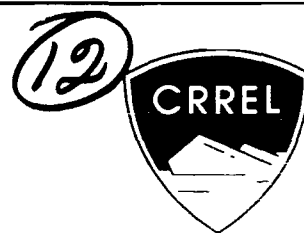


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Gordon Gooch, John Rand, Ben Hanamoto and Jon Zufelt

November 1990

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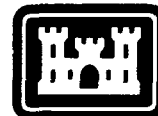
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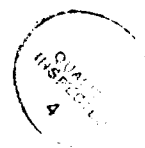
**U.S. Army Corps
of Engineers**
Cold Regions Research &
Engineering Laboratory

Modeling Ice Passage Through Submergible and Non-submergible Tainter Gates

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Prepared for
U.S. ARMY ENGINEER DISTRICT, ROCK ISLAND

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PREFACE

This report was prepared by Gordon Gooch, Civil Engineering Technician, John Rand, Research General Engineer, Ben Hanamoto, Research General Engineer, and Jon Zufelt, Research Hydraulic Engineer, all of the Ice Engineering Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory. Funding for this research was provided by the U.S. Army Engineer District, Rock Island.

Dr. Jean-Claude Tatinclaux and Dr. James Lever technically reviewed the manuscript of this report.

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CONVERSION FACTORS: U.S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

These conversion factors include all the significant digits given in the conversion tables in the ASTM *Metric Practice Guide* (E 380), which has been approved for use by the Department of Defense. Converted values should be rounded to have the same precision as the original (see E 380).

<i>Multiply</i>	<i>By</i>	<i>To obtain</i>
inch	25.4	millimeter
foot	0.3048	meter
foot ³ /second	0.02831685	meter ³ /second
gallon/minute	0.00006309020	meter ³ /second
degrees Fahrenheit	$t^{\circ}\text{C}=(t^{\circ}\text{F}-32)/1.8$	degrees Celsius

Modeling Ice Passage Through Submergible and Non-submergible Tainter Gates

GORDON GOCCH, JOHN RAND,
BEN HANAMOTO AND JON ZUFELT

INTRODUCTION

This study examined ice passage through two types of tainter gates using CRREL's Starved Rock Lock and Dam model (Fig. 1). Our objectives were to model the flow of ice through the existing tainter gates and through submergible tainter gates in the same location (Fig. 2), to move the submergible gates to a location closer to the lock chamber and model the ice passage at that new location, and finally to compare, when possible, plastic ice and real ice and to observe the effect of each.

All tests simulated typical low flow conditions of approximately 6000 ft³/s with normal winter ice conditions of 6 to 18 in. of brash ice in the ship track. Near-surface water velocities were obtained with each gate setting to evaluate any changes in the flow pattern and velocity.

Each test was documented by still photographs and 1/2-in. VHS video. A summary of the video is available from CRREL. Reference photographs are included here as Appendix A.

Throughout this report, submergible tainter gates will be called just that, while the normal tainter gates will be simply tainter gates.

SCALE MODEL HYDRAULIC DESIGN

The Starved Rock Lock and Dam physical model, built in the refrigerated research area of CRREL's Ice Engineering Facility, is an undistorted Froude model, constructed at a length scale ratio of 25:1.

Ice conveyance and transport can be studied as a two-dimensional process in either an undistorted or distorted model. The passage of ice over and under gates, however, is inherently a three-dimensional process. To maintain model similarity near the gate structures, it was necessary to ensure

that the vertical and horizontal scales be equal and thus we used an undistorted model.

In a Froude model, the Froude number of the model and the full-scale structure must be equal.

$$(Fr)_r = \frac{(Fr)_p}{(Fr)_m} = \frac{V_r}{\sqrt{g_r h_r}} = 1$$

where

- Fr = Froude number
- V = velocity
- g = acceleration due to gravity
- h = depth
- V_r = velocity ratio = V_p/V_m
- r = ratio full scale/model scale
- p = prototype (full scale)
- m = model.

The scale of a model is often represented by means of its length ratio L_r , which is equal to the characteristic horizontal length ratio L_p/L_m , the flow depth ratio $h_r = h_p/h_m$, discharge Q and area of cross section A . Since the acceleration due to gravity is the same in the model and in the prototype, g_r (the gravity ratio) = $g_p/g_m = 1$, and since $h_r = L_r$ in an undistorted model, we see that $V_r = (L_r)^{1/2}$. Since $Q_r = A_r V_r$ and $A_r = L_r$, then $Q_r = L_r^{5/2}$.

The mean winter discharge at Starved Rock Lock and Dam is approximately 6300 ft³/s, with a minimum shipping channel depth of 12 ft. The maximum scale for a model (large model) is dependent on the space and pumping capacity available and the minimum scale (small model) is dependent on measurement accuracy and the requirement to avoid viscous and surface tension scale effects. Based on these requirements, a length scale ratio of 25:1 was chosen, which resulted in a mean winter model discharge of approximately 900 gal./min (about mid-range of the facility's

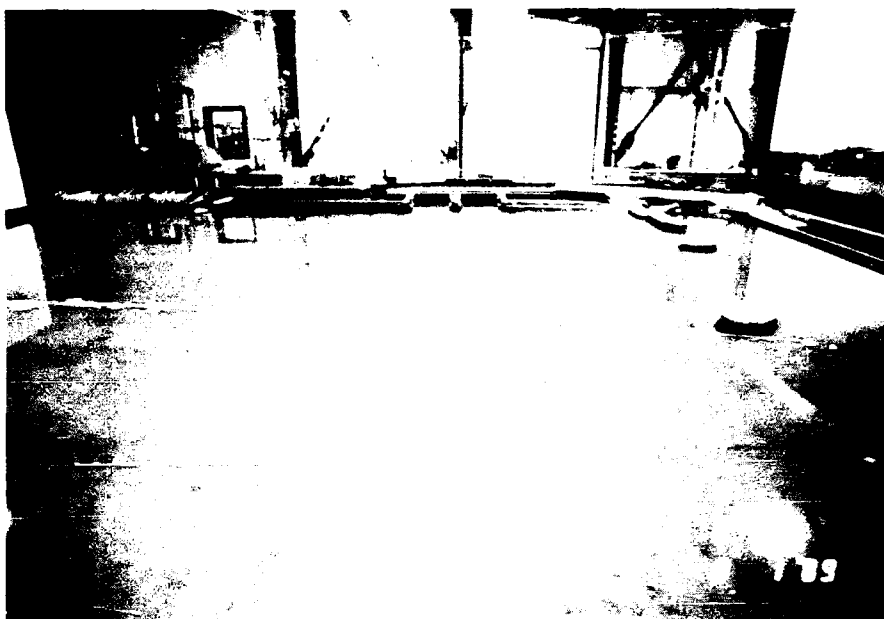


Figure 1. Starved Rock Lock and Dam model. Lock approach on right; submersible gates at site 2 in center; existing tainter gates, site 1, on left.

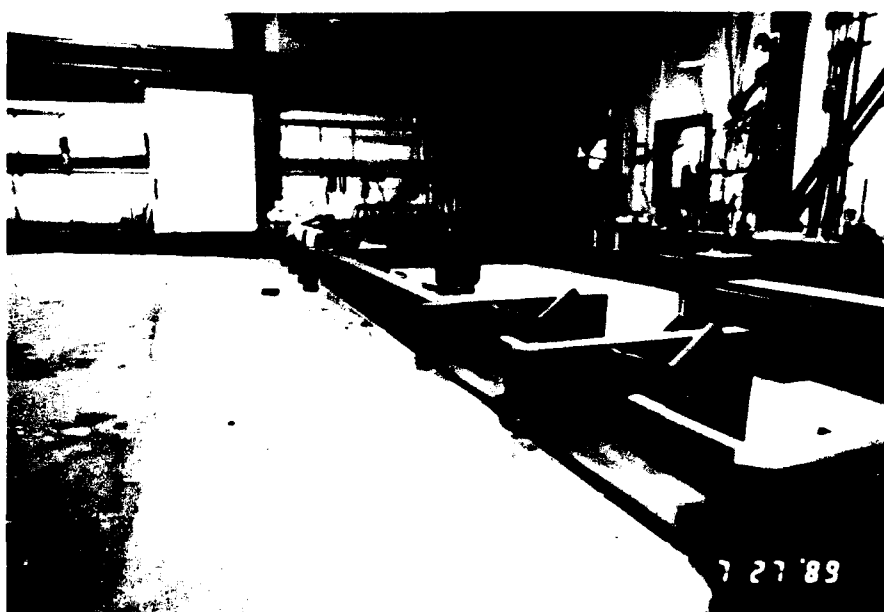


Figure 2. Model submersible gates.

pumping capacity). With this model scale, the model depths would range from 0.1 ft (over submerged Leopold Island) upstream of the dam to approximately 1.0 ft in the deepest sections, which are suitable to retain measurement accuracy.

At this scale, though, a model covering the full river width would be too large to fit in the refrigerated research area. However, during the winter months, when ice passage is a problem at Starved Rock Lock and Dam, only the first one or two tainter gates are operated, with an average total opening of about 4.0 ft. The entire river freezes over except for the continually rebroken shipping lane hugging the right bank. The areas of interest when the river is ice covered are the shipping channel and the portion of the river extending over to the first two tainter gates of the dam. Submerged Leopold Island also forms somewhat of a separation line down the center of the river. Based on this information, we decided to build the model for only a portion of the river and to calibrate the model to the mean winter discharge, velocities and ice conditions.

The model is 40 ft wide by 130 ft long, which is a full-scale size of 1000 by 3250 ft (Fig. 3). It includes the lock approach guide wall, the upper miter gates and three of the ten tainter gates on the dam. Since only the first two tainter gates are operated during the winter (ice problem periods), no adjustments were necessary to the model discharge. The use of a partial model, however, reduced the flow area and made it possible that the

Table 1. Tainter gate openings for January and February 1989.

January	Average 24-hour total gate opening (ft)	February	Average 24-hour total gate opening (ft)
1	8.0	1	6.8
2	7.0	2	6.2
3	6.6	3	6.6
4	5.7	4	5.3
5	6.2	5	4.3
6	7.6	6	3.7
7	8.2	7	4.3
8	12.6	8	4.6
9	13.6	9	4.5
10	11.9	10	3.9
11	12.1	11	4.0
12	10.3	12	4.6
13	9.1	13	3.6
14	8.3	14	4.2
15	7.3	15	5.0
16	7.1	16	4.7
17	6.9	17	5.5
18	6.2	18	4.2
19	6.2	19	4.8
20	6.0	20	4.6
21	5.7	21	4.4
22	5.3	22	4.4
23	5.3	23	4.2
24	5.1	24	4.1
25	5.5	25	4.2
26	6.0	26	4.0
27	6.2	27	4.3
28	5.9	28	3.7
29	6.7	Average	4.5
30	6.5		
31	7.3		
Average	7.2		

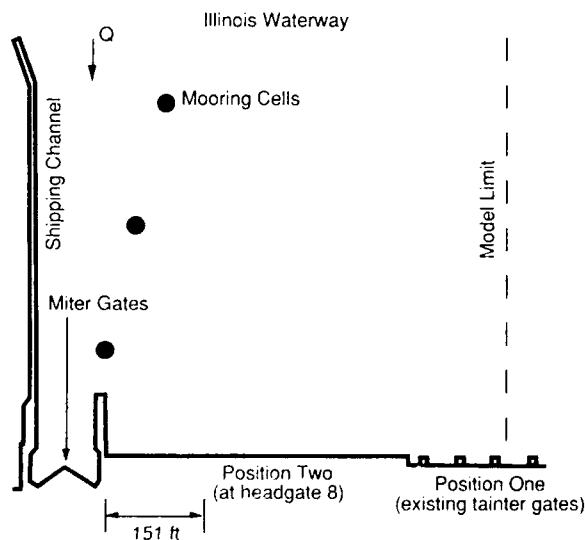


Figure 3. Model limits.

model velocities could be too high and thus not be representative of full-scale conditions. A detailed field survey of two-dimensional water velocities was conducted to calibrate the model velocities. We used flow dividers, aligners and roughness elements to adjust the model velocities to match the full-scale measurements (at $V_r = 5$).

The entire series of tests was based on the typical winter-time hydraulic conditions experienced at Starved Rock. Monthly flow records were provided by the lockmaster and are shown in Appendix B. From these data, we found that the average 24-hour gate opening for Starved Rock for the month of February 1989 was 4.5 ft. The record of the various daily settings is provided in Table 1. According to the USGS stage-discharge rating

Table 2. USGS stage-discharge curve for Starved Rock Dam. After USC S (1981) Stage discharge relationships at dams on the Illinois and Des Plaines rivers in Illinois. U.S. Geological Survey Report 81-1009.

Gate opening (ft)	Discharge (ft ³ /s) for downstream pool elevations of:								
	442	444	446	448	450	452	454	456	458*
0.0	0	0	0	0	0	0	0	0	0
0.5	781	686	594	521	454	387	315	231	102
1.0	1,560	1,490	1,290	1,130	987	841	686	502	221
1.5	2,340	2,340	2,030	1,780	1,550	1,330	1,080	791	348
2.0	3,110	3,110	2,820	2,470	2,150	1,830	1,490	1,090	481
2.5	3,880	3,880	3,630	3,180	2,770	2,360	1,910	1,400	617
3.0	4,620	4,620	4,460	3,910	3,400	2,900	2,360	1,720	757
3.5	5,340	5,340	5,340	4,660	4,060	3,460	2,810	2,040	899
4.0	6,020	6,020	6,020	5,430	4,730	4,030	3,280	2,400	1,040
4.5	6,540	6,540	6,540	6,220	5,410	4,610	3,760	2,750	1,190
5.0	7,210	7,210	7,210	7,030	6,120	5,210	4,240	3,100	1,340
5.5	7,780	7,780	7,780	7,780	6,840	5,830	4,740	3,470	1,490
6.0	8,320	8,320	8,320	8,320	7,590	6,460	5,260	3,840	1,640
6.5	8,860	8,860	8,860	8,860	8,380	7,110	5,780	4,230	1,800
7.0	9,380	9,380	9,380	9,330	9,170	7,800	6,320	4,620	1,950
7.5	9,880	9,880	9,880	9,880	9,880	8,500	6,870	5,030	2,110
8.0	10,400	10,400	10,400	10,400	10,400	9,220	7,490	5,440	2,390
8.5	10,800	10,800	10,800	10,800	10,800	9,960	8,040	5,860	2,580
9.0	11,300	11,300	11,300	11,300	11,300	10,700	8,710	6,360	2,770
9.5	11,800	11,800	11,800	11,800	11,800	11,500	9,360	6,830	2,970
10.0	12,200	12,200	12,200	12,200	12,200	12,200	10,000	7,320	3,170
10.5	12,700	12,700	12,700	12,700	12,700	12,700	10,700	7,820	3,380
11.0	13,100	13,100	13,100	13,100	13,100	13,100	11,500	8,350	3,590
11.5	13,500	13,500	13,500	13,500	13,500	13,500	12,300	8,900	3,810
12.0	13,900	13,900	13,900	13,900	13,900	13,900	13,100	9,550	4,030
12.5	14,300	14,300	14,300	14,300	14,300	14,300	14,300	10,200	4,260
13.0	14,500	14,500	14,500	14,500	14,500	14,500	submerged weir flow		
13.5	14,500	14,500	14,500	14,500	14,500	14,500			

* Feet above mean sea level.

curve for a tainter gate at Starved Rock (Table 2), a discharge rate of 6020 to 6540 ft³/s corresponds to a gate setting between 4 and 4.5 ft and a downstream pool elevation of 446 ft above mean sea level.

Information obtained from the daily navigation report and from personal conversations with the Lockmaster disclosed that the ice that typically forms in the ship tracks is broken floating ice about 6 to 18 in. thick.

GATE HYDRAULICS

We assessed the hydraulics and ice passage capabilities of two types of gates during this model study: standard tainter gates and submergible gates. The hydraulics of the two gate types are quite different, with the tainter operating in a pressure flow situation while the submergible operates in the gravity-free overfall condition.

Consequently, the heads across the gates and their effects on the discharge are also quite different. The tainter is raised to allow flow to pass beneath it, resulting in a high head (the difference between the water surface elevations above and below the gate), forcing flow through an orifice beneath the gate. Discharge is generally given by a formula relating orifice area and the head across the gate

$$Q_t = C_t A_g (2gH)^{1/2}$$

where

- Q_t = discharge under the tainter gate
- C_t = discharge coefficient for a tainter gate
- A_g = area of the gate opening
- H = head across the gate, i.e., the difference in water surface elevations between the upstream and downstream pools.
- g = acceleration due to gravity.

For the tainter gates at Starved Rock, the discharge coefficient C_d was 0.78 for winter conditions and the area of the gate opening A_g is the width of the gate (60 ft) times the gate lift. Thus, for a tainter gate, the discharge varies with the head to the $1/2$ power. Experience at Starved Rock has shown that a tainter gate must be raised at least 4 ft before ice will begin to be drawn under the gate and passed downstream. At this opening, however, ice passage is slow and ice bridges typically form at the gate opening, requiring repeated assistance from tow boats to break them up.

A submergible gate is operated by lowering the gate below the water surface and allowing flow to pass over its crest. This type of gate is similar to an ogee crest overfall spillway and thus the head is measured as the difference between the water surface elevation upstream and the top of the submerged gate. Discharge is generally given by a formula relating this head, gate width and a discharge coefficient

$$Q_s = C_s B H^{3/2}$$

where

Q_s = discharge over the submergible gate

C_s = discharge coefficient for the submergible gate

B = gate width

H = head on the gate or gate opening.

For the model, the discharge coefficient C_s was found to be about 3.4 for the range of winter flows associated with ice passage problems. The submergible gates were slightly narrower than the tainter gates (52 ft, full-scale) because of the gate lowering mechanism. Therefore, the discharge for a submergible gate varies with the head to the $3/2$ power.

