AD-A105 752 COAST GUARD RESEARCH AND DEVELOPMENT CENTER GROTON CT F/G 13/10
WTGB/WAGB COMPARISON TESTS.(U)
JUN 81 M J GOODWIN
UNCLASSIFIED CGR/DC-13/81 USCG-D-45-81 NL

END
DATE FILMED
11 8
DTIC

AD A105752

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
(18) USCG-D (19) 45-81	AD-A105 752	

4. Title and Subtitle	5. Report Date
(6) WTGB/WAGB COMPARISON TESTS	(11) June 1981
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
(10) MICHAEL J. GOODWIN (12) 26	(14) CGR/DC-13/81
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
United States Coast Guard Research and Development Center Avery Point Groton, Connecticut 06340	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Department of Transportation United States Coast Guard Office of Research and Development Washington, DC 20593	(9) Final Report. Feb - May 81
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report presents the results of icebreaking comparison testing between a pair of 140-foot icebreaking tugs (WTGB's) and two larger icebreakers (WAGB's). The tests took place in the Great Lakes in February and March 1981. Testing was conducted in brash ice and in unbroken level ice.

Results of this testing indicated that a pair of WTGB's could do substantially the same work as a WAGB at much lower cost.

17. Key Words	18. Distribution Statement
icebreaking, ship testing	unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED		

Form DOT F 1700.7 (8-72) Reproduction of form and completed page is authorized

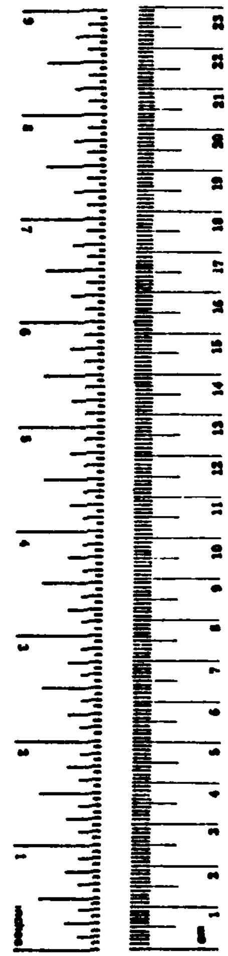
408730 B

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

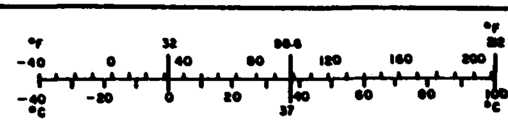


TABLE OF CONTENTS

A

1.0 INTRODUCTION

1.1 Background

The R&D Center conducted tests on the 140-foot WTGB, KATMAI BAY, during the winter of 1978-79. These tests indicated that the WTGB met or exceeded its design requirements. CGDNINE gained further experience with the class during the winter of 1979-80. As a result of this testing and experience, it appeared likely that two WTGB's, working together, might be as capable as a single WAGB. If two WTGB's are as capable as a WAGB, then it is much more economical to conduct operations using two of these tugs instead of a larger WAGB.

Commander, CGDNINE, requested of Commandant (G-OMI) that comparison tests be conducted during February and March 1981 to evaluate this concept. Commandant (G-OMI) forwarded the request to the Office of R&D with a positive endorsement. The actual planning for the tests was assigned to the Marine Systems Branch at the R&D Center. LCDR Michael GOODWIN was assigned as Project Manager.

The comparison tests were conducted from 23 February through 5 March 1981 in accordance with a test plan developed by the R&D Center. Testing took place in the Straits of Mackinac and the St. Marys River. CGDNINE made four cutters available during the test period. These were CGC WESTWIND (WAGB-281), CGC MACKINAW (WAGB-83), CGC MOBILE BAY (WTGB-103), and CGC KATMAI BAY (WTGB-101). Thus, two different WAGB classes were compared to the pair of WTGB's working as a team. The M/V AMOCO WISCONSIN was escorted in the St. Marys River. This provided a realistic operational environment for the brash ice tests.

1.2 Objectives

The objectives of the testing were as follows:

1. Determine the relative effectiveness in level ice 12 to 20 inches thick of the WTGB team compared to each of the WAGB's.

2. Determine the relative effectiveness in level ice thick enough to require ramming by at least one class of icebreaker.

3. Determine methods to utilize the WTGB team in brash icebreaking and compare the effectiveness of these methods to the effectiveness of using a single WAGB.

4. Collect data on fuel consumption, crew costs, and other operating costs to permit a rough comparison of the operating costs of the various ship types.

