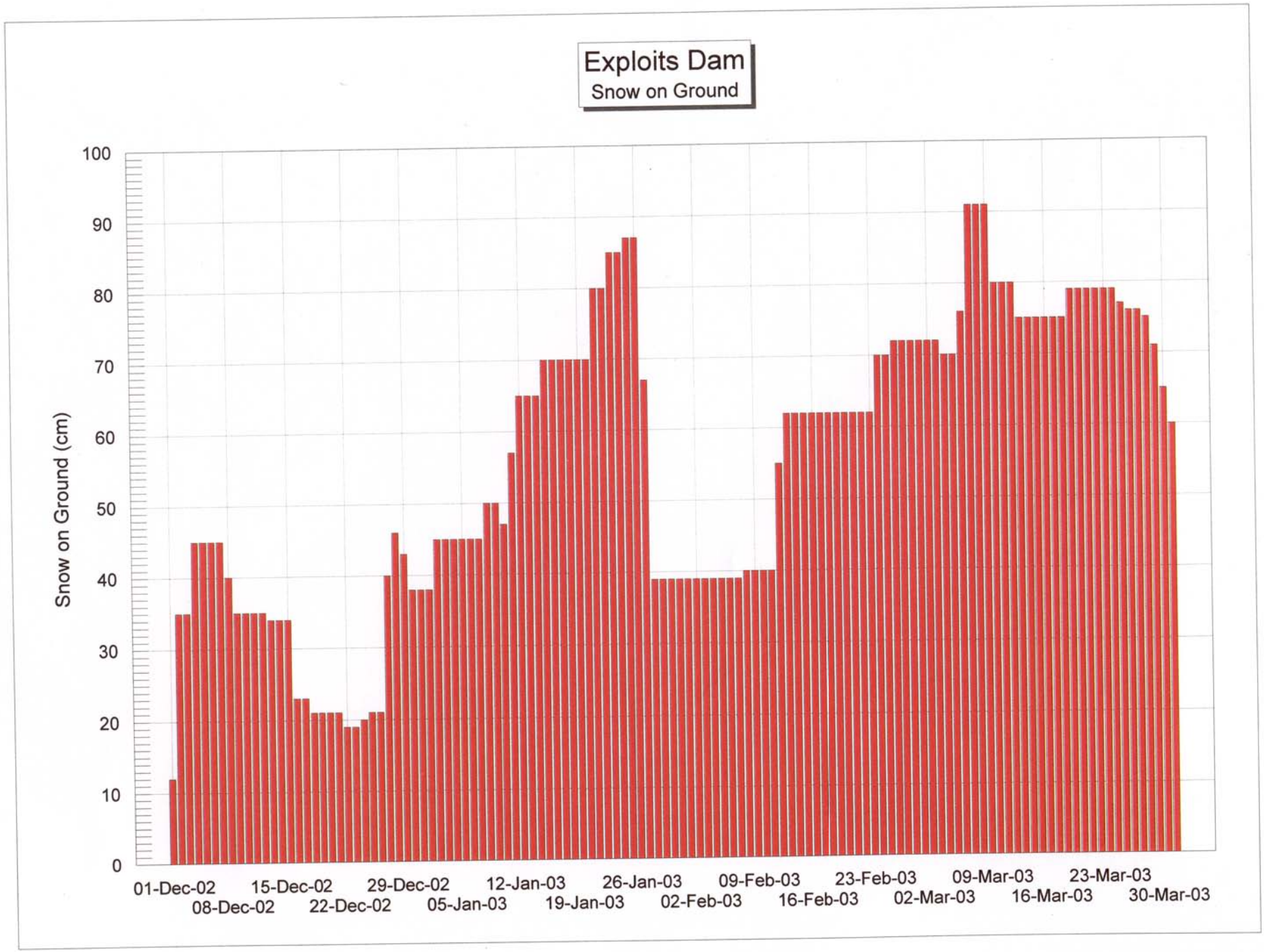
Appendix A

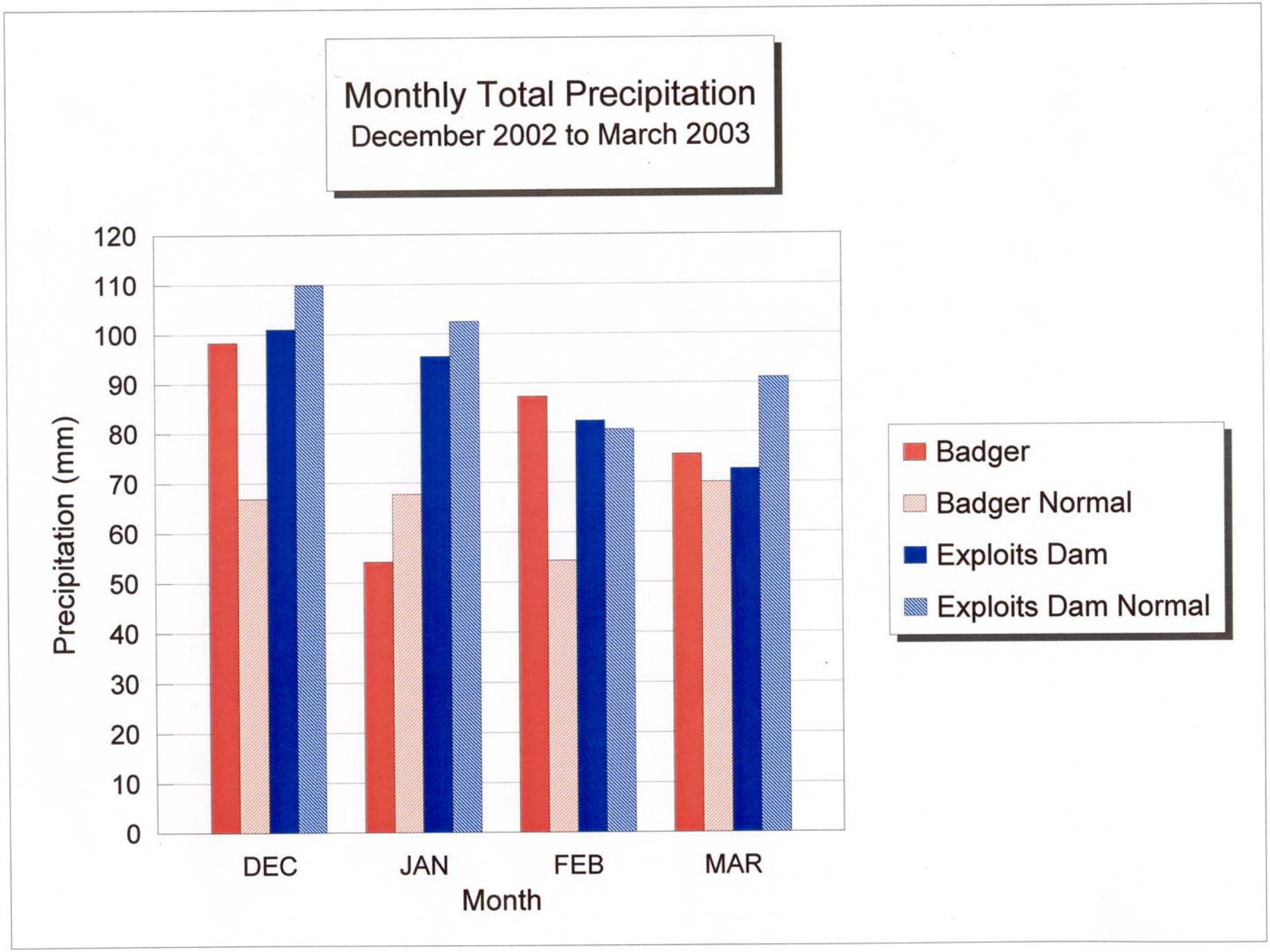
Climate Data

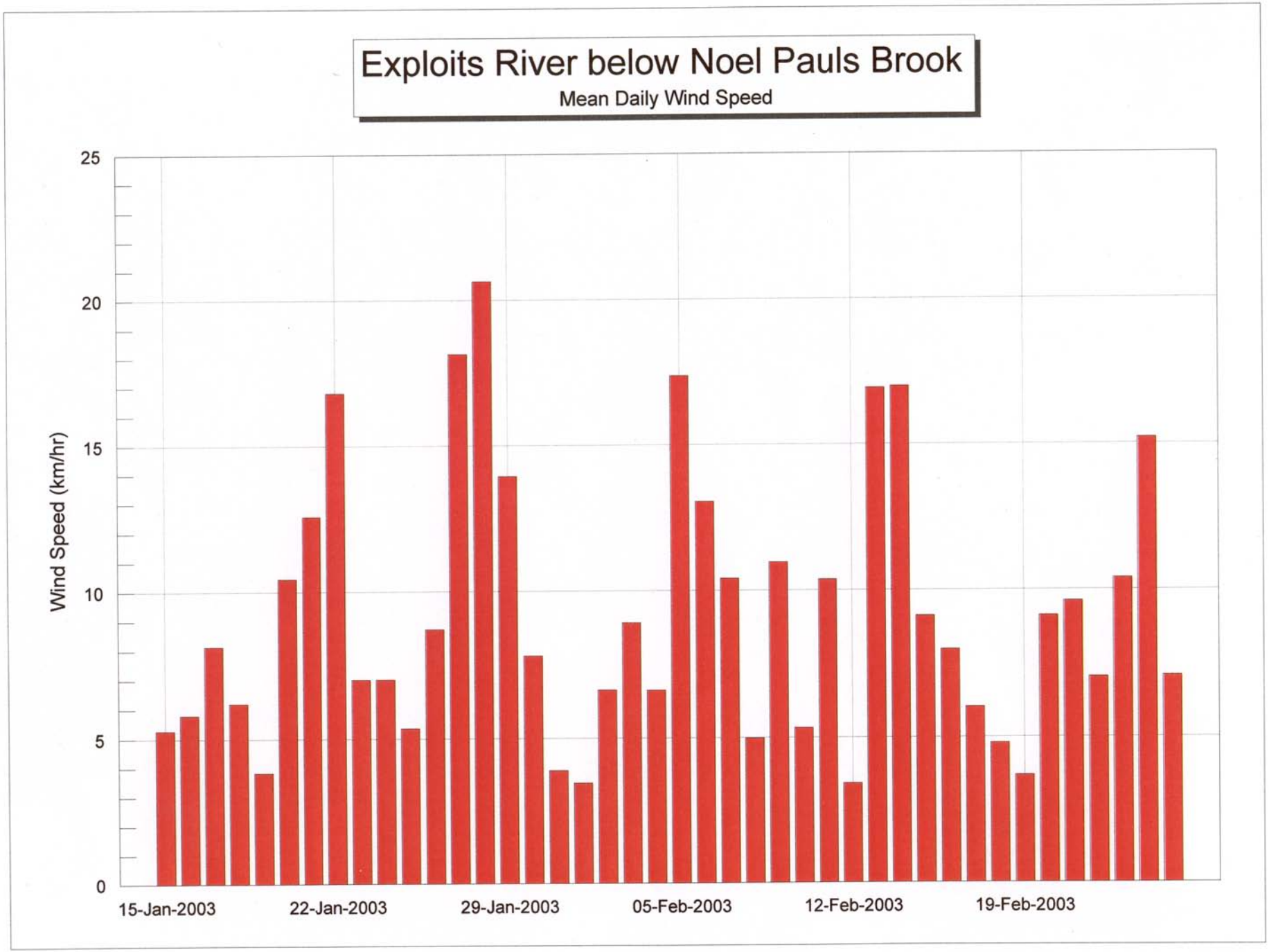

Grand Falls
Mean Daily Air Temperatures
Mean Daily Air Temperature (deg C)
10
0
-10
-20
-30
01-Dec-02
08-Dec-02
15-Dec-02
22-Dec-02
29-Dec-02
05-Jan-03
12-Jan-03
19-Jan-03
26-Jan-03
02-Feb-03
09-Feb-03
16-Feb-03
23-Feb-03
02-Mar-03
09-Mar-03
16-Mar-03
23-Mar-03
30-Mar-03
Mean Daily Air Temperature
Normal Air Temperature


Exploits Dam
Mean Daily Air Temperatures
Mean Daily Air Temperature (deg C)
10
0
-10
-20
-30
01-Dec-02
08-Dec-02
15-Dec-02
22-Dec-02
29-Dec-02