What we see from these formulae for the discharge through the two types of gates is that, for a given discharge, the submergible gate must have a greater opening. This is beneficial in times of low flow when ice passage is difficult. For example, for the mean winter discharge of 6300 ft³/s, one tainter gate must be raised 4.1 ft. At this opening, the tainter will pass ice. For the same discharge, a submergible gate of the same width must be, or more aptly expressed, can be lowered 9.7 ft. Similarly, one could lower two submergible gates 6.1 ft each to accommodate the same flow. With submergible gates, ice passage is not a problem at these openings. Experience at other facilities with submergible gates has shown adequate ice passage at gate openings of 3 ft (which would corre-

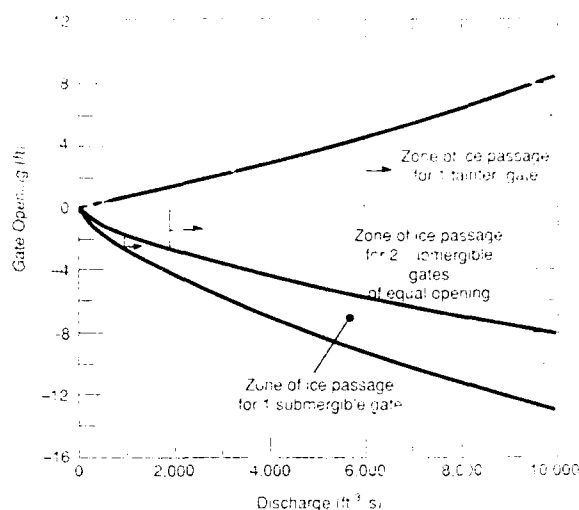


Figure 4. Plot of gate opening vs discharge and the zones of ice passage.

spond to a discharge of about 1100 ft³/s for a 60-ft-wide gate). Figure 4 is a plot of gate openings vs discharge for the two types of gates. The zones of ice passage are also marked for each type of gate. The most appropriate position of submergible gates at Starved Rock Lock and Dam, as well as the probability of ice bridging, are discussed later.

MODEL CALIBRATION

The Starved Rock model was calibrated by matching the model water surface elevation and velocities to the measured full-scale elevation and velocities at a full-scale mean winter discharge of 6300 ft³/s. As stated above, for an undistorted Froude model, the discharge scale ratio is $Q_r = L_r^{5/2}$ or for the Starved Rock Lock and Dam model $(25)^{5/2} = 3125$. Since $Q_r = Q_p/Q_m$, for a full-scale discharge of 6300 ft³/s

$$3125 = \frac{6300 \text{ ft}^3/\text{s}}{Q_m}$$

or

$$Q_m = \frac{2.01 \text{ ft}^3/\text{s} \times 449 (\text{gal.}/\text{min})/(\text{ft}^3/\text{s})}{902 \text{ gal.}/\text{min}}$$

To be assured of standard conditions for the model flow calibration, we maintained runs of 900 gal./min and an upper pool elevation of 458.75 with a single tainter gate opening of 4 ft (full scale). Similar tests with the submergible gates provided

individual full-scale gate settings of 6.75 ft for each of two submergible gates.

TESTING SEQUENCE

The test sequence is summarized in Table 3. As previously stated, the model flow conditions were 900 gal./min (6300 ft³/s full scale) and for the last two tests we used a lower flow of 315 gal./min (1972 ft³/s full scale). The locations of the gates for the various tests are identified as position 1 and position 2. Position 1 is the location of the existing tainter gates at Starved Rock Lock and Dam. Position 2 is a new location, which is proposed as an alternate site for the construction of two new submergible tainter gates. The location of the position 2 is at headgate 8, which is 151 ft from the ramp up to the headgates (Fig. 3).

Another variable in the test sequence was the type of ice used. Our initial tests were conducted with 4-in. squares of 1/4-in.-thick low density polyethylene plastic ice. The scaled thickness of this ice was 0.5 ft. In addition, freshwater ice was used for a number of tests. Its scaled thickness ranged from 0.5 to 1.3 ft.

Test 1 is the open water calibration test in which

a constant pool elevation of 458.75 ft was maintained with a model flow of 900 gal./min. In this test, gate openings that corresponded to full-scale settings for low flow, winter conditions were used for both the tainter gate and the submergible gates. The full-scale gate openings were 4 ft for a single tainter gate or 6.75 ft for each of two submergible gates. As a comparison to later tests, the water velocities near the surface were obtained with two tainter gates open to a 2-ft depth each. Figure 5 shows the flow pattern that developed with this latter condition.

Test 2 was the first of three tests using the plastic ice with the tainter gates in position 1. Two tainter gates were each opened 2 ft (full scale). The plastic ice was placed in the model at mid-pool and allowed to float down to the dam. It was unable to pass under the tainter gates with the 2-ft setting. It should be noted that experience at Starved Rock Lock and Dam shows that they are unable to pass ice with a single gate opening less than 4 ft.

Test 3 was our first test with the submergible gates. Plastic ice was pooled upstream of the dam. As expected, with the increased opening required for the submergible gates and the flow being over the gate, the ice quickly passed. This run was also used to calibrate the submergible gates. The total

Table 3. Test summary.

Test	Q (gal./ min)	Gate	Position	Ice type	Total gate opening (ft)	Average ice thickness (ft)	Temp. (°F)	Date (1989)
1	900	Standard	1	None	4*	open water calibration	50	27 June
2	900	Standard	1	Plastic	4*	0.5	50	28 June
3	900	Submergible	1	Plastic	11.6*	0.5	50	29 June
4	900	Submergible	1	None	13.5*	velocity measurements	50	6 July
5	900	Submergible	1	Plastic	13.5*	0.5; boom test	50	8 July
6	900	Submergible	2	Natural	13.5*	0.6	25	3 Aug
7	900	Submergible	2	Natural	13.5*	1.3	25	4 Aug
8	900	Submergible	2	Natural	13.5*	1.2	25	7 Aug
9	900	Submergible	2	Natural	13.5*	1.2	15	8 Aug
10S	900	Submergible	2	Natural	13.5*	0.6	25	9 Aug
10T	900	Standard	1	Natural	4**	0.6	25	9 Aug
11S	900	Submergible	2	Natural	13.5*	1.3	25	10 Aug
11T	900	Standard	1	Natural	4**	1.3	25	10 Aug
12A	315	Submergible	2	Natural	6.75*	1.1	20	11 Aug
12B	315	Submergible	2	Plastic	6.75*	0.5	20	11 Aug

*Two gates

**One gate

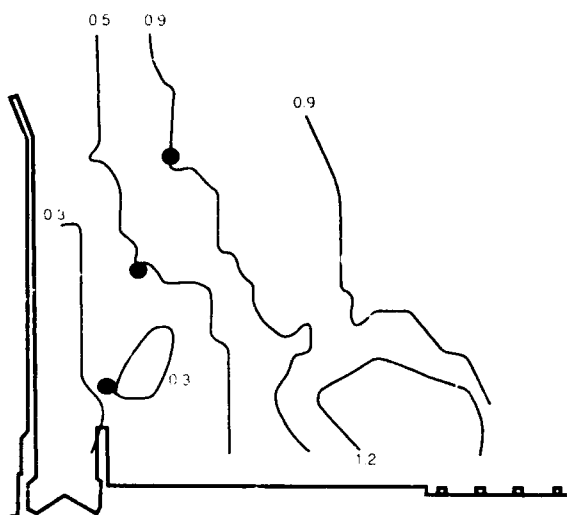


Figure 5. Velocity profile (ft/s) with two tainter gates open to a 2-ft depth (full scale).

gate setting needed to maintain the constant pool elevation was 13.5 ft full scale (6.75 ft $\times$ 2 gates).

Test 4 was used to document the flow patterns around the two submergible gates with a total gate opening of 13.5 ft. The flow pattern developed in open water around the submergible gates in position 1 is shown in Figure 6.

Test 5 analyzed how the submergible gates in position 1 passed plastic ice with ice booms placed

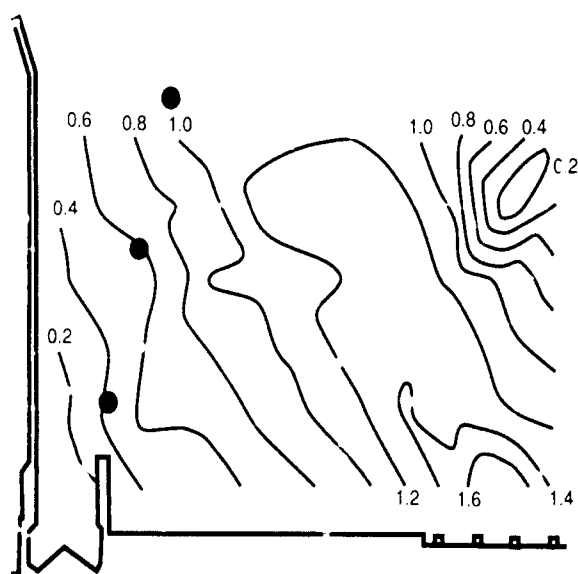


Figure 6. Velocity profile (ft/s) with two submergible gates, each with a 6.7-ft opening (full scale) in position 1.

so that they extended from the gates to the area between the second and third mooring cell, simulating the channel. The area in back of the booms was filled with irregularly shaped pieces of plastic ice. The area between the booms was filled with the 4-in. uniform squares of plastic ice. During the test, all of the model ice cleared the channel, partly because the ice booms were flexible enough to prevent the ice blocks from arching and stopping the ice flow. Had the channel remained rigid, arching might have been experienced.

Test 6 was the first with the gates in the new location, and the first using randomly shaped freshwater ice. The gate settings were established at a total opening of 13.5 ft (full scale). An ice channel was broken out that was approximately 120 ft wide (full scale) in front of the submergible gates and extended to an area between the first and second mooring cell. After the initial conditions were set, the irregularly shaped, broken ice was allowed to pass. The ice arched in the channel approximately 700 ft upstream from the gates. This arch was easily broken by the passage of a model barge in the ship track. Once the initial arch was broken, the flow in the ice channel was such that a second arch never formed. Figure 7 shows the resulting velocity profile.

Test 7 was conducted with an equivalent full-scale ice thickness of 1.3 ft. This test indicates that, with simulated barge traffic, a clear passage can be

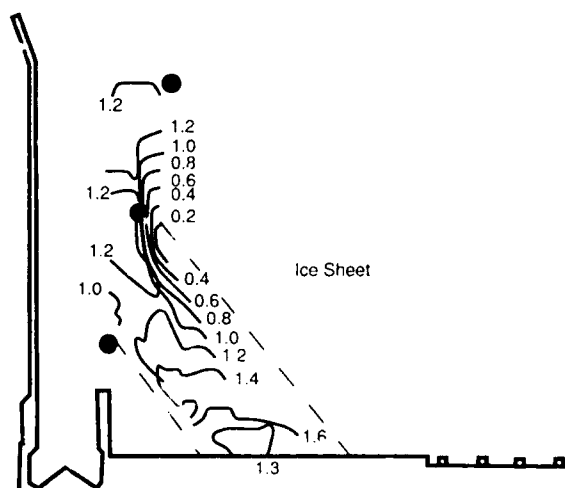


Figure 7. Velocity profile (ft/s) with two submergible gates, each with a 6.7-ft opening and a 120-ft ice channel (all full scale) at position 2.

maintained to the submergible tainters in position 2.

Test 8 was the initial test to compare how well ice passed through a channel of half the width of that used in test 6. Both submergibles were set at the standard 6.75 ft but the ice channel was only broken out to a width of approximately 60 ft (full scale). In the initial period of the test, the ice arched closer to the gates than previously noted, and arching continued even after the initial arch was broken. The ice passed freely again once the channel was widened to 120 ft.

Test 9 was conducted at a lower room temperature, which caused some difficulties. First, we noted that once the ice had been broken it would quickly knit back together. Also, we noticed that the barge had a much harder time maneuvering in the ship track. The ice was more inclined to form larger pancakes, yet would be broken into smaller floes upon impact with the dam piers and could pass over the gates easily.

Test 10 was a comparison test between the submergible tainters in position 2 and the tainter gates in position 1. After the ice test, surface velocity measurements were taken for the submergible tainter (Fig. 7) and the tainter gate in position 1 (Fig. 8).

Test 11 was conducted with Donald Bycznski, Lockmaster, and Edward Leuch, Assistant Chief, Project Operations, Rock Island District, present.

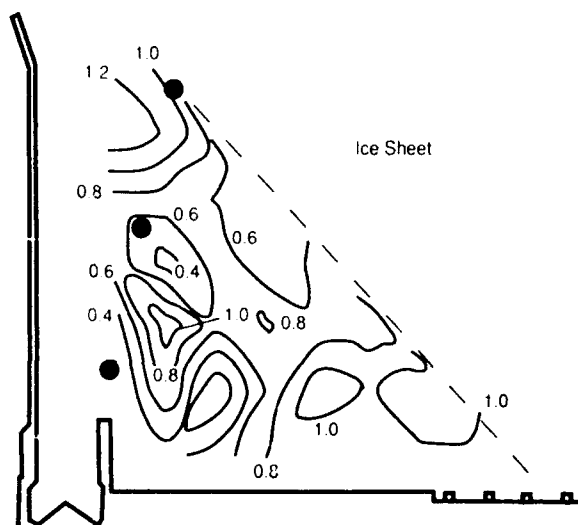


Figure 8. Velocity profile (ft/s) of a single tainter gate with a 4-ft gate opening (full scale) and an ice channel open to the third mooring cell.

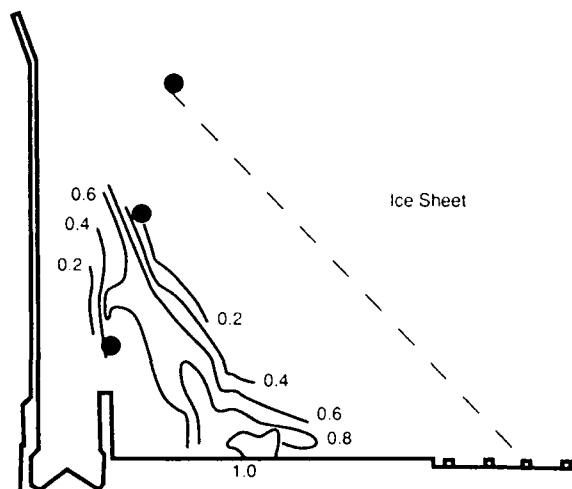


Figure 9. Velocity profile (ft/s) with two submergible gates, each with a 3.3-ft opening (full scale) at position 2.

The room temperature was 25°F, which was typical of most of the tests. A sequence identical to test series 10 was conducted. Initially, the submergible gates in position 2 were operated after the ice was broken. The barge made several trips up and down the river to simulate normal traffic. After the ice had cleared from part of the ship track, a channel was broken to the tainter gate in position 1, which was opened after the two submergible gates were closed. We noticed that flow velocities were much lower and the ice could not pass as freely as when the submergible gates were open in position 2.

Test 12 examined a reduced flow of 315 gal./min (1972 ft³/s full scale). Our primary purpose was to monitor the ice passage over a full-scale submergible gate opening of 3.4 ft per gate. Ice continued to pass over in spite of the reduced velocities (Fig. 9).

SUMMARY

Our first five tests were conducted at location 1, the existing location of the tainter gates at Starved Rock Lock and Dam. Tests 6–12 moved the submergible gates to location 2. Ice flushing improved greatly with the submergible gates at this location. Velocities more than doubled, and a 30% decrease in the broken ice surface area would result if a clear channel was maintained for ice passage. The final test reduced the two submergible gate openings to a total of 6.75 ft. The flow was reduced to 315 gal./min (1972 ft³/s full-scale). The tainter gate open-

ing for this flow would be about 1 ft. Even with this reduced flow, ice could pass over the crest of the submergible gates.

A model tow barge simulated the effect of river traffic on fragmented ice. This disruption of the ice helped heavy ice concentrations move toward the gates. We did not simulate the propeller wash effect that would go along with barge and tow boat traffic, but this additional flushing would only improve ice conveyance. We evaluated ice passage through a previously cut 60-ft channel. Because of the arching of the broken ice in this channel, this width had to be increased to 120 ft to allow efficient and continued ice passage.

CONCLUSIONS AND RECOMMENDATIONS

The model study of Starved Rock Lock and Dam has shown conclusively that submergible gates will effectively pass more ice than the exist-

ing tainter gates. Flow velocities immediately upstream of each gate type showed no appreciable difference from one gate style to another. The major advantage of the submergible gate is that it provides three times the flow depth for the same discharge and pool elevation, allowing for easier ice passage. This in turn would mean less icebreaking requirements from the shipping channel to the dam gates, more ice removal from the shipping channel lock approach area and an overall improvement in ice management for winter navigation. Gate icing problems may also be reduced with the use of submergible dam gates. Simulated barge traffic increased ice movement towards the dam gates, resulting in an ice-free channel from the shipping lane to the dam gate.

We feel that submergible gates located at the second location, which is closer to the lock chamber, will prevent ice problems in the lock approach and allow efficient and timely winter operations at Starved Rock Lock and Dam.

APPENDIX A: REFERENCE PHOTOGRAPHS

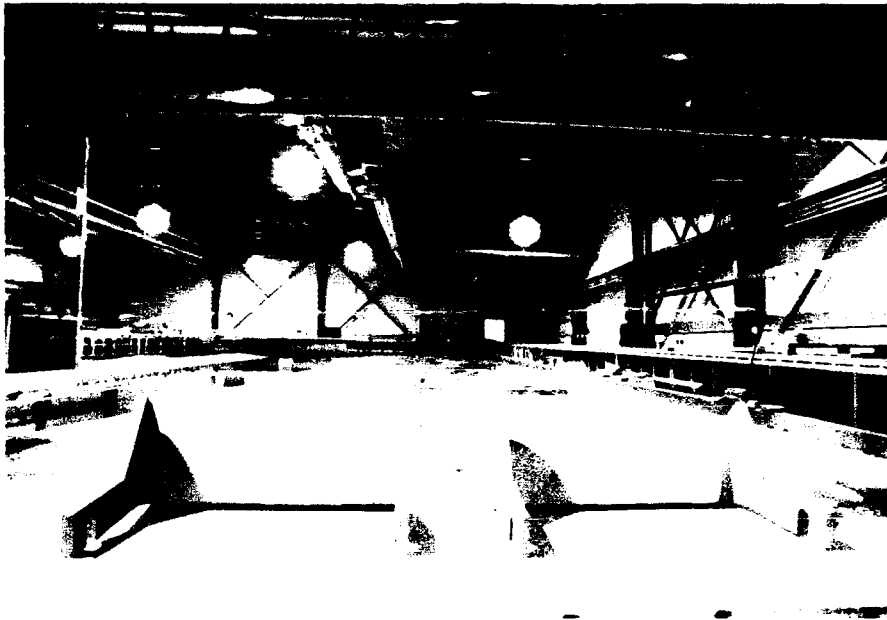


Figure A1. Submergible gates before installation.