5. Provide an opportunity to collect vibrations data on certain hull structures of the WTGB's.

6. Provide an opportunity for CGDNINE to study the relative visibility of the WTGB's. (This objective was subsequently dropped by CGDNINE).

1.3 Weather and Ice Conditions

The weather during the two weeks prior to the testing was unusually mild with daytime air temperatures in the 40's and 50's. During the tests, the air temperature was lower but was still above freezing during the day. As a result, the ice cover in the Straits of Mackinac had begun to deteriorate and was of relatively low strength. Ice thickness was ideal for the tests with most ice 14-20 inches thick. Some areas had ice up to 30 inches thick. The level ice was not so uniform as for the previous tests on KATMAI BAY. Wide, low, pressure ridges were present in the ice field which were capable of stopping any of the test ships.

Brash ice tests were conducted in the St. Marys River. Commercial traffic in the river stopped in early January and the brash track that was present at that time had completely refrozen. To break up this track, the MACKINAW led the other vessels up the river. This formed a brash track that was quite deep but under low side pressure. The track was sufficiently severe so that the M/V AMOCO WISCONSIN was unable to proceed on its own and did require escort.

1.4 Participants

The R&D Center was tasked with coordinating the tests and with collecting test data. Test participants other than the four ships included:

1. CGDNINE(o) which coordinated the test program within the district and provided data to satisfy part of objective 4, determining operating costs,

2. Group Sault Ste. Marie which handled communications and logistics for the test vessels, and

3. Air Station Traverse City which provided air support for the tests including ice reconnaissance and aerial photography.

The help of all these commands in conducting the testing is gratefully acknowledged. In particular, the four vessels are to be commended for the effort they put forth to make the tests a success.

2.0 TESTING AND INSTRUMENTATION

2.1 Tests Conducted

Four types of tests were planned. These included continuous icebreaking effectiveness, limiting icebreaking effectiveness, brash icebreaking effectiveness, and general data collection. Continuous icebreaking included tests in level ice of a thickness which permitted all the test ships to make continuous progress. Limiting icebreaking included tests in ice thick enough to require at least one of the four ships to back and ram to make progress. General data collection included collecting data on crew size, ship characteristics, and annual operating costs.

In practice, the continuous and limiting icebreaking tests were combined. The ice conditions present required occasional ramming when wide low pressure ridges were encountered and during short stretches of thicker ice. The majority of each run was spent in the continuous icebreaking mode. Level ice testing took place over a four-day period from 23 through 26 February 1981. A total of six five-mile runs were conducted during this period.

The R&D Center provided assistance to Commandant (G-ENE) on a concurrent basis by measuring vibration amplitudes on the WTGB's during icebreaking. During a break in the ice testing, open water trials were conducted on the two WTGB's to collect more vibration data. These trials required 1 1/2 days on 27 and 28 February 1981.

Brash ice testing began on 4 March after an idle period awaiting the arrival of the M/V AMOCO WISCONSIN. Because of ice bridges across the St. Marys River, no icebreaking was allowed there until it was necessary to escort the AMOCO WISCONSIN to Sault Ste. Marie, MI. Brash icebreaking trials were conducted by using the WESTWIND and the pair of 140-foot WTGB's to escort the AMOCO WISCONSIN upbound to Sault Ste. Marie and the WESTWIND, MACKINAW, and MOBILE BAY to escort the vessel downbound. The downbound trip occurred on 5 March 1981.

Fuel consumption data was collected during the ice trials. The remainder of the general data (manning, operating costs, ship characteristics, etc.) was provided by CGDNINE. More details on the tests are included in section 3.

2.2 Instrumentation

Very little instrumentation was required for the ice tests. Hand-held radar guns were used to measure ship speed. Ice measurements were made by measuring the thickness of upturned blocks of ice beside one of the 140-foot WTGB's. Temperature profiles of the ice sheet were measured by drilling holes into the ice and inserting temperature probes. Brash ice thickness was measured using a pole to probe the ice to determine the bottom of the ice layer. An attempt was made to use infrared ranging to determine the distance between the WTGB's when working as a team. This attempt failed due to the motion of both ship platforms. As a result, track width was estimated by eye.

2.3 Supplemental Comments

The Commanding Officers of each of the vessels involved in the test were requested to make comments on the trials and to state their own opinions on the comparative icebreaking capabilities of a pair of WTGB's versus a WAGB. To date, the comments of the Commanding Officer, CGC MOBILE BAY, and Commanding Officer, CGC KATMAI BAY have been received. Comments are expected from the other Commanding Officers. The comment letters are included in Appendix A.