05-Jan-03
12-Jan-03
19-Jan-03
26-Jan-03
02-Feb-03
09-Feb-03
16-Feb-03
23-Feb-03
02-Mar-03
09-Mar-03
16-Mar-03
23-Mar-03
30-Mar-03
Mean Daily Air Temperature
Normal Air Temperature


Grand Falls
Mean Daily Wind Speed
Wind Speed (km/hr)
30
20
10
0
01-Dec-02
08-Dec-02
15-Dec-02
22-Dec-02
29-Dec-02
05-Jan-03
12-Jan-03
19-Jan-03
26-Jan-03
02-Feb-03
09-Feb-03
16-Feb-03
23-Feb-03
02-Mar-03
09-Mar-03
16-Mar-03
23-Mar-03
30-Mar-03


Exploits Dam
Snow on Ground
Snow on Ground (cm)
100
90
80
70
60
50
40
30
20
10
0
01-Dec-02
08-Dec-02
15-Dec-02
22-Dec-02
29-Dec-02
05-Jan-03
12-Jan-03
19-Jan-03
26-Jan-03
02-Feb-03
09-Feb-03
16-Feb-03
23-Feb-03
02-Mar-03
09-Mar-03
16-Mar-03
23-Mar-03
30-Mar-03


Monthly Total Precipitation
December 2002 to March 2003
Precipitation (mm)
120
110
100
90
80
70
60
50
40
30
20
10
0
DEC
JAN
FEB
MAR
Month
Badger
Badger Normal
Exploits Dam
Exploits Dam Normal


Exploits River below Noel Pauls Brook
Mean Daily Wind Speed
Wind Speed (km/hr)
25
20
15
10
5
0
15-Jan-2003
22-Jan-2003
29-Jan-2003
05-Feb-2003
12-Feb-2003
19-Feb-2003

Appendix B

Streamflow/Discharge Data

Data is available from
Department on request.

Appendix C

Ice Modelling/Progression

Data is available from
Department on request.