Figure A2. Installed submergible gates, site 2, with unbroken ice cover.



Figure A3. Submergible gates at site 1, with plastic ice.

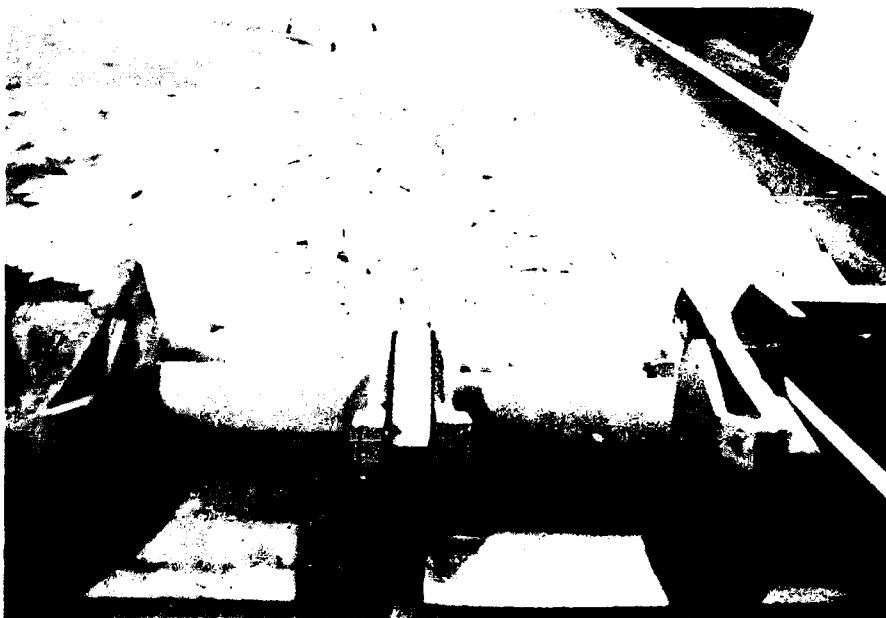


Figure A4. Submergible gates at site 1, gates submerged, plastic ice.

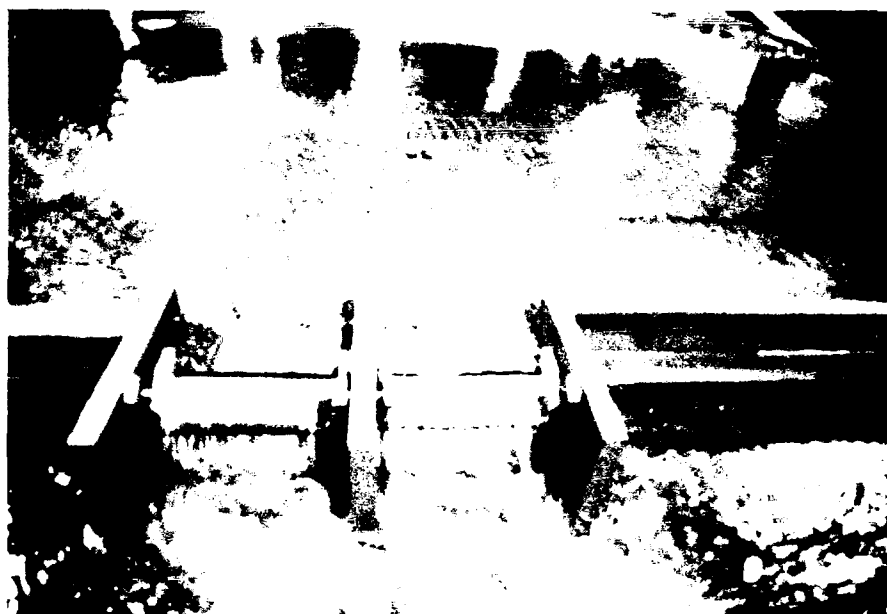


Figure A5. Open-water flow calibration, submersible gates at site 2.



Figure A6. Ice cover intact; shipping channel on left, mooring cells in center, submersible gate pier at bottom center, flow diversion with blocks between cells.



Figure A7. Ice cover broken in shipping channel and in ice clearing channel from shipping channel to dam gates, before testing.



Figure A8. Ice passage over submergible gates at site 2.

a.



b.

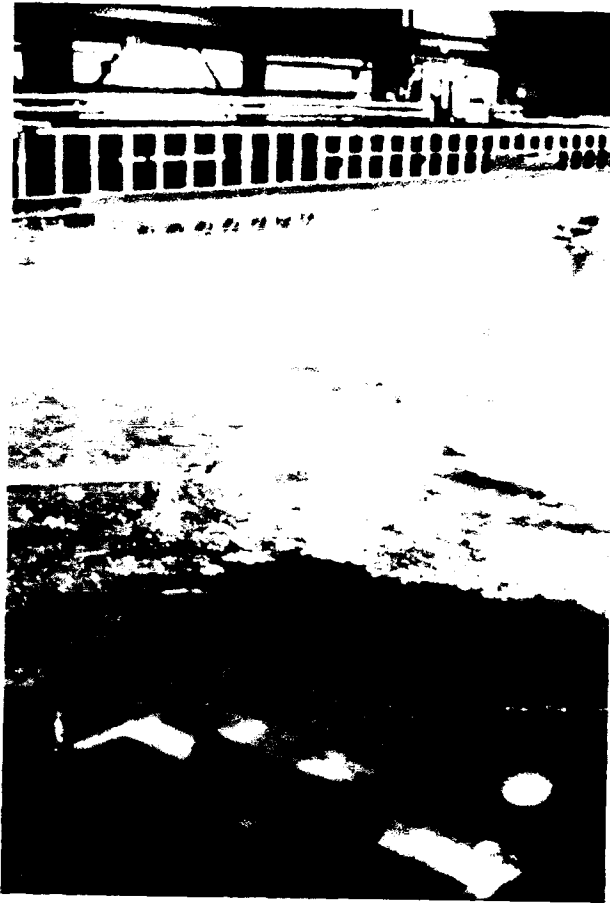


Figure A9. Arching of broken ice cover above dam gates, low-flow winter conditions.



Figure A10. Tow boat Capt. "Buz" simulating one-barge traffic.



Figure A11. Simulated two-barge traffic.



Figure A12. Simulated air bubblers in clearing channel above dam gates; ice-free conditions during ice cover buildup prior to testing.

APPENDIX B. DATA

LOCKMASTER'S DAILY REPORT															DATE		1 JAN 1989	
STARVED ROCK LOCK																		
G. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND		
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT	
12 M	438.78	443.32	3	4	0	0	0	0	0	0	0	0	7'		FG			
1 AM	438.84	43.29												FG				
2	438.89	43.29												FG				
3	438.90	43.45	4											FG				
4	438.90	43.46												FG				
5	438.94	43.57												FG				
6	438.94	43.60	5											FG				
7	438.95	43.68												FG				
8	438.95	43.73												FG				
9	438.94	43.78												FG				
10	438.93	43.80												FG				
11	438.92	43.81												FG				
12	438.90	43.83												FG				
1 PM	438.90	43.85												FG				
2	438.91	43.85												FG				
3	438.90	43.87												FG				
4	438.88	43.87	3	4	0	0	0	0	0	0	0	0	9'	FG				
5	438.87	43.88												FG				
6	438.85	43.91												FG				
7	438.84	43.92												FG				
8	438.77	43.92												FG				
9	438.82	43.82	3											FG				
10	438.82	43.65												FG				
11	438.82	43.63												FG				
24 Hour TEEN.	Start 8:15 am	End 11:15 am	MEN ON DUTY										REMARKS					
MAX. 26°			12 to 8	BUTTMLEY SWARTZ								Votage up @ 7:10 AM - 8K						
MIN. 15°			8 to 4	KOSARSKI SADNICK								V. Temp up @ 3:15 PM - 8K						
6 AM 23°			4 to 12	GALLUP GENTZ								Increased gate pointer - 8K (WT 35 ICE 1A4CX)						
	24 Hour Precip. 6 AM	0																

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 3 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.99	42.94	4'	4'	0	0	0	0	0	0	0	0	8.8	CLOSED 11:00 12:10 A	CL	SW	L
1 AM	58.97	43.21	5'										9'		CL	S	L
2	58.65	43.36													CL	S	L
3	58.65	43.43													CL	S	L
4	58.81	43.49													CL	SW	L
5	58.78	43.38	4'												MIST	S	L
6	58.78	43.44	3'												MIST	SW	L-5
7	58.73	43.69	3'												MIST	WSW	L
8	58.74	42.90	2'												CL	W	L
9	58.77	42.80													CL	NW	L
10	58.77	42.82													PC	W	M
11	58.74	42.65	1'												CL	NW	M
12	58.75	42.60													CL	NW	17-24
1 PM	58.90	42.51													CL	NW	M
2	58.88	42.67	3'												CL	NW	M
3	59.00	42.78	4'												CL	NW	M
4	59.00	42.90	4'												CL	NW	M
5	59.00	43.00													CL	NW	M
6	58.96	43.35													CL	NW	M
7	58.90	43.86													CL	NW	M
8	58.85	43.83													CL	NW	M
9	58.82	43.80													CL	NW	M
10	58.82	43.37													CL	NW	M
11	58.78	43.33	3'												CL	NW	M

24 Hour Temp.	PRECIPITATION		MEN ON DUTY				REMARKS
	Start	End					
MAX. 30°	3:15 A	7:30 A	12	8	BOTTOMLEY	SWARTZ	✓ Average - 4d @ 7:25 AM NIK ✓ Average - 4d @ 3:15 PM NIK
MIN. 15°			8	to	WITALKA	SPIRES	
6 AM 30°				4	PORTER		
	24 Hour Precip. 6 AM		4 to 12		GALLUP	C. CLANT	

Gr. Poles
 (WT 34° ICE RPT 3:15 PM) (FREEZING NIK)

GR. FATHS (FATHOMS NIK)

LOCKMASTER'S DAILY REPORT															DATE 4 JAN 1989			
STARVED ROCK LOCK																		
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CRANGES	WEATHER	WIND DIR.	WIND AMOUNT	
			1	2	3	4	5	6	7	8	9	10						
12 M	458.79	448.12	5	4	0	0	0	0	0	0	0	0	0	7		CL	NW	L
1 AM	458.80	443.07														PC	NW	L
2	458.81	43.00														PC	NW	L
3	458.77	42.97														PC	NW	L
4	458.76	42.93	3													PC	NW	L
5	458.80	42.83														PC	NW	L
6	458.83	42.74														PC	NW	L-3
7	458.85	42.73														PC	NW	L
8	458.93	42.72														PC	NW	L
9	458.89	42.69														PC	NW	L
10	458.87	42.67														PC	NW	L
11	458.84	42.66														PC	NW	L
12	458.80	42.64	5	1										6		PC	NW	L
1 PM	458.81	42.60														PC	NW	L
2	458.74	42.56														PC	NW	L
3	458.90	42.50														PC	NW	L
4	458.74	42.50	5	1	0	0	0	0	0	0	0	0	0	6		PC	NW	L
5	458.71	42.37	4											5		PC	NW	L
6	458.70	42.32														PC	NW	L-10
7	458.73	42.32	3											4		PC	NW	L
8	458.77	42.10														PC	NW	L
9	458.82	42.00														PC	NW	L
10	458.90	41.98														PC	NW	L
11	458.97	42.08	4											6		PC	NW	L
24 Hour Temp. MAX. 33°	PRECIPITATION		MEN ON DUTY										REMARKS					
MIN. 12°	Start	End	12 to 8		KOSARSKI		PORTER											
			8 to 4		WITALKA		SPIRES											
6 AM 13°	24 Hour Precip. 6 AM	T	12 to 12		CALLUP		GELANT						WT-24° ICE RPT Ø					

DATE 5 JAN 1985

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE ORANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
1 AM	459.00	442.24	5	1	0	0	0	0	0	0	0	0	6.6	OPENED #2-1 @ 12:30 A	PC	SW	L
2	458.98	442.46		2									7.7	OPENED #2-1 @ 1:35 A	PC	SW	L
3	458.96	442.75		3									8.8		PC	SW	L
4	458.91	442.87													PC	SW	L
5	458.87	442.94											24	Closed #2-1 @ 4:30	FA	SW	L
6	458.80	442.83		2									7		FA	SW	L
7	458.80	442.81													PC	W	L-3
8	458.79	442.78													PC	W	L
9	458.70	442.65		1									6.6	2103A #2-1 @ 8:34	PC	SW	L
10	458.82	442.35	3										4.1	Closed #2-1 @ 9:10	PC	SW	L
11	458.88	442.18											5.1	OPENED #2-1 @ 11:45	PC	SW	L
12	458.93	442.14	4												PC	SW	L-7
1 PM	458.97	442.17											10	OPENED #2-1 @ 1:58	PC	SE	L
2	458.97	442.12	5										6.1		PC	SE	L
3	458.92	442.01													PC	SE	L
4	458.93	442.30	5	1	0	0	0	0	0	0	0	0	6.1		PC	SE	L
5	458.90	442.84													PC	SE	L
6	458.89	442.37													PC	SE	L
7	458.87	442.25													PC	SE	L
8	458.84	442.30													PC	SE	L
9	458.81	442.34													PC	SE	L
10	458.86	442.37											5.4		PC	SE	L
11	458.90	442.26	2										7.7	OPENED #2-1 @ 11:55 P	PC	SE	L
24 Hour TEMP. MAX.	Start 1340	End	MEN ON DUTY										NOG-6.2	REMARKS			
MIN.	30°		12										8	KOSARSKI	SADNICK		
	9°		8										to	SPINER	Perc		
6 AM	29°		to										4	1.070.12	Futer		
		24 Hour Precip. 6 AM	to										to	GALLUP	CELANA		
			12												WT-34° ICE RPT IF 1/2 L.5		

V Storage 44 @ 11:00 AM - JH
V Storage 44 @ 3:15 PM @

LOOKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 6 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.95	442.35	5	2	0	0	0	0	0	0	0	0	7	opened #2-1' @ 11:05	LT. FOG		CLM
1 AM	58.96	42.42											8		LT. FOG		CLM
2	58.94	42.61		3											FG		CLM
3	58.99	42.70													FG		CLM
4	58.99	42.79													FG		CLM
5	58.98	42.85													FG		CLM
6	58.95	42.90													FG		CLM
7	58.89	42.95													LT. FOG	NE	CLM
8	58.91	42.96													LT. FOG	N	L
9	58.85	42.97													FG	N	L
10	58.80	42.98													FG	N	L
11	58.76	42.80		2									7	closed #1-1' @ 11:53	LT. FOG	N	L
12	58.80	42.89	4										6		LT. FOG	NE	L
1 PM	58.79	42.57													LT. FOG	NE	L
2	58.79	42.53													LT. FOG	NE	L
3	438.86	448.57													LT. FOG	NE	L
4	438.50	442.12											30	opened #1-1' @ 5:30 P	LT. FOG	NE	L
5	438.93	442.54		3									7		LT. FOG	E	L
6	58.95	42.60													CL	E	L
7	58.96	42.63													CL	E	L
8	58.96	42.75		4									8	opened #1-1' @ 8:50 P	MIST	E	L
9	58.96	42.88													MIST	E	L
10	58.96	42.88													MIST	E	L
11	58.93	42.89											24		MIST	E	L
24 Hour Temp.	Start 11:00 A End 11:30 P		MEN ON DUTY										AKG 7:00	REMARKS			
MAX. 37°	8:45 P		12 to 8	KOSIERSKI		SADNICK		NOTING 11:00 AM - 9K									
MIN. 27°			8 to 4	SPIRES		RE-IC											
6 AM 34°			4 to 12	BUTTERLEY		SWARTZ		WT-34° ICE RPT Q									

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 7 JAN 1989

C. S.	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. CFT.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	43.95	44.96	4'	4'	0	0	0	0	0	0	0	0	8'		FG		CLM
1 AM	43.97	44.98													FG		CLM
2	43.99	43.02												32	OPENED #2-1' @ 3:50 P	FG/DRIZZLE	E
3	43.94	43.00											9'		LT. FG	E	L
4	43.94	43.08													CL	E	L
5	43.93	43.12													CL	E	L
6	43.90	43.15													FG	E	L
7	43.88	43.28													FG	SE	L
8	43.83	43.30													FG	SE	L
9	43.81	43.27											54	CLOSED #2-2' @ 9:30	MIST/LT. FG	SE	L
10	43.84	43.11											7'		MIST/LT. FG	SE	L
11	43.85	42.95													MIST/LT. FG	SE	L
12	43.88	42.95													MIST/LT. FG	SE	L
1 PM	43.97	42.95											28	OPEN #2-1' @ 1:20	LT. FG	S	L
2	43.95	43.08											8	OPEN #1-1' @ 2:55	FG	S	L
3	43.75	43.07	5'										9'		FG	S	L
4	43.80	43.28													FG	SW	L
5	43.95	43.36											27	CLOSED #1-1' @ 1:58 AM	RN/FG	W	L
6	43.66	43.49	4'										8'		PC	W	M
7	43.69	43.44													PC	W	M
8	43.70	43.46													CL	W	M
9	43.73	43.47													CL	W	M
10	43.74	43.63													CL	W	M
11	43.72	43.65											48		CL	W	M
24 Hour Temp.	Start	End	MEN ON DUTY										406 = B. Z	REV. RKS			
MAX. 36°	2:15 A	2:35 A	12	KOSARSKI								8	SADNICK	V strong - ice @ 11:05 AM. JMK V strong - ice @ 7:20 AM MJK			
MIN. 33°	4:40 P	5:15 P	8	WITALKA								8	PETRE				
6 AM 35°			to									to		WT - 34° ICE RPT @ 2 PM			
			4									12					
	24 Hour Precip. 6 AM	.02"	to	BOTTOMLEY								to	SWARTZ				
			12														