3.0 DESCRIPTION OF TESTS AND RESULTS

3.1 Continuous and Limiting Icebreaking Effectiveness

As mentioned earlier, these two tests were combined due to ice conditions on-scene.

Objectives:

The objectives of these tests were:

1. To determine the relative effectiveness in level ice 12 to 20 inches thick of the WTGB team compared to each of the WAGB's.
2. To determine the relative effectiveness in level ice thick enough to require ramming by at least one class of icebreaker.
3. To collect data on fuel consumption.
4. To provide an opportunity to collect vibrations data on certain hull structures of the WTGB's.

Time and Scope of Test Runs

The tests were conducted on four consecutive days, 23 through 26 February 1981. The test areas ranged from about five miles east of White Shoal to the area north of Garden Island Shoal. These shoals are located 10-15 miles west of the Mackinac Bridge in Lake Michigan.

A total of six test runs were made, each test run being approximately 5 statute miles long. Two runs were made on 23 February, two on 24 February, and one each on 25 and 26 February. The most severe conditions were encountered on the first run made on 23 February. The WTGB's made an average speed of only 2.8 knots during this run and had to back and ram often. The least severe conditions were encountered in the first run on 24 February. An average speed of 7.1 knots was made by the WTGB's with no ramming required.

Data Collected

Ice thickness was measured at the beginning and end of most of the runs by personnel on one of the WTGB's. Ice thickness could also be estimated quite accurately by observing the upturned pieces broken by the icebreakers. The ice temperature profile was measured once by the ice party and found to be a constant 32°F from top to bottom. This was the expected profile given the warm air temperatures which preceded the tests.

Ship speed was measured using radar guns, ship positions and chip logs. The speeds given in Table B-1 in Appendix B represent the best speed data for each vesel. Track width was estimated by the test director on each vessel. Although four track spacings were used by the WTGB's; 50, 100, 200, and 300 feet; in reality only two different conditions were noted. When the track spacing of the WTGB's was under 100 feet, a single broken track was left in their wake. Greater than 100-foot track spacing resulted in a broad, expanse of fractured but intact ice between the two individual WTGB tracks.

Fuel consumption was computed from tank soundings taken at the beginning and end of each run. There was quite a bit of scatter in the values obtained and they should be used with caution. All the vessels ran at full power with all engines on the line. The exception to this was the trailing WTGB when the WTGB's were in staggered formation. Only about 500 SHP was required for this vessel to maintain station on the lead WTGB. This was due to the weakening of the ice by the lead vessel and the relief track provided by the lead vessel.

The length of open track astern was measured from each vessel by tossing a block onto the ice and timing it until it was abeam the point where the ice track closed. The size of ice in the wake varied from chips to pieces 6 feet square.

All tests in this series were conducted with the two WTGB's working as a team to cut a single track with a WAGB running about 700-1000 yds away on each side. All ships ran for approximately 5 statute miles on parallel courses. One of the WAGB's then doubled back to run its own broken track and then the broken track of the WTGB's. In some tests, the track of the second WAGB was also run.

Approximately 1500 to 2000 SHP was used by the WAGB's when running the broken tracks. This resulted in a speed of around 9 knots in the broken tracks.

Test Results

Table B-1 in Appendix B shows the speeds for each vessel during these tests. Table B-2 gives data collected on the speed of the WAGB while running the broken track. Fuel consumption data is shown in Table B-3.

In each of the test runs, the pair of WTGB's proceeded at a speed from 2.9 to 4.6 mph slower than the WAGB's. This speed difference did not vary significantly with ice thickness, i.e., all vessels slowed an equal amount as ice thickness increased. The two WAGB's proceeded at nearly the same speed with small differences due to the ice conditions encountered.

WTGB track spacing of 100 feet or less produced a single wide track which was easier for the WAGB to follow than the track left by the WTGB's when running at a track spacing of greater than 100 feet. In fact, the WTGB's left a section of unbroken ice between individual WTGB tracks at a track spacing of greater than 100 feet. The ice between the tracks was heavily fractured and easier for the WAGB to run through than the surrounding unbroken ice, however. The speed of the WAGB in the track dropped approximately 1 mph when track spacing for the WTGB's was increased from less than 100 feet to approximately 200 feet. This represented about a 12 percent drop in speed at the power setting used. In all cases, the WAGB ran up the center of the combined track of the WTGB's.