THUNDER

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 8 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	45.8.76	44.3.64	4'	4'	0	0	0	0	0	0	0	0	8'		CL	W	M
1 AM	58.8.8	43.6.6													LT SN	W	M
2	58.8.7	43.6.9		6'									10'	OPENED #2-2' @ 2:50 A	LT SN	W	M
3	58.8.5	43.7.9													CL	W	M
4	58.8.2	44.0.0	6'										12'	OPENED #1-2' @ 4:20 A	CL	W	M
5	58.8.6	44.2.8													LT SN	W	M
6	58.8.6	44.4.3													LT SN	W	M
7	58.8.8	44.5.6													LT SN	W	M
8	58.8.0	44.5.1													LT SN	W	M
9	58.8.7	44.7.5													LT SN	W	M
10	58.8.8	44.8.7													LT SN	W	M
11	58.9.5	44.9.8													LT SN	W	M
12	58.9.5	44.9.2													LT SN	W	M
1 PM	58.9.9	45.0.5	7'										13'	OPENED #1-1' @ 1:10	LT SN	W	M
2	58.9.6	45.1.3													LT SN	W	M
3	59.0.0	45.2.8	7'										14'	OPENED #2-1' @ 1:45 PM	LT SN	W	M
4	59.0.0	45.2.8													LT SN	W	M
5	58.9.3	45.4.8	9'										16'		LT SN	W	M
6	58.9.1	45.5.5													LT SN	W	M
7	58.9.0	45.5.7													LT SN	W	M
8	58.8.2	45.6.2													LT SN	W	M
9	58.7.9	45.6.2													LT SN	W	M
10	58.8.6	45.6.1	8'										80	CLOSED #2 1' @ 2:15	LT SN	W	M
11	58.9.8	45.6.1											15'15"		LT SN	W	M
12	58.9.8	45.6.1											17'17"	OPENED #1-2' @ 11:50 P	LT SN	W	M
24 Hour Temp.	Start 12:54	End 2:30 A	MEN ON DUTY										NOG = 12.6	REMARKS			
MAX. 51°	Start 5:20 A	End 7:00 A	12	8	8	8	8	8	8	8	8	8	8	KOSARSKI	SADNICK	Vatanga 4d @ 11:05 AM - BK	
MIN. 3°	Start 10:45	End 11:15	8	8	8	8	8	8	8	8	8	8	8	WITALKA	PETRE	Vatanga 4d @ 7:20 AM - MU	
6 AM 13°	Start 24 Hour	End 6 AM	12	12	12	12	12	12	12	12	12	12	12	BOTTOMLEY	SWARTZ	WT-34° ICE RPT @	

DATE: 9 JAN 1985

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GAGES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.91	445.27	97	8'											FA	W	L
1 AM	58.79	45.81													FA	W	L
2	58.75	46.00	71	7'											FA	W	L
3	58.79	45.80													FA	W	L
4	58.81	45.65													FA	W	L
5	58.82	45.59													FA	W	L
6	58.80	45.58													FA	W	L
7	58.77	45.57													FA	W	L
8	58.81	45.52													FA	W	L
9	58.84	45.47													FA	W	L
10	58.85	45.45													FA	W	L
11	58.82	45.43													FA	W	L
12	58.80	45.42													FA	W	L
1 PM	58.76	45.39													FA	W	L
2	58.71	45.37													FA	W	L
3	58.73	45.37													FA	W	L
4	58.70	45.35													FA	W	L
5	58.69	45.35													FA	W	L
6	58.74	45.31													FA	W	L
7	58.77	45.31													FA	W	L
8	58.83	45.08													FA	W	L
9															FA	W	L
10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
4															FA	W	L
5															FA	W	L
6															FA	W	L
7															FA	W	L
8															FA	W	L
9															FA	W	L
10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
4															FA	W	L
5															FA	W	L
6															FA	W	L
7															FA	W	L
8															FA	W	L
9															FA	W	L
10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
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1 PM															FA	W	L
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1 PM															FA	W	L
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12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
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10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
4															FA	W	L
5															FA	W	L
6															FA	W	L
7															FA	W	L
8															FA	W	L
9															FA	W	L
10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
4															FA	W	L
5															FA	W	L
6															FA	W	L
7															FA	W	L
8															FA	W	L
9															FA	W	L
10															FA	W	L
11															FA	W	L
12															FA	W	L
1 PM															FA	W	L
2															FA	W	L
3															FA	W	L
4															FA	W	L
5															FA	W	L
6															FA	W	L
7															FA	W	L
8															FA	W	L
9															FA	W	L
10															FA	W	L
11					</												

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 10 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CRANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.86	445.23	7'	6'	0	0	0	0	0	0	0	0	13'		CL	S	M
1 AM	458.84	445.24													CL	S	M
2	458.80	445.35													CL	S	M
3	458.91	445.39													CL	S	M
4	458.84	445.45													CL	S	M
5	458.83	445.52													CL	S	M
6	458.76	445.60	6'	6'	0	0	0	0	0	0	0	0	14'	OPENED #2-1' @ 8:45	CL	S	M
7	458.25	445.44													CL	S	M
8	458.78	445.40	6'	6'	0	0	0	0	0	0	0	0	12'	CLOSED #1 + #2-1' @ 6:20 A	CL	S	M
9	458.80	445.24	5'	5'	0	0	0	0	0	0	0	0	11'	CLOSED #2-1' @ 8:43 AM	CL	S	M
10	458.83	445.19													CL	S	M
11	458.85	445.14													CL	S	M
12	458.80	445.18													CL	S	M
1 PM	458.84	445.49													CL	S	M
2	458.89	445.14													CL	S	M
3	458.84	445.24	6'	6'	0	0	0	0	0	0	0	0	12'	OPENED #2-1' @ 2:50 PM	CL	S	M
4	458.78	445.25													CL	S	M
5	458.70	445.20													CL	S	M
6	458.71	445.17	5'	5'	0	0	0	0	0	0	0	0	11'	CLOSED #1-1' @ 1:30 PM	CL	S	M
7	458.76	445.14													CL	S	M
8	458.80	445.13													CL	S	M
9	458.85	445.08													CL	S	M
10	458.84	445.03													CL	S	M
11	458.93	445.04													CL	S	M

24 Hour Temp. MAX.	PRECIPITATION		MEN ON DUTY										REMARKS
	Start	End	Ant.	12	10	8	6	4	2	12	10	8	
32°													V Strong up @ 11:05 PM - PK
MIN.													Strong up @ 7:10 AM
9°													
6 AM													
31°													
	24 Hour Precip. 6 AM	0		12	10	8	6	4	2	12	10	8	WT. = 4° ICE RPT 0
													8:10

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 11 JAN 1989

27

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.49	445.03	5	6	0	0	0	0	0	0	0	0	11	OPENED #1-2 @ 12:35AM	PC	NE	L
1 AM	459.01	451.10	7										13	OPENED #2-1 @ 1:45AM	PC	E	L
2	458.99	451.18	7										14	OPENED #1-1 @ 2:50AM	PC	E	L
3	458.98	451.47	8										15		FA	E	L
4	458.96	451.58													PC	E	L
5	458.98	451.66													PC	E	L
6	458.85	451.68													PC	E	L-8
7	458.85	451.58	6										13	CLOSED #1-2 @ 6:20	FA	E	M
8	458.84	451.50	6										13		FA	E	1-10
9	458.81	451.46	7										13	CLOSED #2-1 @ 9:23	FA	E	M
10	458.83	451.35	6										12		FA	E	M
11	458.85	451.35													FA	E	M
12	458.83	451.32													PC	E	17-15
1 PM	458.83	451.31													CL	E	M
2	458.79	451.28													CL	E	M
3	458.72	451.20	5										11	CLOSED #2-1 @ 2:39	CL	E	M
4	458.75	451.14													CL	E	M
5	458.71	451.10													CL	E	M
6	458.71	451.12													MIST	E	M
7	458.70	449.98	5										10	CLOSED #1-1 @ 10:40 AM	FA	E	M-20
8	458.69	449.93													CL	E	M
9	458.69	449.90													CL	E	M
10	458.66	449.94													MIST	SW	M
11	458.69	449.85											50		CL	SW	L
24 Hour Temp.	Start 40SP	End 9:5AM	MIN ON DUTY AUG. 12.11											REMARKS			
MAX. 41°			12 to 8	WUTALKA	PETRE									✓ strong ~ yd 6 11:20 PM till			
MIN. 26°			8 to 4	GALLUP	SPICES									Vib to 4 PM @ 10 AM. CES.			
6 AM 29°			4 to 12	ROSTER	GEANT									W-34° Ice Apt-D			
	24 Hour Precip. 6 AM	0"	12 to 12	BOTTOMLEY	SWARTZ												

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 12 JAN 19 89

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	DIR.	WIND									
			1	2	3	4	5	6	7	8	9	10														
12 M	458.72	444.82	5	5	0	0	0	0	0	0	0	0	10		CL	W	L									
1 AM	58.70	44.78													LTFS	W	L									
2	58.65	44.85												30	CLOSED 11:2-11:40 2:30 AM	LTFS	W	L								
3	58.68	44.70	4	4									8		LTFS	NW	N									
4	58.74	44.65													C2	NW	N									
5	58.75	44.52													PC	NW	N									
6	58.91	44.42													PC	NW	N									
7	58.98	44.43	5	5										12:10	OPENED 11:11 (01 7:10)	PC	NW	N								
8	58.97	44.46	6	5	0	0	0	0	0	0	0	0	11		PC	W	M									
9	58.99	44.86											27	OPENED 11:10 9:30 AM	PC	W	M									
10	58.92	45.14											12		PC	W	M									
11	58.89	45.12													PC	W	M									
12	58.87	45.17													PC	NW	N-13									
1 PM	58.84	45.24													PC	NW	M									
2	58.80	45.29													PC	NW	M									
3	58.76	45.17	5										11		PC	NW	M									
4	58.76	45.10													PC	NW	M									
5	58.76	45.05													PC	NW	M									
6	58.76	45.00													PC	NW	M									
7	58.73	44.95													PC	NW	L									
8	58.73	44.94													PC	NW	L									
9	58.73	44.80													PC	NW	L									
10	58.72	44.75													PC	NW	L									
11	58.73	44.78											40		PC	NW	L									
24 Hour Temp.			PRECIPITATION										MEN ON DUTY					REMARKS								
MAX.	42°	Start	0155 AM	End	0210 AM	A.S.		MEN ON DUTY					MEN ON DUTY		REMARKS											
		12	8	8	8	8	8	WITAKA	PETRE																	
MIN.	29°	8	8	8	8	8	8	GALLUP	SPICES	Vaterag-yd @ 11:20 PM 11:14																
		to	to	to	to	to	to	PORTER	GEHANT	Vaterag-yd @ 7:05 AM																
6 AM	29°	4	4	4	4	4	4																			
		to	to	to	to	to	to	BOTTOMLEY	SWARTZ																	
		24 Hour Precip.	6 AM	0.01"															NITE 34°		100°F-0					

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 13 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.64	444.72	5	5	0	0	0	0	0	0	0	0	10		FA	W	L
1 AM	58.71	44.68													FA	W	L
2	58.66	44.68												40 CLOSED 2-10 3:30AM	FA	W	L
3	58.68	44.67													FA	W	L
4	58.71	44.53		4									9		FA	W	L
5	58.72	44.49													FA	W	L
6	58.71	44.44													FA	W	L-5
7	58.72	44.40													FA	W	L
8	58.73	44.39	5	4	0	0	0	0	0	0	0	0	9		FA	NW	L
9	58.72	44.35													FA	NW	L
10	58.78	44.36													FA	W	L
11	58.85	44.36													FA	W	L
12	58.87	44.36													FA	W	L
1 PM	58.87	44.40													FA	W	L
2	58.84	44.34													FA	W	L
3	58.83	44.35													FA	W	L
4	58.85	44.32													FA	W	L
5	58.87	44.31													FA	W	L
6	58.91	44.32													FA	W	L-3
7	58.94	44.29													FA	W	L
8	58.90	44.27													FA	W	L
9	58.88	44.27													FA	W	L
10	58.87	44.25													FA	W	L
11	58.82	44.22											180		FA	W	L

24 Hour Temp.		PRECIPITATION		MEN ON DUTY		REMARKS	
MAX.	MIN.	Start	End	AMT.			
31°					WITALKA	PETRE	Vatnag 40' @ 11:25 pm AM.
					CALLUA	SPIRES	Vatnag 40' @ 7:15 am AM.
					PORTER	GEHANT	Vatnag 40' @ 3:00 am AM.
21°							
6 AM							
21°							
		24 Hour Precip. 6 AM	5"		KOSARSKI	SADNICK	W.T. 30° 1:45 PM

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 14 JAN 1985

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.77	44.27	5	4	0	0	0	0	0	0	0	0	9'		FA	S	M
1 AM	58.73	44.25													FA	S	M
2	58.70	44.04													FA	SE	L
3	58.68	44.16													FA	SE	L
4	58.74	44.04	4										8'		FA	SE	L
5	58.77	43.99													FA	SE	L
6	58.83	43.94													FA	SE	L
7	58.84	43.86													FA	SE	L
8	58.89	43.81	4	4	0	0	0	0	0	0	0	0	8'		PC	SE	L
9	58.95	43.83													PC	SE	L
10	58.94	43.89	5										9'		PC	SE	L
11	58.94	43.94													SN	SE	L
12 PM	58.90	43.99													SN	SE	L
1	58.87	44.01													SN	SE	L
2	58.85	44.05													SN	SE	L
3	58.83	44.03													SN	SE	L
4	58.76	44.00	4												PC	SE	L
5	58.78	43.91											8'		CL	S	L
6	58.74	43.86													CL	S	L
7	58.77	43.83													CL	S	L
8	58.75	43.79	3												CL	S	L
9	58.80	43.68											7'		PC	SW	L
10	58.81	43.53													PC	SW	L
11	58.81	43.47											21		FA	SW	L

24 Hour Temp.	PRECIPITATION		MIN ON DUTY				REMARKS
	Start	End	Ant.	12 to 8	8 to 4	4 to 12	
MAX. 35°	9:05 AM	2:45 PM		WITALKA	PETRE		Storage yd @ 11:20 AM MW
MIN. 19°							Storage yd @ 7:15 AM @
							Storage yd @ 3:00 AM - JK
6 AM 25	24 Hour Precip. 6 AM	0"		KOSARSKI	SADNICK		WT-34 Ice Pt-O

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 15 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.79	448.44	3	4'	0	0	0	0	0	0	0	0	7'		PC	SW	L
1 AM	58.87	43.47													PC	SW	L
2	58.83	43.43													FA	SW	L
3	58.84	43.42													FA	SW	L
4	58.87	43.39													FA	SW	L
5	58.88	43.38													FA	SW	L
6	58.91	43.40													FA	SW	L
7	58.91	43.44												OPENED #1-11 @ 6:20	FA	W	L-6
8	458.92	443.46	4'	4'	0	0	0	0	0	0	0	0	8'		FA	W	L
9	58.90	43.50													CL	W	L
10	58.83	43.49													CL	W	L
11	58.85	43.52													CL	W	L
12	58.77	43.40													CL	W	L
1 PM	58.81	43.45	3'										7'	Closed #2-1 @ 12:35	CL	W	L-6
2	58.80	43.38													CL	W	L
3	58.84	43.35													CL	W	L
4	58.86	43.26													CL	W	L
5	58.89	43.24													CL	W	L
6	58.92	43.19													CL	W	L
7	58.96	43.16	4'											OPENED #2-1 @ 7:05 P	CL	W	L
8	58.92	43.27											8'		CL	W	L
9	58.88	43.32													CL	W	L
10	58.84	43.33													CL	W	L
11	58.83	43.33											32		PC	W	L
24 Hour Temp.	PRECIPITATION		Start	End	Ant.	MEN ON DUTY							416 = 7.3	REMARKS			
MAX. 33°						12 to 8	WITALKA							Storage yd @ 11:20 PM P.C.			
MIN. 25°						8 to 4	GALLUP							Storage yd @ 7:20 AM @			
6 AM 28°														Storage yd @ 5:00 PM - X			
	24 Hour Precip. 6 AM 1.02"					4 to 12	KOSARSKI							U.T. - 34° Ice F.L. - C			

DATE 16 JAN 1989

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	45.78	42.40	4	4	0	0	0	0	0	0	0	0	8		FA	W	L
1 A	58.78	45.33													FA	SW	L
2	58.70	43.34												24 CLOSED 12-10 2:30 AM	FA	SW	L
3	58.73	43.22											7		FE	SW	L
4	58.72	43.16	3												FA	SW	L
5	58.73	43.09													FA	SW	L
6	58.72	43.07													FA	SW	L
7	58.76	43.04													FA	SW	L
8	458.79	443.00													FA	SW	L
9	58.84	43.09													FA	SW	L
10	58.86	43.08													FA	SW	L
11	58.97	43.06												63 OPEN 10:00 A - 11:50 AM	PC	SW	L
12	58.97	43.06	4										8		PC	S	L-S
1 PM	58.91	43.14													PC	S	L
2	58.89	43.15													PC	S	M
3	58.85	43.21													PC	S	M
4	58.83	43.26													PC	S	M
5	58.75	43.28	3	3											PC	S	M
6	58.70	43.22											6	40 CLOSED #1 + #2 - 10:05:55 P	PC	S	M-16
7	58.73	43.28													PC	SW	M
8	58.73	43.21													PC	SW	M
9	58.80	43.26													PC	SW	M
10	58.82	43.21													PC	SW	M
11	58.78	43.20											30		PC	SW	M

REMARKS

Waterage up to 11:00 PM. M.W.
V Storage up to 8:05 PM. BK

406 = 7.1

MEN ON DUTY

PRECIPITATION

Start End

24 Hour Temp.

MAX. 33	WITALVA	PETRE
MIN. 20	GRANT	SWARTZ
6 AM 20	KOSARSKI	SWADNICK
24 Hour Precip. 6 AM	0'	to 12
		to 4
		to 8
		to 12

U.T. -34 Ice RPT-C

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 17 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.76	442.73	3	3	0	0	0	0	0	0	0	0	6'		FA	SW	M
1	58.76	42.71													FA	SW	M
2	58.78	42.68													FA	SW	M
3	58.81	42.65													FA	SW	M
4	58.82	42.63													FA	SW	M
5	58.86	42.62													FA	SW	M
6	58.90	42.64	4										7'	OPENED #1-1' @ 5:04 AM	FA	SW	L-10
7	58.90	42.70													FA	SW	L
8	58.94	42.74											8'	OPENED #2-1' @ 8:30 AM	FA	SW	L
9	58.96	42.85	4												PC	SW	L
10	58.96	42.94													PC	SW	L
11	58.98	43.00											9'	OPENED #1-1' @ 1:00 PM	PC	SW	L-4
12	58.93	43.14	5												PC	SW	L
1 PM	58.94	43.25													PC	SW	L
2	58.98	43.27											7'	CLOSED #1-1' @ 2:40 PM	PC	SW	L
3	58.90	43.04	3												PC	SW	L
4	58.77	42.95													PC	SW	L
5	58.75	42.87													PC	SW	L
6	58.71	42.80	3												CL	SW	L-8
7	58.71	42.59											6'	CLOSED #2-1' @ 6:05 PM	CL	SW	L
8	58.73	42.57													CL	SW	L
9	58.73	42.45													CL	SW	L
10	58.73	42.40													CL	SW	L
11	58.72	42.41											30		CL	SW	L

24 Hour TEEN. MAX. 45° MIN. 18° 6 AM 36°

PRECIPITATION Start End AMT.

24 Hour Precip. 6 AM

KEY ON DUTY: WITALKA, PETRE, BOTTOMLEY, SWARTZ, GRANT, KOSAREK, SADNICK

REMARKS: Storage yd @ 11:25 PM. MW
Storage yd @ 3:05 PM. MK
WT-24' Ice HFT-6 SP

LOCKMASTER'S DAILY REPORT STARTED BACK LOCK

DATE 18 JAN 1961

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	DIR.	WIND	
			1	2	3	4	5	6	7	8	9	10						
12 M	458.72	444.34	3'	3'	0	0	0	0	0	0	0	0	6'		CL	SW	L	
1 AM	58.78	42.37													PC	SW	L	
2	58.81	42.37													PC	SW	L	
3	58.84	42.37													PC	SW	M	
4	58.86	42.36													PC	SW	L	
5	58.90	42.35													PC	W	L	
6	58.87	42.43	4'												PC	W	L-6	
7	58.84	42.52													FA	W	L	
8	58.84	42.53													FA	W	L	
9	58.77	42.60													FA	W	M	
10	58.75	42.54	3'												FA	W	M	
11	58.80	42.51													FA	W	M	
12	58.83	42.56													FA	W	M-15	
1 PM	58.80	42.57													FA	W	M	
2	58.80	42.57													PC	W	M	
3	58.80	42.47													CL	W	M	
4	58.76	42.41													CL	W	M	
5	58.80	42.39													CL	W	M	
6	58.79	42.33													PC	W	L-5	
7	58.87	42.29													PC	W	L	
8	58.88	42.27													PC	W	L	
9	58.89	42.24													FA	W	L	
10	58.92	42.20													FA	W	L	
11	58.94	42.19	4'												PC	W	L	
24 Hour Temp.	PRECIPITATION			MEN ON DUTY										REMARKS				
MAX.	Start	End	Ant.	12	1	2	3	4	5	6	7	8	9	10	V. Long 11:10 PM 1. Long 11:00 PM - 11:00 PM (17 35) (11:00 PM) 6P			
	MEN ON DUTY																	
MIN.				12	1	2	3	4	5	6	7	8	9	10				
6 AM																		

LOCKMASTER'S DAILY REPORT															STARVED FOCK LOCK										DATE 19 JAN 1959		
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND											
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT										
12 M	58.87	42.35												7		PC	NW	L									
1 PM	58.89	42.39													CLOSED #1-1' @ 11:05A	PC	NW	L									
2	58.80	42.43												6'		PC	NW	L									
3	58.78	42.30														PC	NW	L									
4	58.80	42.25														PC	NW	L									
5	58.79	42.26														PC	NW	L									
6	58.78	42.24														PC	NW	L									
7	58.77	42.20														PC	NW	L									
8	58.88	42.02														PC	NW	L									
9	58.94	41.96														PC	NW	L									
10	58.98	41.99														PC	NW	L									
11	58.98	42.06														PC	NW	L									
12	58.97	42.32												6'	CLOSED #1-1' @ 11:00 AM	PC	NW	L									
1 PM	58.95	42.54												7'	CLOSED #1-1' @ 11:35 AM	PC	NW	L									
2	58.93	42.58														PC	NW	L									
3	58.93	42.65														PC	NW	L									
4	58.92	42.73														PC	NW	L									
5	58.89	42.71														PC	NW	L									
6	58.79	42.79														PC	NW	L									
7	58.76	42.79														PC	NW	L									
8	58.72	42.82														PC	NW	L									
9	58.72	42.73														PC	NW	L									
10	58.73	42.60														PC	NW	L									
11	58.74	42.47														PC	NW	L									
24 Hour Temp. MAX.	46		MEN ON DUTY										HOB = 6.2		REMARKS												
MIN.	24		GALLUP										DORFEE		✓ Temp. 1st 11:00 AM												
	24		BOTTINLEY										SWARTZ														
	6 AM		SPIRES										GEHANT														
27		24 Hour Precip. 6 AM										0		(W.T. 24) 'ICE (1st C)													

LOCKMASTER'S DAILY REPORT															DATE		19 89	
STANDARD LOCK LOCK																		
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND		
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT	
12 M	58.80	42.29	2	3	0	0	0	0	0	0	0	0	0			PC	NW	M-16
1 PM	58.87	42.25														CL	NW	M
2	58.90	42.25														CL	NW	M
3	58.97	42.20														CL	NW	M
4	58.98	42.23	3													CL	NW	M
5	58.96	42.37		4												CL	NW	M
6	58.97	42.52														CL	NW	M-16
7	58.94	42.55														CL	NW	M
8	58.95	42.53														CL	NW	L
9	58.81	42.56														CL	NW	L
10	58.82	42.33		2												PC	N	L
11	58.82	42.21														PC	N	L
12	58.86	42.14														PC	NW	L-8
1 PM	58.87	42.10														PC	NW	L
2	58.90	42.06														PC	NW	L
3	58.96	42.04														PC	N	L
4	58.96	42.15		3												PC	N	L
5	58.97	42.20		4												PC	N	L
6	58.97	42.36														FA	N	L
7	58.98	42.41														FA	N	CLM
8	58.98	42.00														FA	N	CLM
9	58.96	42.07														FA	N	CLM
10	58.94	42.54														FA	N	CLM
11	58.92	42.56														FA	N	CLM
24 Hour TEMP. MAX.	51		MEN ON DUTY										106 = 6.0	REMARKS				
MIN.	27		12 to 1	1 to 8	GAILUR								REMARKS					
	33		8	to 4	BOTTOMLEY								SWANTZ					
	6 AM				S. R. RES								G. HANT					
24 Hour PRECIP. 6 AM		0	12 to 12	J. TALKA								P. TRE						

V. L. Temp. 41.0 11.15 AM 42
 V. L. Temp. 41.0 2.00 PM 42
 V. L. Temp. 41.0 3.00 PM 42

LOCKMASTER'S DAILY REPORT STAINED ROCK LOCK DATE 21 JAN. 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CRANGES	WEATHER	DIE.	WIND
			1	2	3	4	5	6	7	8	9	10					
12 M	58.87	42.53	3	4	0	0	0	0	0	0	0	0	7		FA		CLM
1 AM	58.88	42.53													FA		CLM
2	58.89	42.54													FA		CLM
3	58.90	42.53													FA		CLM
4	58.83	42.54													FA		CLM
5	58.20	42.53													FA		CLM
6	58.68	42.34													FA		CLM
7	58.70	41.96	1												FA		CLM
8	58.73	41.78													FA		CLM
9	58.81	41.67													FA		CLM
10	58.86	41.58													FA		CLM
11	58.53	41.62	2												FA		CLM
12	58.52	41.78													FA		CLM
1 PM	58.55	41.78													FA		CLM
2	58.97	41.79	3												FA		CLM
3	58.96	42.02													FA		CLM
4	58.99	42.33													FA		CLM
5	58.94	42.48													FA		CLM
6	58.96	42.61													FA		CLM
7	58.89	42.64													FA		CLM
8	58.87	42.70													FA		CLM
9	58.55	42.75													FA		CLM
10	58.82	42.80													FA		CLM
11	58.79	42.75	5												FA		CLM

REMARKS

Storage up to 11:20 AM @
Storage up to 3:15 PM @

AVG = 5.7

MEN ON DUTY

12

8

to

4

24 Hour Precip. 6 AM

0

WITALKA

PETRE

22

6 AM

35

MIN.

17

37

LOCKHART'S DAILY REPORT STARVED ROCK LOCK

DATE 22 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.82	42.71	3'	3'	0	0	0	0	0	0	0	0	6'		FA	SW	M-14
1 AM	58.79	42.68	3'	3'	0	0	0	0	0	0	0	0	6'	Closed #12-1/2 @ 1:55 A	FA	S	L
2	58.83	42.56	3'	3'	0	0	0	0	0	0	0	0	4'		FA	SW	L
3	58.83	42.22													FA	SW	M
4	58.80	42.14													FA	SW	M
5	58.84	42.00													FA	SW	M-16
6	58.84	41.95													FA	SW	M-16
7	58.88	41.73													FA	SW	L
8	58.93	41.96													FA	SW	L
9	58.91	41.88													FA	SW	L
10	58.91	41.91												310 OPENED #1-1 @ 11:10	FA	SW	L
11	58.97	41.99	3'										5'		FA	SW	L
12	58.97	42.04												10 OPENED #2-1 @ 12:50	FA	SW	M-13
1 PM	58.99	42.25	3'										6' 6	OPENED #1-1 @ 1:30	FA	SW	M
2	58.97	42.49	4'										7'		FA	SW	M
3	58.91	42.60													FA	SW	M
4	58.89	42.65													FA	SW	M
5	58.84	42.69													FA	SW	M
6	58.83	42.69													FA	SW	M
7	58.81	42.59	3'											35 CLOSED #1-1 @ 1:45 PM	FA	SW	L-12
8	58.78	42.51											6'		FA	SW	L
9	58.78	42.51													FA	SW	L
10	58.78	42.53													FA	SW	L
11	58.77	42.51											30		FA	SW	L

24 Hour Temp.	PRECIPITATION		MEN ON DUTY										24 Hour Precip. 6 AM	REMARKS	
	Start	End	12 to 6	6 to 12	12 to 6	6 to 12	12 to 6	6 to 12	12 to 6	6 to 12	12 to 6	6 to 12			
MAX. 38					GALLUP	PORTER								V. Temp. 10 C 11:05 PM	
MIN. 21					BOTTOMLEY	SKIFFS								V. Storage 40.0 E 3:15 PM	
6 AM 30														(WT 34) (see note)	GP

LOCKMASTER'S DAILY REPORT <u>STARVED POCK LOCK</u> DATE <u>22 JUN 1969</u>																	
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND DIR.	WIND AMOUNT
			1	2	3	4	5	6	7	8	9	10					
12 M	58.76	42.48	3										6		FA	SW	L
1 AM	58.74	42.45											12	Closed #1-10 1:25 A	FA	SW	L
2	58.80	42.25	2										5		FA	SW	L
3	58.82	42.24													FA	SW	L
4	58.84	42.20													FA	SW	L
5	58.85	42.21													FA	SW	L
6	58.88	42.25													FA	SW	L
7	58.89	42.22													FA	SW	L
8	58.89	42.20													FA	SW	L
9	58.95	42.13													FA	SW	L
10	58.95	42.14													FA	SW	L
11	58.95	42.12													FA	SW	L
12	58.95	42.11													FA	SW	L
1 PM	58.97	42.11													FA	SW	L
2	58.98	42.12													FA	SW	L
3	58.95	42.10													FA	SW	L
4	58.99	42.06													FA	SW	L
5	58.85	42.20	3										75	OPEN #1-10 4:30	CL	S	L
6	58.84	42.19											6		CL	S	L
7	58.75	42.30													CL	SE	L
8	58.50	42.31													CL	SE	L
9	58.75	42.35													CL	SE	L
10	58.66	42.31													CL	SE	L
11	58.66	42.27	2										310	Closed #1-10 10:30 AM	CL	SE	L
12	58.66	42.27	2										5		CL	S	L
24 Hour Temp.	PRECIPITATION		MEN ON DUTY										REMARKS				
MAX.	Start	End	Art.	8 to 12		GALLUP		ROFEN		V. Large #1 @ 11:10 PM CE V. Strong #1 @ 3:25 PM NW (W.T. 35) (Ice Rpt. 0) A.P.							
MIN.				8		SADWICK		SWARTZ									
				to													
6 AM				4													
	24 Hour Precip.	6 AM	0	to 12		WITALKA		PETRE									

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 24 JAN 1964

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
1 AM	58.64	44.20	2'	3'	0	0	0	0	0	0	0	0	5'	Closed 2-10 1:45 AM	PC	S	L
2	58.69	42.12		2'									4'		PC		CLM
3	58.72	41.86													PC		CLM
4	58.80	41.83													PC		CLM
5	58.85	41.79													PC		CLM
6	58.89	41.74											20	OPENED 2-10 6:50 PM	PC		CLM
7	58.90	41.87	3'										5'		PC		CLM
8	58.95	41.88											13	opened 1-1' @ 9:45	PC	E	L
9	58.95	41.94											6'		PC	E	L
10	58.91	42.04	3												PC	E	L
11	58.91	42.19													PC	E	L
12	58.89	42.24													PC	E	L-2
1 PM	58.85	42.18													CL	E	L
2	58.82	42.15													CL	NE	L
3	58.76	42.21											30	Closed 1-1' @ 3:15	CL	NE	L
4	58.84	42.05	2'										5'		CL	NE	L
5	58.86	42.01													CL	N	L
6	58.88	41.93													CL	N	L-3
7	58.90	41.92													CL	N	L
8	58.91	41.84											25	OPENED 1-1' @ 8:30 PM	CL	NE	L
9	58.90	42.03	3'										6'		CL	NE	L
10	58.89	42.13													CL	NE	L
11	58.84	42.14											18		CL	NE	L
24 Hour Temp. MAX.	47		MEN ON DUTY										47.5 = 5.1	REMARKS			
MIN.			12 to 8														
			8														
			to 4														
6 AM	33																
	36	24 Hour Precip. 6 AM	0														

✓ Storage job
 V Storage upl @ 7:00 AM - JK
 opened gate further - JK
 (W.T. 34) (ICE RT. C)

DATE 25 JAN 1989

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.83	442.16	3'										6'		LT RN	E	L
1 AM	58.85	42.17													CL	ENE	L
2	58.80	42.22											5'		CL	RNE	L
3	58.86	42.03													CL	E	L
4	58.84	41.97													CL	E	L
5	58.86	41.55													CL	E	L
6	58.88	41.51													CL	E	L
7	58.92	41.90													CL	E	L
8	58.93	41.90													CL	E	L
9	58.94	41.91													CL	SE	L
10	58.94	41.91													CL	SE	L
11	58.94	41.91													CL	SE	L
12	58.99	41.90	3'										6'		CL	SE	L-4
1 PM	58.95	42.07													FG		CLM
2	58.95	42.12													FG		CLM
3	58.94	42.16													FG		CLM
4	58.92	42.20													RN	E	L
5	58.86	42.24													RN	E	L
6	58.85	42.27													RN/FG	E	L-4
7	58.84	42.30													FG/MIST		CLM
8	58.83	42.30													LT FG/MIST		CLM
9	58.82	42.30													CL	SW	L
10	58.79	42.40													CL	NW	L
11	58.80	42.38													CL	NW	L

24 Hour Temp.		PRECIPITATION		MEN ON DUTY		REMARKS
MAX.	MIN.	Start	End	12	8	
44°	32°	11:50P	12:15A	BOTTOMLEY	SPILLES	Vibrating bed @ 7:00AM ✗
		8:25P	5:15P	KOSARSKI	SARNICK	
		5:50PM	8:10PM	SWARTZ	GEHAUT	
6 AM	38°					
		24 Hour Precip. 6 AM	T	WALKER	PETRE	(1.1" 36) (1.00 APT 0) Sounded gate buzzer - ✗

LOOKMASTER'S DAILY REPORT STARVED FOLK LOCK

DATE 26 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.82	42.39	3	3	0	0	0	0	0	0	0	0	6		CL	W	L
1 AM	58.82	42.40													CL	W	L
2	58.83	42.42													CL	W	L
3	58.83	42.41													CL	W	L
4	58.82	42.41													CL	W	L
5	58.81	42.44													CL	W	L
6	58.80	42.45													CL	W	L
7	58.80	42.48													CL	W	L
8	58.80	42.48													CL	W	L
9	58.83	42.42													CL	W	L
10	58.80	42.48													CL	W	L
11	58.78	42.50													CL	W	L
12	58.83	42.33	2										5	72 CLOSED #1-1' @ 11:20	FA	W	L
1 PM	58.85	42.33											10	OPENED #1-1' @ 1:25	FA	W	L
2	58.96	42.44	3										6		FA	W	L
3	58.92	42.46													FA	W	L
4	58.90	42.50													FA	W	L
5	58.95	42.45													FA	W	L
6	58.95	42.46													FA	W	L
7	58.95	42.46													FA	W	L
8	58.95	42.46													FA	W	L
9	58.97	42.46	4										7	42 OPENED #1-1' @ 5:10	FA	W	L
10	58.96	42.68													FA	W	L
11	58.80	42.72											21	CLOSED #1-1' @ 11:04	FA	W	L