When the two WTGB's were running in staggered formation, the trailing WTGB could use much less power to widen the track. The power used varied from 400-1000 SHP compared to 2500 SHP used by the lead WTGB.

Average fuel consumption for two WTGB's was 60 gals/mile in level ice. This compares to an average consumption of 85 gals/mile for the MACKINAW and 63 gals/mile for the WESTWIND although data for the WESTWIND was very inconsistent.

The track remained open astern of each of the vessels for about two ship lengths. There was a substantial amount of ice in the track immediately aft of each vessel, however. This ice filled about 50 percent of the track.

In summary, the pair of 140-foot WTGB's performed as well as a single WAGB except for speed. The speed of the WTGB's was consistently 3-5 MPH (2.6-4.4 knots) less than that of the WAGB.

3.2 Brash Icebreaking Effectiveness

Objectives

The objectives of these tests were:

1. To determine methods to utilize the WTGB team in brash icebreaking and compare the effectiveness of these methods to the effectiveness of using a single WAGB.

2. Collect data on fuel consumption.

Time and Scope of Test Runs

Two transits of the St. Marys River were made while escorting the M/V AMOCO WISCONSIN. An upbound transit was made on 4 March 1981 and a downbound transit on 5 March 1981. Brash ice was formed by having the MACKINAW break up the refrozen channel on the upbound trip. This resulted in a loose brash channel which was 4-7 feet thick. Ice thicknesses are shown in Figure B-1 in Appendix B.

During the upbound trip, the WESTWIND began the escort several miles behind the MACKINAW. The escort began at the south end of Lime Island Channel and continued to Hay Point. At Hay Point, the two 140's, which had been following the AMOCO WISCONSIN, took the lead and maintained it all the way to Sault Ste. Marie. The WESTWIND followed the AMOCO WISCONSIN the remainder of the upbound trip. The 140's began the escort with one in the main track and one cutting a relief track about 50-100 feet outside the broken channel. After approximately a half hour, the 140's shifted from cutting a relief track to staggered formation in the broken channel. This formation was maintained to Sault Ste. Marie.

Downbound MACKINAW began the escort and continued as far as Stribling Point. At that point, the MOBILE BAY took over the escort by itself as far as Rocky Point. There the WESTWIND picked up the escort and maintained it to the mouth of the river.

The speed of the MACKINAW in breaking the refrozen brash and the need to take ice measurements limited the speed that could be maintained during the upbound journey. Downbound, the speed of the AMOCO WISCONSIN was the limiting factor. As a result, both transits were made at much less than full power with several stops.

Data Collected

Ice thickness was measured at approximately two-mile intervals during the upbound passage. Personnel on the MACKINAW made the measurements. Ship speed was measured but was limited by either the speed of the MACKINAW upbound or the speed of the AMOCO WISCONSIN downbound and no significant conclusions could be drawn from the data. Similarly, fuel consumption data which was collected did not provide any conclusive results.

Test Results

As the vessels approached the mouth of the river on the second day of brash icebreaking, the captain of the AMOCO WISCONSIN was asked to comment on the various methods of escort tried. His observations, reported below, agree closely with those of the test personnel from the R&D Center.

Comments of Captain of AMOCO WISCONSIN:

1. There was little difference between the track left by the two 140's and the WESTWIND on 4 March so far as the ability of the AMOCO WISCONSIN to make progress was concerned.

2. Having the two 140's in the track in staggered formation resulted in a slightly easier track to follow than the one resulting with one 140' cutting a relief track outside the channel.

3. On 5 March the best progress was made when the MACKINAW was in the lead.

4. Poor progress was made when the MOBILE BAY ran just ahead of the AMOCO WISCONSIN at the same speed.

5. Better progress was made when the MOBILE BAY ran ahead in spurts at maximum speed and waited for the AMOCO WISCONSIN to catch up occasionally.

6. Except for the escort with the MOBILE BAY running just ahead, the AMOCO WISCONSIN had little difficulty in making good progress in any of the escorting modes.

3.3 General Data Collection

Objectives

The objectives of this section were to determine fuel consumption, crew costs and other operating costs to permit a rough comparison of the operating costs of the various ship types.

Data Collected

CGDNINE(o) provided most of the data required. Fuel consumption data collected for level icebreaking is reported in Table B-3. A proportionate amount of fuel should be required by the vessels when running at full power in brash ice. Crew size rather than costs was available and no attempt was made to relate the crew size to crew cost.