24 Hour Temp.		PRECIPITATION		MEN ON DUTY		AVG 6.0		REMARKS
MAX.	MIN.	Start	End	Ant.	16	8	4	
44	34				BOTTOMLEY	SPARES	SWARTZ	
					SADWICK			
					JEHANT			
6 AM	37	24 Hour Precip. 6 AM	16		WITALKA	PETRE		(WT37)(ice RPT 6) Sh. Dinkus

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 27 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	48.74	45.68	3'	3'	0	0	0	0	0	0	0	0	6'		FA	W	L-8
1 AM	48.70	42.54													FA	W	L
2	48.71	42.55													FA	W	L
3	48.71	42.47													FA	W	L
4	48.71	42.46													FA	W	L
5	48.73	42.47													FA	W	L-2
6	48.76	42.40													FA	W	L
7	48.80	42.40													FA	SW	L
8	48.79	42.39													FA	SW	L
9	48.80	42.41													FA	SW	L
10	48.84	42.44													FA	SW	L
11	48.90	42.45													FA	W	L
12	48.95	42.45	4'												FA	W	L
1 PM	48.92	42.71	4'										7'	OPENED #2-1' @ 12:15P	FA	W	L-3
2	48.90	42.89											8'	OPENED #1-1' @ 12:45P	FA	W	L
3	48.89	42.94													FA	W	L
4	48.87	43.03	4'												FA	SW	L
5	48.80	43.01											40'	CLOSED #48-120.5:10P	FA	SW	L-10
6	48.77	42.72	3'										6'		FA	SW	L-4
7	48.75	42.65											5'	CLOSED #1-1' @ 2:50P	FA	SW	CLM
8	48.75	42.55	2'												FA	SW	CLM
9	48.75	42.37													FA	SW	L
10	48.75	42.29													FA	SW	L
11	48.75	42.22											20		FA	SW	L

24 Hour TEEN.		PRECIPITATION		MEN ON DUTY										REMARKS	
MAX.	MIN.	Start	End	ABT.	12	1	2	3	4	5	6	7	8	9	10
40°	29°				12	8									
					8										
					to										
					4										
6 AM	32°	24 Hour Precip. 6 AM	0		to	12									

Vatungu yd C 7:00 AM - JK
Vatungu yd C 5:10 PM @

(WT 58°) (ICE NOT δ) SQUAD RATE PUNIT: 94

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 28 JAN 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.74	442.18	2'	3'	0	0	0	0	0	0	0	0	5'		FA	SW	L
1 AM	58.74	42.14													FA	W	L
2	58.80	42.13													FA	W	L
3	58.85	42.13													FA	W	L
4	58.92	42.13													FA	W	L
5	58.97	42.34	4'										7'	20 OPENED #1 2' @ 7:40A	FA	SW	L
6	58.94	42.50													FA	SW	L
7	58.97	42.58													FA	SW	L
8	58.92	42.60													PC	SW	L
9	58.87	42.64													PC	SW	L
10	58.93	42.69	4'												PC	SW	L
11	58.86	42.86											8'	20 OPENED #2 1' @ 10:54	FA	SW	L
12	58.74	42.88	3'	3'									6'	10 CLOSED #1 2' @ 12:00P	PC	SW	L-6
1 PM	58.68	42.82													PC	SW	L
2	58.67	42.74	2'										5'	10 CLOSED #1 1' @ 2:40P	CL	SW	L
3	58.68	42.53													LT RN	SW	L
4	58.71	42.33													LT RN	SW	L
5	58.74	42.33													LT RN	W	L
6	58.77	42.26													LT RN	SW	L
7	58.80	42.26													LT RN	SW	L
8	58.82	42.21													LT RN	SW	L
9	58.84	42.19													LT RN	SW	L
10	58.88	42.14													LT RN	SW	L
11	58.87	42.14	3'	4'									7'	20 OPENED #2 1' @ 2:40P	CL	SW	L
12	58.87	42.14													LT RN	SW	L
24 Hour Temp.	REMARKS																
MAX. 48°	Water temp up to 7:15 AM - 8°C																
MIN. 29°	Water temp up to 3:15 PM - 6°C																
6 AM 35°	WT 38° ICE RPT 0																
Observed surface water - 8°C																	

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 30 JAN 1989

C. S.	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND
			1	2	3	4	5	6	7	8	9	10				
12 M	458.53	442.89	5'	4'	0	0	0	0	0	0	0	0	5'	CLOSED #1 1' @ 1210	AT RN	W
1 AM	57.52	46.72	4'										8'		AT RN	W
2	57.52	46.72													AT RN	W
3	57.52	46.72													CL	WSW
4	57.51	45.10													CL	W
5	57.54	43.14													CL	W
6	57.54	43.17													CL	SW
7	57.52	43.18													CL	SW
8	57.52	43.17													CL	SW
9	57.52	43.17											64	CLOSED #2-1' @ 945	CL	SW
10	57.51	43.18		3'									7'		CL	SW
11	57.52	43.11													CL	SW
12	57.52	43.11													CL	SW
1 PM	57.52	43.02													FA	W
2	57.72	43.02													FA	W
3	57.72	43.02													FA	W
4	57.72	43.02													FA	W
5	57.77	43.53													FA	W
6	57.73	42.49													FA	W
7	57.83	42.35													FA	W
8	57.83	42.38													FA	W
9	57.93	42.25													FA	W
10	57.94	42.42		3'									30	OPENED #2-1' @ 9:40 PM	FA	W
11	57.97	42.44		4'									6'		FA	W
12	57.97	42.44											12	OPENED #1 1' @ 11:48 P	FA	W
24 Hour Temp.	45°															
MIN.	35°															
6 AM	35°															
24 Hour Precip. 6 AM			.02			CALLUP			PORTER			to 12			4:10 10:10-8	
24 Hour Precip. 6 AM			.02			CALLUP			PORTER			to 12			4:10 10:10-8	
24 Hour Precip. 6 AM			.02			CALLUP			PORTER			to 12			4:10 10:10-8	

REMARKS

✓ Stop #2 @ 3:00 PM

W 4:10 10:10-8 4:10 PM

LOCKMASTER'S DAILY REPORT <u>STARVED ROCK LOCK</u> DATE <u>31 JAN</u> 19 <u>89</u>																			
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND			
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT		
12 M	458.59	442.57	47	31	0	0	0	0	0	0	0	0	71	OPENED 11:00 AM	CL	SW	L		
1 AM	59.00	42.46													CL	SW	L		
2	58.57	42.97	51												PC	SW	L		
3	58.00	43.08													PC	SW	L		
4	58.96	43.20													PC	SW	L		
5	58.80	43.30													PC	SW	L		
6	58.73	43.37	31										30	CLOSED 12:00 AM	PC	SW	L-5		
7	58.72	43.11											71		FA	SW	L		
8	458.77	443.07													FA	SW	L		
9	58.78	43.06													FA	SW	L		
10	58.79	43.05													FA	SW	M		
11	58.80	43.07													FA	SW	M		
12	58.80	43.10													FA	SW	M-13		
1 PM	58.80	43.16													FA	SW	M		
2	58.83	43.18													FA	SW	M		
3	58.86	43.17													FA	SW	M		
4	458.88	443.17	31	41	0	0	0	0	0	0	0	0	71		FA	SW	M-22		
5	58.87	43.14													FA	SW	M		
6	58.84	43.13													FA	SW	M-14		
7	58.88	43.10													FA	SW	L		
8	58.89	43.12													FA	SW	L		
9	58.89	43.12													FA	SW	L		
10	58.88	43.11													FA	SW	L		
11	58.89	43.11											100		FA	SW	L		
24 Hour Temp.	PRECIPITATION		MEN ON DUTY										REMARKS						
MAX. 50°	Start	End	Asst.	16	8	8	8	8	8	8	8	8	8	AUG 7.3					
MIN. 35°				BOTTONLEY SPINES															
6 AM 41°				8	Sadnick / Petre														
				to	WITALKA														
				4	SWARTZ														
				12	CALLUP										PORTER				
	24 Hour Precip. 6 AM	0		12	CALLUP										PORTER				

WT 42° ICE RPT of La Pointe

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 1 FEB 19 89

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	MOON
			1	2	3	4	5	6	7	8	9	10					
12 M	458.88	443.10	3'	4'	0	0	0	0	0	0	0	0	7'		FA	S	L
1 AM	58.89	43.08													FA	S	L
2	58.89	43.08													FA	S	L
3	58.89	43.06													FA	S	L
4	58.90	43.03													FA	NW	L
5	58.91	43.04													FA	NW	L
6	58.91	43.04													FA	NW	L-5
7	58.91	43.03													FA	N	L
8	58.91	43.00													FA	N	L
9	58.90	42.95													FA	N	L
10	58.91	42.90													FA	N	L
11	58.90	42.86													FA	N	L-10
12 PM	58.89	42.80													FA	N	L
1	58.82	42.70													FA	N	L
2	58.82	42.70													FA	N	L
3	58.82	42.60													FA	N	L
4	58.82	42.55													FA	N	L
5	58.80	42.51													FA	N	L
6	58.83	42.47													FA	N	L-10
7	58.83	42.40													FA	N	L
8	58.82	42.37													FA	N	L
9	58.75	42.82													FA	N	L
10	58.73	42.75													FA	N	L
11	58.76	42.62													FA	N	L
24 Hour Teer.	690																
MAX.																	
MIN.																	
36°																	
6 AM																	
36°																	

REMARKS
 Vntang, wind @ 11:10 PM - 4K
 Vntang 206 3:00 PM @

WT - 45° 10 E RPT & 20 Fintels

LOCKMASTER'S DAILY REPORT <u>STARVED ROCK LOCK</u> DATE <u>2 FEB</u> 19 <u>65</u>																		
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CRANGES	WEATHER	WIND DIR.	WIND AMOUNT	
			1	2	3	4	5	6	7	8	9	10						
12 M	458.78	442.58	2	3	0	0	0	0	0	0	0	0	0			LT SN	N	L
1 AM	458.79	42.49														CL	N	L
2	58.73	42.48														CL	N	L
3	58.82	42.47														LT SN	N	L
4	58.89	42.44														CL	N	L
5	58.90	42.42														CL	N	L
6	58.91	42.40														CL	N	L
7	58.92	42.40														CL	NE	L-2
8	458.92	442.49	4											48 OPENED #2-11 @ 6:55A		CL	NE	L
9	58.94	42.56												7'		CL MET	NE	L
10	58.96	42.60														LT SN	E	L
11	58.92	42.67														LT SN	NE	L
12	58.90	42.68														LT SN	NE	L
1 P	58.90	42.66														LT SN	NE	L
2	58.88	42.62														LT SN	NE	L
3	58.88	42.67														LT SN	NE	L
4	58.86	42.57														LT SN	NE	L
5	58.79	42.70												70		LT SN	N	L
6	58.81	42.40	2											5'		LT SN	N	L-6
7	58.83	42.34														LT SN	N	L
8	58.87	42.34														LT SN	N	L
9	58.86	42.27														LT SN	N	L
10	58.87	42.16												25		LT SN	N	L
11	58.88	42.16	4											717		LT SN	N	L
24 Hour Temp.	37°		MEN ON DUTY										HUG 6.2		REMARKS			
			16	KOSARSKI				GENANT										
M.R.	26°		8	WITALKA				PETRE				V. Strong wind @ 11:55 PM-8K						
			to															
6 AM	28°		4									WT. 420 ICE MET & 2, P. 11.4						
			to															
			24 Hour Precip. 6 AM	T		SPARKER		RICAR										

LOCKMASTER'S DAILY REPORT															DATE		3 FEB		1989		
STARTED BACK LOCK																					
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND					
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT				
12 M	458.89	442.40	3'	4'										7'		LT SN	N	L			
1 AM	458.87	42.54														LT SN	N	L			
2	458.85	42.66														LT SN	N	L			
3	458.84	42.70														LT SN	N	L			
4	458.79	42.70														LT SN	N	L			
5	458.84	42.69														LT SN	N	L			
6	458.80	42.71														LT SN	N	L-2			
7	458.73	42.71	3'													LT SN	N	L			
8	458.76	42.59														LT SN	N	L			
9	458.84	42.80	4'	4'										8'		SN	N	L			
10	458.84	42.89														SN	N	L			
11	458.88	42.97														LT SN	NW	L			
12	458.85	43.02														LT SN	NW	L-12			
1 PM	458.84	43.07														LT SN	NW	L			
2	458.85	43.02														LT SN	NW	L			
3	458.75	43.04														LT SN	NW	L			
4	458.72	40.86	3'													LT SN	NW	L			
5	458.72	42.74	2'	3'										5'		LT SN	N	L			
6	458.74	42.49														LT SN	N	L			
7	458.81	42.30														LT SN	N	L			
8	458.79	42.26														LT SN	N	L			
9	458.85	42.17														LT SN	N	L			
10	458.85	42.11														LT SN	N	L			
11	458.87	42.05												55		LT SN	N	L			
24 Hour Temp.	Start		End		Precipitation		Ant.		MEN ON DUTY							AUG		6.10		REMARKS	
MAX.	29°								16		16		KOSARSKI		GEHANT				V. TONGU yd @ 11:10 AM - 8K		
MIN.	17°								8		8		WITALKA		PETRE				V. TONGU yd @ 7:15 AM - 0.5K		
6 AM									to		4		SADNICK		SWARTZ						
17°									to		12		BOTTOMLEY		SPIRES				WT. 41° ICE RPT X		
			24 Hour Precip. 6 AM		.51'														In Pines		

LOCKMASTER'S DAILY REPORT

STARVED ROCK LOCK

DATE 4 FEB 1985

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CRANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.88	42.06	2	3	0	0	0	0	0	0	0	0	5		LT SN	N	L
1 AM	58.88	42.02													LT SN	N	L
2	58.88	41.98													SN	N	L
3	58.92	41.95													SN	N	L
4	58.92	41.94													SN	N	L
5	58.94	42.00	3											OPENED #1-10 5:00 A	SN	N	L
6	58.94	42.09	4											OPENED #2-10 6:50 A	SN	N	L-2
7	58.96	42.27											7		SN	N	L
8	58.96	42.37													SN	N	L
9	58.90	42.07													SN	NW	L
10	58.80	42.54													SN	NW	L
11	58.82	42.42	2	3									5		SN	NW	L
12	58.82	42.44													SN	NW	L
1 PM	58.81	42.18													SN	NW	L
2	58.85	42.13													SN	NW	L
3	58.86	42.06													SN	NW	L
4	58.84	42.04													SN	NW	L
5	58.89	42.03													SN	NW	L
6	58.89	42.02													SN	N	L
7	58.87	42.02													SN	N	L
8	58.80	42.02													SN	N	L
9	58.87	42.04													SN	N	L
10	58.84	42.05													SN	N	L
11	58.83	42.05											65		SN	N	L
24 Hour Temp. MAX.	20°		MEN ON DUTY										406 5.3	REMARKS			
MIN.	0		to 8	KOWARSKI								to 8	GENANT	V. STONGLY at 11:10 PM - 9K			
			8	WITALKA								to	SWARTZ				
			to 4									4					
6 M + 1°		24 Hour Precip. 6 AM 1.05"	to 12	BOTTINLEY								to 12	S.P. CES	WT - 38° ICE RPT @ 1" SNOW			

LOCKMASTER'S DAILY REPORT <u>STARVED ROCK LOCK</u>															DATE <u>5 FEB</u> 19 <u>89</u>		
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.83	442.04	2'	3'	0	0	0	0	0	0	0	0	5'		SN	NW	L
1 AM	58.88	42.05													SN	NW	L
2	58.87	42.03													LT SN	NW	L
3	58.85	42.02													LT SN	NW	L
4	58.83	42.01													LT SN	N	L
5	58.80	42.00													LT SN	N	L
6	58.78	42.01													LT SN	N	L-4
7	58.76	42.00													LT SN	N	L
8	58.77	41.84	2'										4'		LT SN	N	L
9	58.80	41.84													SN	N	L
10	58.81	41.82													SN	N	L
11	58.84	41.79													SN	NW	L
12	58.87	41.75													LT SN	NW	L
1 PM	58.86	41.74													LT SN	NW	L
2	58.80	41.71													LT SN	NW	L
3	58.90	41.81													LT SN	NW	L
4	58.87	41.80													LT SN	NW	L
5	58.88	41.78													LT SN	NW	L
6	58.86	41.83													LT SN	NW	L-11
7	58.87	41.84													LT SN	NW	L
8	58.86	41.84													PC	NW	L
9	58.84	41.87													PC	NW	L
10	58.84	41.82													PC	NW	L
11	58.80	41.82													PC	N	L
12	58.81	41.85													PC	N	L
24 Hour Temp.	Start 0720 P		End 0720 P		MEN ON DUTY		Avg 4.3										
MAX.	6°			12 to 8		KOSMISEI		GEHANT									
MIN.	0°			8 to 4		ULITALKA		SHAKTE									
6 AM	2°	24 Hour Precip. 6 AM		.32"		Bottomley		SPIRES									

Remarks: Voltage yd @ 11:15 AM. & K

WT-350 100 225 0 +3" SNOW

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 6 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.81	441.91	5	2	0	0	0	0	0	0	0	0	4'		PC	W	M
1 AM	58.80	41.92													PC	W	M
2	58.82	41.90													PC	W	L
3	58.84	41.87													PC	W	L
4	58.76	41.86	1'										20	CLOSED #1-1 @ 4:45A	CL	SW	L
5	58.78	41.80											3'		CL	SW	L
6	58.81	41.74													CL	W	L-7
7	58.82	41.71													CL	W	L
8	58.89	41.70	3'										5'		CL	W	L
9	58.84	41.93													CL	W	L
10	58.85	41.97													CL	W	L
11	58.85	41.75													CL	W	L
12	58.84	41.10	2'										4'		CL	W	L-10
1 PM	58.82	41.04													CL	SW	L
2	58.85	41.03													CL	SW	L
3	58.80	41.96													CL	SW	L
4	58.78	41.97													CL	SW	L-10
5	58.76	41.78	1'										3'		CL	SW	L
6	58.75	41.71													CL	SW	L-9
7	58.73	41.62													CL	SW	L
8	58.74	41.59													CL	SW	L
9	58.82	41.61													CL	SW	L
10	58.85	41.63													PC	W	L
11	58.98	41.63	2'										4' A		FA	SW	L

24 Hour Temp. MAX.	PRECIPITATION		MEN ON DUTY		NOG	3.7	REMARKS
	Start	End	ABT.				
7°				12 86	KOSARSKI	GEHANT	V. Strong 4k @ 11:15 AM. AK
MIN.				8	PORTER	PELAE	
-3°				to 4			
6 AM							
-3°				to 12	BOTTOMLEY	SPIRES	GA Pinned WT - 330 ICE RPT @ +2" snow!

LOOKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 7 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND		
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT	
12 M	458.98	441.77	2'	2'	0	0	0	0	0	0	0	0	4' 1"	OPENED #1-1 @ 12:30 A	FA	SW	L	
1 AM	58.99	42.01	3'										5' 5"	OPENED #1-1 @ 1:55 A	FA	SW	L	
2	58.99	42.03	4'										6'		FA	SW	L	
3	58.99	42.33													FA	SW	L	
4	58.97	42.48													FA	SW	L	
5	58.94	42.57													FA	W	L	
6	58.87	42.68	3'										30	CLOSED #1-1 @ 6:35 A	FA	W	L-8	
7	58.85	42.61											5'		FA	W	L-6	
8	58.78	42.59	3'	3'	0	0	0	0	0	0	0	0	5'		FA	W	L-6	
9	58.76	42.60													FA	W	L	
10	58.80	42.63													FA	W	L	
11	58.79	42.62													FA	W	L	
12	58.75	42.50	2'										25	CLOSED #1-1 @ 11:45 A	FA	W	L	
1 PM	58.71	42.35	1'										4' 1"	CLOSED #2-1 @ 12:16 PM	FA	SW	L	
2	58.71	42.21											3'		FA	SW	L	
3	58.77	41.98													FA	SW	L	
4	58.81	41.85													FA	SW	L	
5	58.82	41.84													FA	SW	L	
6	58.85	41.76													FA	SW	L-5	
7	58.87	41.72													FA	SW	L	
8	58.90	41.67													FA	SW	L	
9	58.92	41.83	2'										24	OPENED #2-1 @ 8:45	FA	SW	L	
10	58.92	41.92											4'		FA	SW	L	
11	58.93	41.99											12		FA	SW	L	
24 Hour Temp.	PRECIPITATION			MEN ON DUTY										Avg 4.3		REMARKS V storage yd @ 11:10 AM - 8K V storage yd @ 2:15 AM - 03 WT-32° ICE RAT 9 A2C8		
MAX.	11°				12 to 8													
MIN.	-2°				8													
					to 4													
6 AM	4°	24 Hour Precip. 6 AM	0"		12 to 12													

LOCKMASTER'S DAILY REPORT Starved Rock Lock DATE 8 Feb 19 89

LOCKMASTER'S DAILY REPORT Starved Rock Lock

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	450.93	440.07	2	2	0	0	0	0	0	0	0	0	4		PC	SW	L
1 AM	450.93	438.10												OPENED #1 - 1' c 0141 AM	PC	SW	L
2	450.95	428.23	3										5		PC	SW	M
3	450.91	428.30													CL	SW	M
4	450.90	428.41													CL	W	M
5	450.87	428.48													PC	W	M
6	450.87	428.59													PC	W	M
7	450.87	428.69													FA	W	M
8	450.88	428.69													FA	W	M
9	450.81	428.80													FA	WNW	M
10	450.81	428.85													FA	WNW	M
11	450.79	428.90													FA	WNW	M
12	450.80	428.77	2										60	Closed #1 - 1' @ 11:30	FA	WNW	M 18
1 PM	450.81	428.74											4		FA	WNW	M
2	450.83	428.69													FA	WNW	M
3	450.85	428.62													FA	W	M
4	450.90	428.50													FA	W	M
5	450.90	428.53													FA	W	M
6	450.91	428.47													FA	W	M
7	450.94	428.47													FA	W	M
8	450.95	428.43													FA	W	M
9	450.89	428.62	4										10		FA	W	M
10	450.87	428.81													FA	W	M
11	450.87	428.93											18		FA	W	M
24 Hour Temp.	23°												REMARKS				
MAX.	23°												Waterage gals 11:30 am. 11:30				
MIN.	4°																
6 AM	16°																
24 Hour Precip. 6 AM			0"		to 12		BOTTOMNEY		SPICER				WT-32° JOE RPT. 9A 3C10 2.8 in.				

LOCKMASTER'S DAILY REPORT <u>STARVED ROCK LOCK</u> DATE <u>10 FEB</u> 19 <u>89</u>																	
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CRANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.74	442.90	2	2	0	0	0	0	0	0	0	4			FA	NW	M
1 AM	58.75	42.87													FA	NW	L
2	58.71	42.84													FA	NW	L
3	58.64	42.82	1									3			FA	NW	L
4	58.91	42.52													FA	NW	L
5	58.93	42.62	2												FA	NW	L
6	58.96	42.66													FA	NW	L
7	58.45	42.59	3									5			FA	NW	L
8	458.95	42.89													FA	NW	L
9	58.94	42.92													FA	NW	L
10	58.94	42.98													FA	NW	L
11	58.89	43.13													FA	NW	L
12	58.88	43.13													FA	NW	L
1 PM	58.90	43.04	2	2								30			FA	NW	L
2	58.88	42.93										4			FA	NW	L
3	58.88	42.77	1									3			PC	NW	L
4	58.87	42.69										2			FA	NW	L
5	58.92	42.58													FA	NW	L
6	58.91	42.49													PC	NW	L
7	58.93	42.28	21									15			PC	NW	L
8	58.92	42.31										41			PC	NW	L
9	58.89	42.28													PC	NW	L
10	58.85	42.36													PC	NW	L
11	58.83	42.40										10			PC	NW	L
24 Hour Temp. MAX.	22°																
MIN.	-4°																
6 AM	11°																
24 Hour Precip. 6 AM		0'															
MEN ON DUTY			WITALKA		SWAFT		PETRE		PORTER		KOSAREK		GENANT				
REMARKS			V storage yd @ 11:00pm NW V storage yd @ 3:15pm NW WT-32 ICE RT 1044C13 <i>by Pmily</i>														

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 11 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.80	442.38	2	2	0	0	0	0	0	0	0	0	4		PC	SW	L
1 AM	588.1	423.57													PC	SW	L
2	588.2	423.45													PC	W	L
3	588.1	423.50													PC	W	L
4	588.3	423.53													PC	W	L
5	588.4	423.57													PC	W	L
6	588.5	423.54													FA	W	L
7	588.91	423.55													FA	NW	L
8	458.91	442.53													FA	W	L
9	588.95	423.50													FA	W	L
10	588.98	423.54													FA	W	L
11	588.99	423.57													FA	W	L
12	588.97	423.67	3										5'	40	FA	W	L-16
1 PM	588.97	423.81													FA	W	L
2	588.91	423.86													FA	W	L
3	588.86	423.90	2										4'		FA	W	L
4	588.84	423.78													FA	W	M
5	588.84	423.70													FA	W	M
6	588.81	423.63													FA	SW	L-8
7	588.80	423.60													FA	SW	L
8	588.79	423.58	11												FA	SW	L
9	588.82	423.49													FA	SW	L
10	588.83	423.48													FA	SW	L
11	588.86	423.28											9		FA	W	L

24 Hour Temp. 27°

MIN. 8°

6 AM 16°

PRECIPITATION

Start End Amt.

16 to 8

8 to 4

4 to 12

MIN ON DUTY

WITKALA

Sadnick

KOSARSKI

SWARTZ

PORTER

GENANT

REMARKS

Storage up to 11:20pm MW

Storage up to 3:15pm JK

Gen. Final

100 ft. 10/24/13

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 12 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.7	442.16	1	2	0	0	0	0	0	0	0	0	3	OPENED #1-1 @ 12:30 AM	FA	W	L
1 AM	58.89	42.24	2										4		FA	W	L
2	58.91	42.23													FA	W	L
3	58.96	42.27													FA	W	L
4	58.97	42.29													FA	W	L
5	58.97	42.31											20	OPENED #1-1 @ 5:10 AM	FA	W	L
6	58.94	42.47	3										5		FA	NW	L
7	58.96	42.58													FA	NW	L
8	58.96	42.62													FA	NW	L
9	58.93	42.79	4	1											FA	NW	L
10	58.91	42.83													FA	NW	L
11	58.92	42.85													FA	S	L
12	58.92	42.86													FA	SE	L-6
1 PM	58.92	42.79													FA	SE	L
2	58.94	42.68													FA	SE	L
3	58.95	42.65													FA	SE	L
4	58.93	42.55													FA	S	L
5	58.87	42.38													CL	S	L
6	58.85	42.40													CL	SE	L-6
7	58.82	42.41													CL	SE	L
8	58.83	42.19													CL	SE	L
9	58.85	42.20													CL	SE	L
10	58.85	42.18											50		CL	SE	L
11	58.75	42.19	2										53	CLOSED #1-2 @ 11:05 PM	CL	SE	L

24 Hour Temp. MAX.	PRECIPITATION		MEN ON DUTY		REMARKS
	Start	End	Asst.		
33				4.0	✓ storage yd @ 11:20 PM
MIN. 16°			WITALKA	SUNNITZ	✓ storage yd @ 3:15 PM - OK
			BOTTOMLEY	SADNICK	
6 AM 16°					
	24 Hour Precip. 6 AM				
			KOSARSKI	GEHNNT	ICE FT 10 ANGLE

LOCKMASTER'S DAILY REPORT

Starked Rock Lock

DATE 13 Feb 1985

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.76	442.03	2	1	0	0	0	0	0	0	0	0	3		CL	SE	L
1 AM	58.71	41.85													SW	E	L
2	58.75	41.85													SW	SE	L
3	58.80	41.81													SW	E	L
4	58.85	41.74													SW	E	M
5	58.82	41.70	3										10	OPENED #1-10 4:10AM	SW/RN	E	L
6	58.55	41.94	4										5	OPENED #1-10 5:10AM	MIST	S	L-6
7	59.00	42.15											10		CL	SW	L
8	59.01	42.20	3										4	CLOSED #1-10 0830AM	CL	SW	L
9	58.94	42.30	2										3	CLOSED #1-10 9:00 AM	CL	SW	L
10	58.99	42.1													CL	SW	L
11	58.90	42.25													CL	SW	L
12	58.97	42.12													CL	SW	L-8
1 PM	58.96	42.10													CL	SW	L
2	58.93	42.07													CL	SW	L
3	58.77	42.25											21	OPENED #1 REARRANGED GATES	CL	SW	L
4	58.75	42.25	15										3		CL	SW	L
5	58.71	42.35											10	CLOSED #1-10 5:05 P	CL	SW	L
6	58.73	42.26											4		CL	SW	L-6
7	58.71	41.99													CL	SW	L
8	58.74	41.83													CL	SW	L
9	58.79	41.78													CL	SW	L
10	58.82	41.74													CL	SW	L
11	58.90	41.71											24		CL	SW	L
24 Hour Temp.	PRECIPITATION		MEN ON DUTY										REMARKS				
MAX.	Start	End	Avg 3.0										V storage yd @ 11:25pm AM V storage yd @ 3:10 AM-8K				
	12 10AM	6:20P	16	8	8	8	8	8	8	8	8						
MIN.			WITPLKA										GR. PINTALS				
			8	8	8	8	8	8	8	8	8						
6 AM			PORTER										WT-32°				
			to	to	to	to	to	to	to	to	to						
	24 Hour Precip.	6 AM	28										ICE RPT 10A4C13 SNOW-3"				
			to	to	to	to	to	to	to	to	to						
			12	12	12	12	12	12	12	12	12	12	GENANT				
			KOSARESKI														
			SWARTZ														
			GEHANT														

DATE 15 FEB 1989

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND		
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT	
12 M	58.85	47.62	3	1	0	0	0	0	0	0	0	0	0	4		CL	N	L
1 AM	58.84	47.60														LT SN	E	L
2	58.86	47.57														LT SN	E	L
3	58.88	47.58														LT SN	E	L
4	58.89	47.57														LT SN	N	L
5	58.90	47.55														SN	N	L
6	58.91	47.54														SN	N	L
7	58.92	47.50	5'													SN	N	L
8	58.93	47.95														SN	N	L
9	58.97	47.08														SN	N	L
10	58.94	47.02														SN	N	L
11	58.88	47.05														LT SN	N	L
12	58.87	47.09														CL	N	L
1 PM	58.86	47.11														CL	N	L
2	58.85	47.13														CL	N	L
3	58.77	47.06	6"													CL	N	L
4	58.73	47.03														CL	N	L
5	58.80	47.95														CL	N	L
6	58.83	47.96														CL	N	L
7	58.87	47.93														CL	N	L
8	58.89	47.94														CL	N	L
9	58.92	47.85														CL	N	L
10	58.95	47.84														CL	N	L
11	58.92	47.72	5"													PC	N	L
24 Hour Temp.	Start 12:00 A	End 12:00 P	MEN ON DUTY										HUG 5.0	REMARKS				
MAX. 33°			8	BOTTOMLEY							8	VIBRATING YD C 3:15AM - MC						
MIN. 19°			8	PETREI							8							
			to	PORTER							to							
6 AM 29°			4								4							
	24 Hour Precip. 6 AM	.11	to 12	KOSARSKI							to 12	WT 32° ICE 5-10 A 5 C 4						
				GEHANT								XP						

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK DATE 16 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1 5'	2 6"	3 0	4 0	5 0	6 0	7 0	8 0	9 0	10 0				DIR.	AMOUNT
12 M	45.53	42.10	56"										6		PC	N	L
1 AM	58.86	42.09													PC	NE	L
2	58.86	42.07													PC	NE	L
3	58.89	42.17													PC	NE	L
4	58.84	42.16													PC	N	L
5	58.75	42.15													PC	N	L
6	58.76	42.16													PC	N	L
7	58.75	42.06 46"											51	CLOSED 1 1' @ 6:10 A	PC	N	L
8	58.74	42.02													FA	NE	L-3
9	58.76	41.85 46"											3	CLOSED 1 2' @ 8:30 A	FA	NE	L
10	58.75	41.81													FA	N	L
11	58.87	41.56													FA	N	L
12	58.50	41.54													FA	N	L-4
1 PM	58.94	41.51													FA	N	L
2	58.93	41.44													PC	N	L
3	58.90	41.50 42"											3	OPENED 1 2' @ 2:45 P	PC	NE	L
4	58.90	41.87													PC	NE	L
5	58.86	41.84													PC	N	L
6	58.84	41.83													PC	N	L-2
7	58.85	41.84													PC	N	L
8	58.83	41.79													PC	NE	L
9	58.80	41.80													PC	NE	L
10	58.82	41.82													FA	NE	L
11	58.84	41.81													FA	NE	L
24 Hour Temp.	PRECIPITATION		MEN ON DUTY										4.7	REMARKS			
MAX. 30°	Start	End	Ast.	16	Bottomley		SADWICK		V. Strong w. @ 3:10 PM - JK								
				8	Petie		SPIRES										
MIN. 8°				to	Porter												
6 AM 8°				4					WT 32° ICE RFT 10 @ 5 @ 4				2 AM				
	24 Hour Precip. 6 AM	.14	to 12		KOSARSKI		GEHANT										

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 18 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CRANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.91	447.57	4	1	0	0	0	0	0	0	0	0	S		FA	E	L
1 AM	58.95	41.93													FA	E	L
2	58.96	41.93													FA	E	L
3	58.94	41.94													FA	E	L
4	58.94	41.96													PC	E	L
5	58.89	41.95													PC	E	L
6	58.90	41.94													PC	E	L
7	58.88	41.95													PC	E	L
8	58.85	41.98													PC	E	L
9	58.80	41.94													CL	E	L
10	58.78	41.73	2										3	closed 21-22 @ 5:20	CL	NE	L
11	58.83	41.61													CL	NE	L
12	58.82	41.54													PC	NE	L-4
1 PM	58.84	41.49													PC	NE	L
2	58.92	41.46													PC	NE	L
3	58.90	41.41													PC	NE	L
4	58.90	41.35													CL	E	L
5	58.91	41.43													CL	SE	L
6	58.91	41.39													CL	SE	L
7	58.96	41.43													CL	SE	L
8	59.00	41.76	4										5	OPENED 1-2 @ 7:15pm	CL	SE	L
9	59.00	41.80													CL	SE	L
10	59.00	41.86	5										6	OPENED 1-1 @ 2:53	CL	E	L
11	58.99	41.90	6										7	OPENED 1-1 @ 22:55	CL	E	L

24 Hour REEN.		PRECIPITATION		MEN ON DUTY										REMARKS	
MAX.	MIN.	Start 7:10pm	End 8:20	12	1	2	3	4	5	6	7	8	9	Average up @ 3:20pm min	
28°				8											
				8											
				to											
				4											
6 AM	11°	24 Hour Precip. 6 AM	0											WT 32° ice off 1F45X	91

LOCKMASTER'S DAILY REPORT

DATE 20 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GAGES										TOT. OPEN	GATE CRANGES	WEATHER	WIND DIR.	WIND AMOUNT
			1	2	3	4	5	6	7	8	9	10					
12 M	458.81	447.71	4'	6"									4' 6"		SN	SW	L
1 M	58.70	41.63													SN	SW	L
2	58.69	41.70	18"										2'	CLOSED #1 - 2 1/2" @ 3:35 A	CL	SW	L
3	58.74	41.48													LT SN	SW	L
4	58.77	41.30															L
5	58.88	41.28	4'										5'	OPENED #1 - 2 1/2" @ 5:25 A	SN		CLM
6	58.97	41.52	5'										5' 6"	OPENED #1 - 1 1/2" @ 5:55 A	SN		CLM
7	58.99	41.72	6'										11	OPENED #1 - 1" @ 7:10	LT SN		CLM
8	59.00	41.98											6' 6"		LT SN	NNE	L - C
9	58.91	41.95													SN	NNE	C
10	58.96	42.05													SN	NNE	L
11	58.94	42.08													SN	NNE	L
12	58.88	42.07													SN	NNE	L - 1
1 PM	58.80	42.12											3'	CLOSED #1 2' @ 1:30	SN	NNE	L
2	58.81	42.01	4'										4' 6"		CL	E	L
3	58.76	41.90													LT SN	NNE	L
4	58.73	41.77													SN	NNE	L
5	58.75	41.72													SN	NNE	L
6	58.77	41.68													SN	NNE	L
7	58.79	41.66													SN	NNE	L
8	58.79	41.66													SN	NNE	L
9	58.77	41.67													LT SN	N	L
10	58.75	41.68											40.5		LT SN	N	L
11	58.70	41.55	2'										2' 6" 2.5	CLOSED #1 - 2' @ 11:20 P	LT SN	N	L
24 Hour TEER.	Start	End	MEN ON DUTY										ADG A.G	REMARKS			
MAX.	3:20 A	1:25 P	8	KOSARSKI							8	Votung up @ 11:05 AM - 8K					
MIN.	3:45 P		8	SPIRES							to	WT-24° 10E RPT of 1/4" NEW SNOW					
			to								4						
			4								4						
6 AM	24 Hour Precip. 6 AM	1.02"	4	WINTAKA							4	SWIFT					
26			12								12	LOWER GAGE - 2012-1785					