The principal characterstics of the vessels, their crew size, and operating costs for FY80 are given in Table B-4. These costs are not average costs, but costs for a recent year of operation with some adjustment made for inflation.

Results

The total crew of a pair of 140-foot WTGB's is 24-29 percent of the crew for a single WAGB. Operating costs are similarly 29-42 percent of those for a single WAGB. Acquisition costs are also much lower.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Performance in Level Ice

The 140-foot WTGB's demonstrated that they could make progress in the level ice encountered but at a speed of 2.9-4.6 MPH slower than a WAGB. The track width and quality of track left by a pair of WTGB's is as good as or better than that of a WAGB. A track spacing of 100 feet or less is recommended for dual WTGB operation with one ship staggered behind the other.

4.2 Performance in Brash Ice

There is little difference in the ability of two WTGB's to escort a vessel in a brash channel compared to a WAGB. Operation with the WTGB's in the broken track in staggered formation appears to work best.

4.3 Vessel Costs

Operating, crew, and acquisition costs for a pair of WTGB's is much lower than similar costs for a WAGB.

4.4 Miscellaneous Factors

One of the drawbacks of the 140-foot WTGB's is the limited crew size which restricts operations to approximately 24 hours between rest periods. The WAGB's have essentially unlimited endurance from a personnel standpoint. The endurance of the 140-foot WTGB will be a significant limitation unless crews are rotated or some other crewing concept is adopted.

APPENDIX A

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Commanding Officer
CGC MOBILE BAY (WTGB-103)
Sturgeon Bay, WI 5-235

16150
7 April 1981

From: Commanding Officer, USCGC MOBILE BAY (WTGB-103)
To: Commanding Officer, USCG Research and Development Center
Via: (1) Commander, U.S. Coast Guard Group, Milwaukee, WI
(2) Commander, Ninth Coast Guard District (o)

Subj: WAGB/WTGB Comparision Tests; comments concerning

1. The following observations were made by MOBILE BAY's OODs and the commanding officer during the WAGB/WTGB comparison tests:

A. Straits of Mackinac and Level Icebreaking

1) When the WTGBs operated abeam at a track spacing less than 150 feet there was a strong tendency to shear inward and be drawn together. The technique is considered unsafe due to the steering difficulties in attempting to remain apart. Most operators would no doubt employ this method only as a last alternative.

2) The most efficient and safe mode of dual ship icebreaking was to have the WTGBs run staggered preferably with a WTGB off the lee quarter of the lead cutter (approximately 200-300 feet astern). The following WTGB should widen the initial track and not break an entirely new path. This conflicts with past WYTM/WLB operations, but the increased horsepower and efficient hull form of the WTGBs make this a safer and more viable method.

3) Breaking a track utilizing two WTGBs that are abreast (200-300 foot spacing) is considered a marginally effective technique. The center section of fractured ice would not be acceptable in several situations such as escorting tug-barge combinations and very low-powered vessels. The escorted vessel could perhaps more effectively utilize these "railroad tracks" by steaming in one track and using the second as a pressure relief.

4) The WTGB hull air lubrication system ("bubbler system") was observed to be effective only in ice thickness greater than 16-18 inches. However, this system was very important in aiding the extraction of the MOBILE BAY when stuck on pressure ridges of 4-6 foot thickness. It is important not to underestimate the versatility and usefulness of the bubbler system during mooring, the clearing of ice clogged piers and where there is a substantial snow cover on level ice.

5) Sallying the WTGB rudder (15-20 degrees) when the ship was stopped by a 4-6 foot ridge produced excellent results. Usually a single WTGB could make it through a ridged area on the second ram utilizing maximum power, the bubbler system and sallying the rudder.

SPEED LIMIT 55

16150
7 April 1981

Subj: WAGB/WTGB Comparison Tests; comments concerning

B. St. Mary's River and Brash Testing

1) Running the MOBILE BAY in refrozen brash at slow speeds several hundred yards ahead of the AMOCO WISCONSIN proved to be ineffective. The AMOCO WISCONSIN was capable of easily following the MACKINAW and WESTWIND at slow speeds no doubt due to their respective wider beams. However, having the MOBILE BAY run ahead at full power, thereby loosening up the refrozen track, allowed the tanker to maitain very acceptable progress (6-8 knots in 6-foot brash). The icebreaking potential of the WTGB's wake was underestimated during the comparison tests.

2) Two WTGBs operating in brash ice appeared to be as effective as a single WAGB. In certain circumstances (i.e. widening narrow turns, passing close aboard the escorted vessel) I suggest that having two WTGBs operate in the same area of the St. Mary's River may be more effective than a lone WAGB.

2. Although not conclusive it is my opinion that the test showed that in all but one of the ice conditions encountered a single WTGB would have been an adequate icebreaking resource. The lone exception was the initial spring breakout of the St. Mary's River which was effectively handled by the MACKINAW. I believe that two WTGBs working in tandem (staggered alignment) could have accomplished the same task in less than double MACKINAW's time.

3. Endurance is certainly of key importance in comparing the WAGB and WTGB cutters. However, if our cutters are not called upon to conduct nighttime icebreaking, the "fatigue factor" of the WTGB class can be minimized.

4. The comparison tests provided additional knowledge of the characteristics and utilization of our icebreakers. Considering all factors included in these tests it is my opinion that the WTGB class cutter is an entirely adequate and cost-effective resource. Dual operation of the WTGBs compares very favorable with a WAGB.

Lawson W. BRIGHAM

Copy to:
COMDT (G-OMI)

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Commanding Officer
USCGC KATMAI BAY
(WTGB 101)
Sault Ste Marie, MI

3960
4 May 1981

From: Commanding Officdr, USCGC KATMAI BAY (WTGB 101)
To: Commanding Officer, U.S. Coast Guard Research and Development Center, Groton, Ct.

Subj: Evaluation of WTGB/WAGB Comparison Tests

1. As requested the following comments are submitted regarding the WTGB/WAGB comparison tests:

a. It is my opinion that the first day of the testing brought out the single , obvious, physical advantage of the WAGB over the two WTGB's working together. One word summarizes that advantage-horsepower. Two 2500hp WTGB's do not make one 10000hp icebreaker, nor do they make one 5000hp icebreaker. There are many times when ice conditions in such areas as the Mackinac Straits and Whitfish Bay are such that the only way a low-powered laker is going to get through it is with an icebreaker with the horsepower of a WAGB directly ahead of her. The ice conditions of the type to which I am referring occur over a peroid of 3 to 4 weeks during spring break out, when heavy winds cause substantial pressure ridging in the large floes such as were encountered the first day of the comparison tests.

b. The dual WTGB icebreaking approach is certainly effective in level and brash ice. On level ice, however, track separation of less than 150ft while the two ships are abeam of each other is extremely risky because of the difficulty in maintaining separation. I feel that the amount of track separation should vary with the ice thickness and in every case the two icebreakers should be staggered with the trailing icebreaker 200-300ft astern- again, depending on the thickness of the ice. It seems that in level ice greater than 20 inches thick the track separation should be from 50 to 100ft, and the trailing icebreaker no closer than 300ft. This would be effective in breaking-up the "ice island" between the two tracks and also provide a margin of safety in the event the leading vessel gets stuck.

c. As I stated previously, there are times when two WTGB's are not going to be able to do the job of a WAGB, however, such is not the case in the river. I'm speaking mainly of the St. Mary's River because there lies most of my experience. The WTGB's shallow draft and maneuverability provide a considerable advantage over a WAGB, when operating in the narrow channels of the St Mary's River. Because of the characteristics of brash ice, the additional horsepower of the WAGB is advantageous only when an unusually large plug of the brash ice ~~the additional horsepower of the~~ has formed or when the track has had a month or more to refreeze without traffic. Even under the situations just mentioned, two WTGB's working together could effectively move traffic.

4 May 1981

Subj: Evaluation of WTGB/WAGB Comparison Tests

d. In summary, I would say, that with the exception of crew endurance, the comparison tests substantially indicate that under most ice conditions, two WTGB's can be as effective at domestic icebreaking as one WAGB.