LOOKMASTER'S DAILY REPORT

STARVED ROCK LOCK

DATE 21 FEB 1989

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND						
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT					
12 M	458.73	441.41	2'	6"	0	0	0	0	0	0	0	0	2'6"		LT. SN	N	L					
1 AM	58.74	41.26											7.5		LT. SN	N	L					
2	58.77	41.10	40'										5'	OPENED #1-2' @ 3:20A	CL	N	L					
3	58.85	41.02											15		CL	N	L					
4	58.83	41.40											3.5		CL	N	L					
5	58.77	41.50											4	CLOSED #1-1' @ 6:20A	CL	NW	L-2					
6	58.76	41.58	51'												CL	NW	L					
7	58.78	41.45													CL	NW	L					
8	58.87	41.42											17	OPENED #1-1' @ 9:33	CL	N	L					
9	58.93	41.50											5'6"		CL	N	L					
10	58.95	41.60	5												CL	N	L					
11	58.92	41.76													CL	N	L					
12	58.91	41.78													CL	N	L					
1 PM	58.86	41.80											7.0	CLOSED #1-2' @ 1:07	PC	NW	L-2					
2	58.82	41.65	3'	1'									4'4		PC	NW	L					
3	58.83	41.46	2'										3'	CLOSED #2-1' @ 2:35	CL	NW	L					
4	58.82	41.35													CL	NW	L					
5	58.83	41.33													CL	NW	L					
6	58.98	41.25											17	OPENED #1-2' @ 6:05pm	CL	NW	L					
7	58.96	41.50	4'	2'									6'	OPENED #2-1' @ 6:35pm	CL	NW	L					
8	58.97	41.70													PC	NW	L					
9	58.95	41.75													PC	NW	L					
10	58.95	41.85													PC	NW	L					
11	58.90	41.88											3.0		FA	NW	L					
24 Hour Temp.	PRECIPITATION												MEN ON DUTY						AUG 4.4		REMARKS ✓ strong - 4' @ 11:05pm - SK ✓ strong - 4' @ 3:20pm - NW WT-350 ICE RPT @ NEW SNOW 2 1/2' SN	
MAX.	31°	Start	End	ABT.	12	8	KOSARSKI		SADWICK													
MIN.	20°				8	to	SPIRES		6.00													
						to	Peret															
6 AM	21°	24 Hour Precip.	6 AM	.23"	to	12	WITALKA		SWARTZ													

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 22 FEB 19 89

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.70	441.72	4	2	0	0	0	0	0	0	0	0			FA	NW	L
1 AM	58.89	442.00													FA	NW	L
2	58.86	44.01													PC	NW	L
3	58.80	44.09													PC	NW	L
4	58.79	44.10													CL	NW	L
5	58.75	44.06	3										30	CLOSED #1-10 4:50 P	CL	NW	L
6	58.71	44.05											10	CLOSED #1-10 6:10 A	CL	NW	L-9
7	58.73	44.05	2										9	CLOSED #1-10 6:50 A	PC	NW	L
8	58.72	44.50													FA	NW	L
9	58.74	44.48													FA	NW	L
10	58.82	44.32													FA	NW	L
11	58.84	44.30											15	OPENED #1-10 11:57	FA	NW	L
12	58.82	44.32	2										4		FA	NW	L-10
1 PM	58.81	44.38													CL	NW	L
2	58.82	44.42													CL	NW	L
3	58.78	44.40													CL	NW	L
4	58.78	44.38													PC	NW	L
5	58.80	44.34													CLSN	NW	L
6	58.80	44.33													PC	NW	L
7	58.84	44.33											28	OPENED #1-2' @ 7:30pm	PC	NW	L
8	58.96	44.57	4										6		PC	NW	L
9	58.93	44.46													PC	NW	L
10	58.90	44.79													PC	NW	L
11	58.88	44.82											24		PC	NW	L
24 Hour Temp.	Start 4:10pm	End 5:10	MEN ON DUTY AUG 4.4										REMARKS				
MAX. 30°			12 to 8	BOTTOMLEY		PETRE					V average yds 3:20pm NW						
MIN. 15°			8 to 4	SPIRES		Gelco +					WT 35° ICE RPT 0						
6 AM 15°											JL						

LOCKMASTER'S DAILY REPORT <u>STARVER LOCK LOCK</u> DATE <u>23 FEB</u> 19 <u>89</u>																			
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND			
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT		
12 M	58.84	41.84	4	2	0	0	0	0	0	0	0	0	0	6		FA	N	L	
1 PM	58.80	41.91												12	CLOSED 11' @ 1:30A	FA	NW	L	
2	58.82	41.91	3											5		FA	NW	L	
3	58.76	41.83														FA	N	L	
4	58.74	41.78														FA	N	L	
5	58.72	41.67	2											15	CLOSED 11' @ 4:15A	FA	N	L	
6	58.72	41.57	1											4.4	CLOSED 11' @ 5:55A	FA	N	L	
7	58.72	41.40												3		FA	NW	L-6	
8	58.81	41.35														FA	NW	L	
9	58.83	41.32														FA	N	L	
10	58.87	41.12														FA	N	L	
11	58.86	41.19														FA	NW	L	
12	58.84	41.15														FA	N	L-7	
1 PM	58.83	41.18														FA	N	L	
2	58.87	41.14														FA	NW	L	
3	58.84	41.06														FA	NW	L	
4	58.85	41.12														FA	NW	L	
5	58.96	41.16	3											1/4	OPENED 11' @ 1:10 PM	FA	NW	L	
6	58.95	41.92												5		FA	NW	L	
7	58.93	41.46														FA	NW	L	
8	58.92	41.50														FA	NW	L	
9	58.96	41.52														FA	NW	L	
10	58.97	41.60														FA	NW	L	
11	58.97	41.63												30		FA	CLM	CLM	
24 Hour Temp.	PRECIPITATION			MEN ON DUTY										REMARKS					
MAX.	Start	End	Act.	AUG: 4, 2															
MIN.				12 to 8	BOTTOMLEY					PETRE									
				8 to 4	PORTER					GCHANT									
					SPIRES														
6 AM																			
				24 Hour Precip. 6 AM	T	WITALIKA					SWARTZ					GR. PINTAIS			
																W 34° 101-PT 0			

LOCKMASTER'S DAILY REPORT

STARVED ROCK LOCK

DATE 24 FEB 1989

C. S. TIME	UPPER GAUGE		LOWER GAUGE		POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
	Start	End	Start	End	1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	45.77	44.65	41.65	41.65	3	2	0	0	0	0	0	0	0	0	0	5	FG	SW	
1 AM	45.97	41.60	41.60	41.60													FG	SW	
2	45.95	41.60	41.60	41.60													FG	SW	
3	45.92	41.61	41.61	41.61													FG	SW	
4	45.90	41.63	41.63	41.63													FG	SW	
5	45.88	41.66	41.66	41.66													FG	SW	
6	45.86	41.70	41.70	41.70													FG	SW	
7	45.83	41.70	41.70	41.70													LT FG	N	
8	45.81	41.65	41.65	41.65													LT FG	N	
9	45.75	41.69	41.69	41.69	4	1											PC	SW	
10	45.70	41.62	41.62	41.62	3												PC	SW	
11	45.66	41.60	41.60	41.60	2												PC	SW	
12	45.70	41.50	41.50	41.50	2												PC	SW	
1 PM	45.71	41.34	41.34	41.34													PC	SW	
2	45.70	41.30	41.30	41.30	1												PC	SW	
3	45.77	41.08	41.08	41.08													PC	SW	
4	45.80	41.02	41.02	41.02	1	1	0	0	0	0	0	0	0	0	0	4	PC	SW	
5	45.86	41.03	41.03	41.03	3												PC	SW	
6	45.89	41.14	41.14	41.14													PC	SW	
7	45.93	41.26	41.26	41.26													PC	SW	
8	45.86	41.36	41.36	41.36													PC	SW	
9	45.89	41.36	41.36	41.36													PC	SW	
10	45.88	41.39	41.39	41.39													PC	SW	
11	45.88	41.37	41.37	41.37													PC	SW	
24 Hour Temp.	20°				MEN ON DUTY										AUG - 4.1		REMARKS		
MAX.	20°				BOTTOMLEY										PETRE		Votomay rd @ 7:05 AM PK		
MIN.	-6°				8										KOSARSKI		1/2 trap #1 @ 3:15 PM		
6 AM	-2°				to										PORTER		opened gate further PK		
					4												WT 34° ICE RPT 10F 1/2 CX		
					to										GALLUS				
					12										SADVI, CA				
					24 Hour Precip. 6 AM										0				

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK															DATE 25 FEB 1989			
C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND		
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT	
12 M	458.84	441.37	3	1	0	0	0	0	0	0	0	0	0	4'		PC	S	L
1 AM	58.88	41.36														PC	SW	L
2	58.88	41.34														FA		CLM
3	58.79	41.41														FA		CLM
4	58.80	41.35														FA		CLM
5	58.80	41.35														FA		CLM
6	58.80	41.35														FA		CLM
7	58.88	41.38														FA		CLM
8	58.84	41.38														FA		CLM
9	58.97	41.48														FA		CLM
10	58.96	41.42														FA		CLM
11	58.96	41.42														FA		CLM
12	58.94	41.85														FA		CLM
1 PM	58.91	41.90														FA		CLM
2	58.76	41.95														FA		CLM
3	58.80	41.57														FA		CLM
4	58.78	41.42														FA		CLM
5	58.81	41.25														FA		CLM
6	58.87	41.18														FA		CLM
7	58.89	41.24														FA		CLM
8	58.92	41.32														FA		CLM
9	58.94	41.18														FA		CLM
10	58.98	41.27														FA		CLM
11	58.92	41.41														FA		CLM
24 Hour Temp.	PRECIPITATION		MEN ON DUTY										REMARKS					
MAX. 23°	Start 3:35 P	End 5:30 P	12	8	8	8	8	8	8	8	8	8	8	4-2	Votungu yd @ 7:15 AM - 8K			
MIN. 0	7:15 AM	10:45	8	8	8	8	8	8	8	8	8	8	8		Votungu yd @ 3:20 PM			
-2			to	to	to	to	to	to	to	to	to	to	to		Lower gauge out @ 1:00 PM - 8K			
6 AM 0			4	4	4	4	4	4	4	4	4	4	4		Guard gate pulled - 8K			
12	24 Hour Precip. 6 AM	6 AM	4	4	4	4	4	4	4	4	4	4	4		WT 33° ICE KPT 10 F 1 CX			

DATE 26 FEB 1989

LOCKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	58.85	44.54	4	1	0	0	0	0	0	0	0	0	5'	closed #1-1 @ 12:10	PC	NW	L
1 AM	58.83	41.52	4	1	0	0	0	0	0	0	0	0	4'		PC	NW	L
2	58.82	41.47													PC	NW	L
3	58.84	41.46													PC	NW	L
4	58.85	41.43													PC	NW	L
5	58.80	41.42													PC	NW	M
6	58.83	41.60	4										5'	opened #1-1 @ 5:05	CL	NW	M-15
7	58.94	41.57													CL	NW	M
8	58.94	41.56													CL	NW	L
9	58.91	41.73													CL	NW	M
10	58.83	41.75													PC	NW	M
11	58.81	41.77											3'	closed #1-2 @ 11:35 P	PC	NW	M
12	58.78	41.66	2												PC	NW	L-8
1 PM	58.73	41.53													PC	NW	L
2	58.75	41.48													PC	NW	M
3	58.81	41.42	2	1	0	0	0	0	0	0	0	0	3'		PC	NW	M
4	58.73	41.36													PC	NW	M-18
5	58.80	41.30													PC	NW	M
6	58.90	41.27													PC	NW	M-16
7	58.92	41.15													PC	NW	M
8	58.82	41.38	4										5'	opened #1-2 @ 2:30 PM	PC	NW	M
9	58.87	41.36													PC	NW	L
10	58.85	41.39													PC	NW	L
11	58.85	41.40											20		PC	W	L
24 Hour Temp.			MEN ON DUTY										AVG 4.0	REMARKS V strong yd @ 7:10 AM - 9K V strong yd @ 3:10 PM - 6K Quarrel gate pointer - 9K WT 34° ICE RPT 0			
MAX. 40°			12	8													
MIN. 12°			8														
			to														
6 AM 30°			4														
			to														
24 Hour Precip. 6 AM			12														

DATE 27 FEB 19 80

LOOKMASTER'S DAILY REPORT STARVED ROCK LOCK

DATE 27 FEB 19 80

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN.	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.89	447.42	4'	1'	0	0	0	0	0	0	0	5		PC	W	L	
1 AM	58.89	47.43												PC	W	L	
2	58.89	47.44												PC	NW	L	
3	58.92	47.46												PC	NW	L	
4	58.94	47.49												PC	NW	L	
5	58.95	47.50												FA	W	L	
6	58.95	47.51												FA	W	L-4	
7	58.94	47.50												FA	W	L	
8	458.94	447.62												FA	W	L	
9	58.94	47.50												FA	W	L	
10	58.91	47.59												FA	W	L	
11	58.95	47.56												FA	W	L	
12	58.86	47.57												FA	W	L	
1 PM	58.86	47.56												FA	S	L-4	
2	58.87	47.53	3'									4'	CLOSED #1-1'e 1345 PM	FA	S	L	
3	58.85	47.43												FA	S	L	
4	458.85	447.31	3'	1'	0	0	0	0	0	0	0	4 1/2	CLOSED #1-1' @ 425	FA	S	L	
5	58.77	47.29	2'									3'		FA	S	L	
6	58.76	47.23												FA	S	L-6	
7	58.76	47.19												PC	S	L	
8	58.77	47.10												PC	S	L	
9	58.80	47.05												PC	S	L	
10	58.89	40.99										18	OPENED #1-2' @ 10:55 PM	PC	S.W	L	
11	58.93	47.13	4'									5 1/2		PC	SE	L	
24 Hour TEMP.		Start	End	Ast.	MEN ON DUTY AUG 4, 3										REMARKS VSTRAD PC 3:10 PM @ WT. 34° / CE 2 PT @ 3P.		
MAX. 31°					18	BOTTOMLEY		PETAE									
MIN. 10°					8	GEHANT		SUMETZ									
					to												
6 AM 10°					4												
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DATE 28 FEB 1989

LOOKMASTER'S DAILY REPORT STARVED ROCK LOCK

C. S. TIME	UPPER GAUGE	LOWER GAUGE	POSITION OF GATES										TOT. OPEN	GATE CHANGES	WEATHER	WIND	
			1	2	3	4	5	6	7	8	9	10				DIR.	AMOUNT
12 M	458.82	444.29	4	17									3		CL	S	L
1 AM	58.86	41.30													PC	S	L
2	58.86	41.30													PC	S	L
3	58.86	41.30													PC	S	L
4	58.86	41.30													PC	S	L
5	58.86	41.30													PC	S	L
6	58.86	41.30													PC	S	L
7	58.86	41.30													PC	S	L
8	58.86	41.30													PC	S	L
9	58.86	41.30													PC	S	L
10	58.86	41.30													PC	S	L
11	58.86	41.30													PC	S	L
12	58.86	41.30													PC	S	L
1 PM	58.86	41.30													PC	S	L
2	58.86	41.30													PC	S	L
3	58.86	41.30													PC	S	L
4	58.86	41.30													PC	S	L
5	58.86	41.30													PC	S	L
6	58.86	41.30													PC	S	L
7	58.86	41.30													PC	S	L
8	58.86	41.30													PC	S	L
9	58.86	41.30													PC	S	L
10	58.86	41.30													PC	S	L
11	58.86	41.30													PC	S	L

24 Hour Temp.	PRECIPITATION		MIN ON DUTY AVG = 3.7										REMARKS
	Start	End	1	2	3	4	5	6	7	8	9	10	
MAX. 23°	2:35A	5:50A											
MIN. 8°													
6 AM 21°													

✓ 1. Temp. at 3:15 pm (60)

WT 35° PCG RT 0 MT

REPORT DOCUMENTATION PAGE

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4. TITLE AND SUBTITLE Modeling Ice Passage Through Submergible and Non-submergible Tainter Gates				5. FUNDING NUMBERS	
6. AUTHORS Gordon Gooch, John Rand, Ben Hanamoto and Jon Zufelt					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Cold Regions Research and Engineering Laboratory 72 Lyme Road Hanover, New Hampshire 03755-1290				8. PERFORMING ORGANIZATION REPORT NUMBER Special Report 90-39	
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13. ABSTRACT (Maximum 200 words) In the colder regions of the U.S., ice accumulation in the approach area of navigation locks has been a constant problem. This ice is often pushed into the lock ahead of a towboat, sometimes requiring a separate lock cycle. This reduces the efficiency of the lock and slows down ship traffic. By modeling this problem and testing the solution to it, the research team has been able to conclusively show that submergible tainter gates located near the approach will solve the above-mentioned ice problems.					
14. SUBJECT TERMS Ice Ice problems Navigation locks Rivers River ice management River transportation				15. NUMBER OF PAGES 81	
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