J.V. EMBLER,LT

APPENDIX B

TABLE B-1
Ship Speeds in Level Ice

SHIP	DATE	DISTANCE RUN STATUTE MILES	RUNNING TIME (MIN)	AVERAGE SPEED (MPH)	AVERAGE ICE THICKNESS (IN)	TRACK WIDTH FT
MACKINAW	2/23	4.9	42	7.0		90-100
MOBILE BAY	AM	5	108	2.8	16"-30"	90-350
KATMAI BAY		5	108	2.8		
WESTWIND		4.06	38	6.41		70-80
* MACKINAW	2/23	4.85	27	10.78		90-100
MOBILE BAY	PM	5	48	6.25	16"-20"	90-350
KATMAI BAY		5	48	6.25		
MACKINAW	2/24	5	29	10.34		90-100
MOBILE BAY	AM	5	42	7.14	12"-18"	90-350
KATMAI BAY		5	42	7.14		
WESTWIND		5	27	11.1		70-80
**MOBILE BAY	2/24	Averaged	from Speeds	7.1		90-350
KATMAI BAY	PM	Averaged	from Speeds	6.8	12"-15"	
WESTWIND		4.94	26	11.4		70-80
MACKINAW	2/25	4.7	29	9.72		90-100
MOBILE BAY		4	35	6.86	13"-16"	90-350
KATMAI BAY		4	35	6.86		
WESTWIND		5	28	10.71		70-80
MACKINAW	2/26	5	33	9.1		90-100
MOBILE BAY		5	59.5	5.0	12"-30"	90-350
KATMAI BAY		5	60	5.0		
WESTWIND		5.31	59	5.4***		70-80

* WESTWIND running broken tracks
** MACKINAW on assistance call
*** WESTWIND stopped by ice ridge. Average speed 9.6 MPH out of ridge

TABLE B-2
Speed of WAGB in Broken Tracks

SHIP RUNNING TRACK	TRACK BROKEN BY	DATE	>100' TRACK SPEED (MPH)	<100' TRACK SPEED (MPH)	REMARKS
WESTWIND	WESTWIND	2/23	7.8		
	140's		7.1		
	MACKINAW		9.3		Track opened 20 ft.
MACKINAW	MACKINAW	2/23	9.9		
	140's		8.4		
WESTWIND	WESTWIND	2/24	9.8		
	140's		8.9	9.2	
WESTWIND	WESTWIND	2/24	7.4		Track closing
	140's		6.4	8.0	
MACKINAW	MACKINAW	2/25	7.8		
	140's		8.6		
WESTWIND	WESTWIND	2/26	8.7		
	140's		7.1	8.1	
	MACKINAW		8.2		

TABLE B-3
Fuel Consumption

SHIP	DATE	TEST RUN	GALS/MILE	REMARKS
MACKINAW	2/23	1	76	
		2	47.6	Easy going
	2/24	1	105	
	2/25		85.1	
	2/26		71	
MOBILE BAY	2/23	1	50	Not used for average
		2	29.6	
	2/24	1	31.4	
		2	23.6	Offline for period of engine work
	2/25		30.8	
	2/26		36	
KATMAI BAY	2/23	1	37.2	
		2	23.0	
	2/24	1	24.8	Following MOBILE BAY
		2	36.6	Idling during MOBILE BAY engine repairs
	2/25		26.2	Following MOBILE BAY
	2/26		26.2	Following MOBILE BAY
WESTWIND	2/23	1	70.4	
	2/24	1	23	Not used for average
		2	34.6	Not used for average
	2/25		51.6	
	2/26		65.5	

TABLE B-4

	WESTWIND	MACKINAW	KATMAI BAY	MOBILE BAY	TWO 140's
LOA	269	290	140	140	
BEAM	64	74	37.5	37.5	
DRAFT	29	19	12	12	
DISPLACEMENT	6515	5252	662	662	
SCREWS	2	3	1	1	
SHP	10000	10000	2500	2500	5000
MAX RANGE	38000	41000	4000	4000	
ECON SPEED	10.5	9	12	12	
MAX SPEED	16	18.7	14.7	14.7	
RANGE AT MAX SPEED	16000	10000	2260	2260	
NO. OFFICERS	12	8	2	2	4
NO. WARRANT OFFICERS	2	3	1	1	2
NO. ENLISTED	127	106	14	14	28
TOTAL CREW	141	117	17	17	34
TWO-140's/WAGB	24%	29%			
FY80 ACT COSTS + 9.75% COL IN $K					
OG 30 LESS FUEL	464	395	51	51	102
FUEL	264	237	76	48	124
OG-42	28	33	2	1	3
OG-43		1			
OG-45	419	152	117		117
TOTAL	1175	818	246	100	346
TWO-140's/WAGB	29%	42%			
COST FOR NEW SHIP	$ 125m	$ 125m	$ 15m	$ 15m	$ 30m
TWO-140's/WAGB	24%	24%			

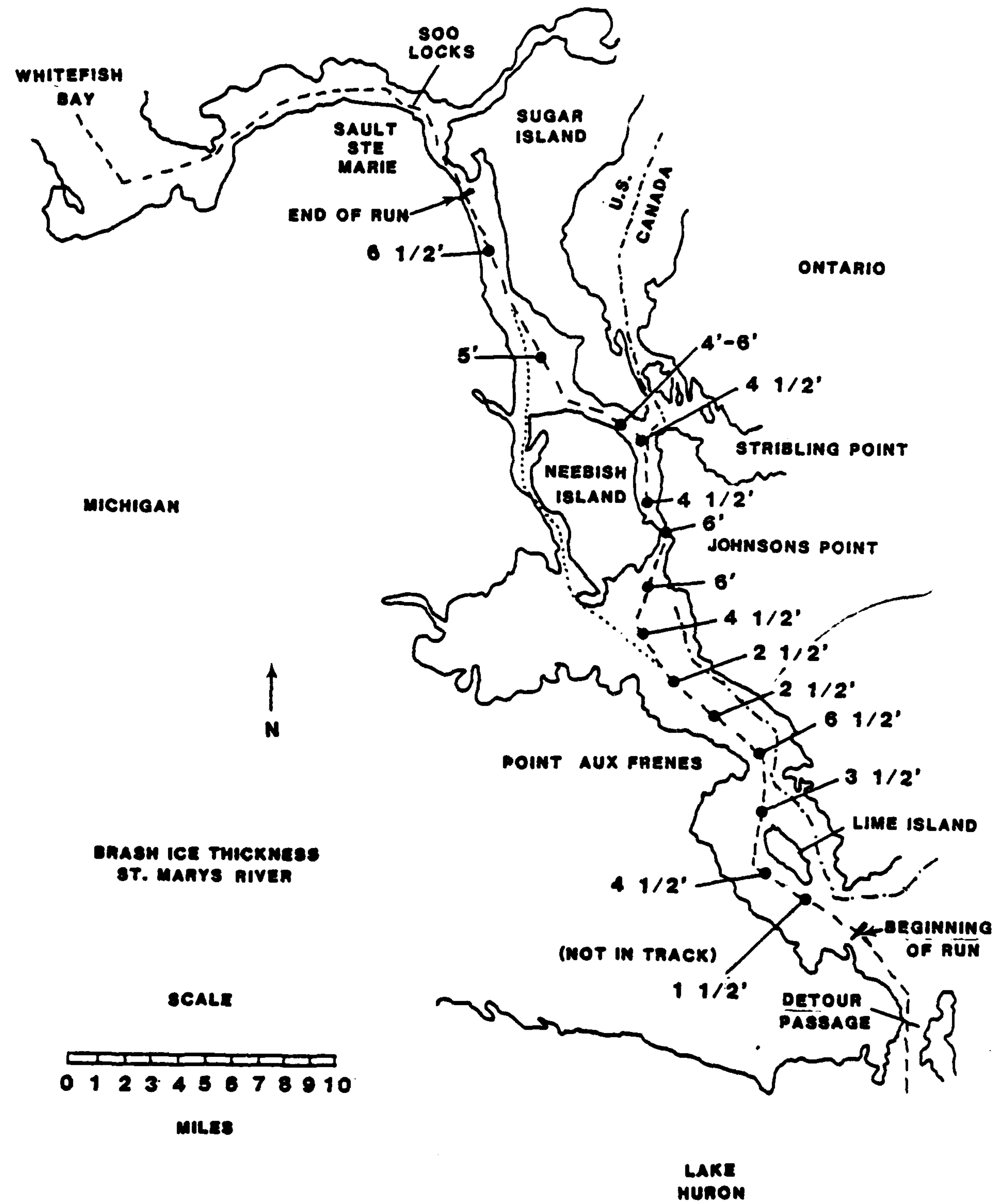

SOO
LOCKS
WHITEFISH
BAY
SAULT
STE
MARIE
SUGAR
ISLAND
U.S.
CANADA
END OF RUN
6 1/2'
ONTARIO
5'
4'-6'
4 1/2'
STRIBLING POINT
NEEBISH
ISLAND
MICHIGAN
4 1/2'
6'
JOHNSONS POINT
6'
4 1/2'
2 1/2'
2 1/2'
N
6 1/2'
POINT AUX FRENES
3 1/2'
LIME ISLAND
BRASH ICE THICKNESS
ST. MARYS RIVER
4 1/2'
BEGINNING
OF RUN
(NOT IN TRACK)
1 1/2'
SCALE
DETOUR
PASSAGE
0 1 2 3 4 5 6 7 8 9 10
MILES
LAKE
HURON

FIGURE B-1

DATE
FILMED
— 8