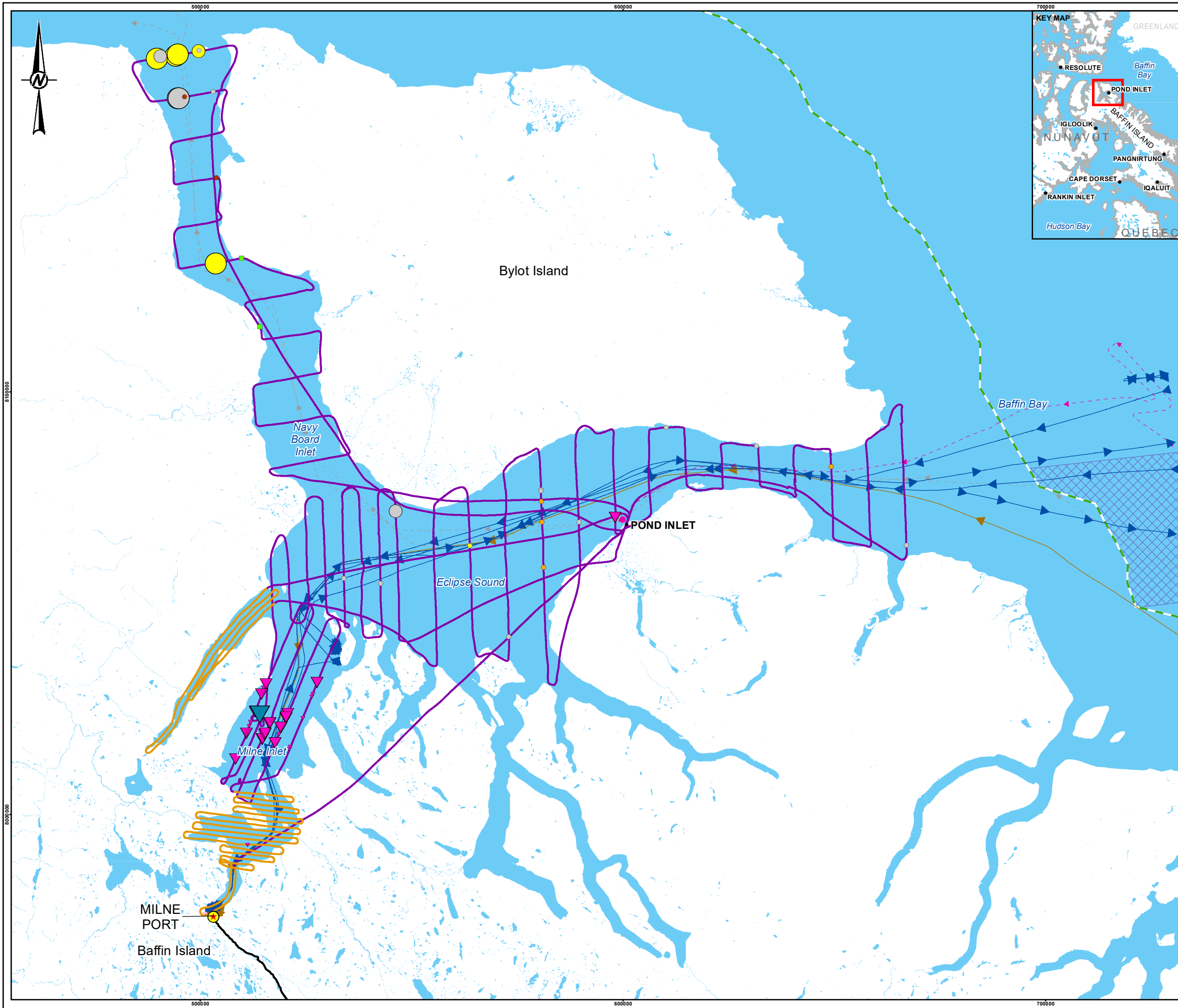


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LEGEND

• COMMUNITY

★ MILNE PORT

□ PHOTO LOCATION

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BEARDED SEAL

• 1

• 1

• 2 - 10

• 10+

HARP SEAL

• 1

• 2 - 10

• 10+

KILLER WHALE

▼ 10+

▼ 1

▼ 2 - 10

NARWHAL

■ 1

■ 2 - 10

POLAR BEAR

■ 1

RINGED SEAL

• 1

• 2 - 10

• 10+

UNIDENTIFIED SEAL/PINNIPED

• 1

• 2 - 10

• 10+

— MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

— PHOTOGRAPHIC

— VISUAL

PROJECT VESSEL SHIP TRACKS

▶ BULK (ORE) CARRIER

▶ GENERAL CARGO VESSEL

▶ ICEBREAKER (BOTNICA)

▶ SERVICE VESSEL

NON-PROJECT VESSEL SHIP TRACKS

▶ ICEBREAKER (LOUIS S ST LAURENT)

▶ OTHER

▨ 40 km BUFFER ZONE

— NUNAVUT SETTLEMENT AREA BOUNDARY

■ WATERBODY

NOTE(S)

CONDITIONS GOOD WITH BF 0-3 FOR MUCH OF THE SURVEY AREA AND NO FOG. BF 4 ENCOUNTERED ON PORTIONS OF EASTERN ECLIPSE SOUND. NARWHALS CONCENTRATED IN THE CENTRAL PORTION OF TREMBLAY SOUND AND DISPERSED THROUGHOUT SOUTH MILNE INLET/KOLUKTOO BAY AREA. KILLER WHALES OBSERVED IN NORTH MILNE INLET.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT

2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

POND INLET LEG 2 SURVEY 5 - AUGUST 29-30, 2019

CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

PROJECT NO. 1663724

CONTROL 22000

REV. B

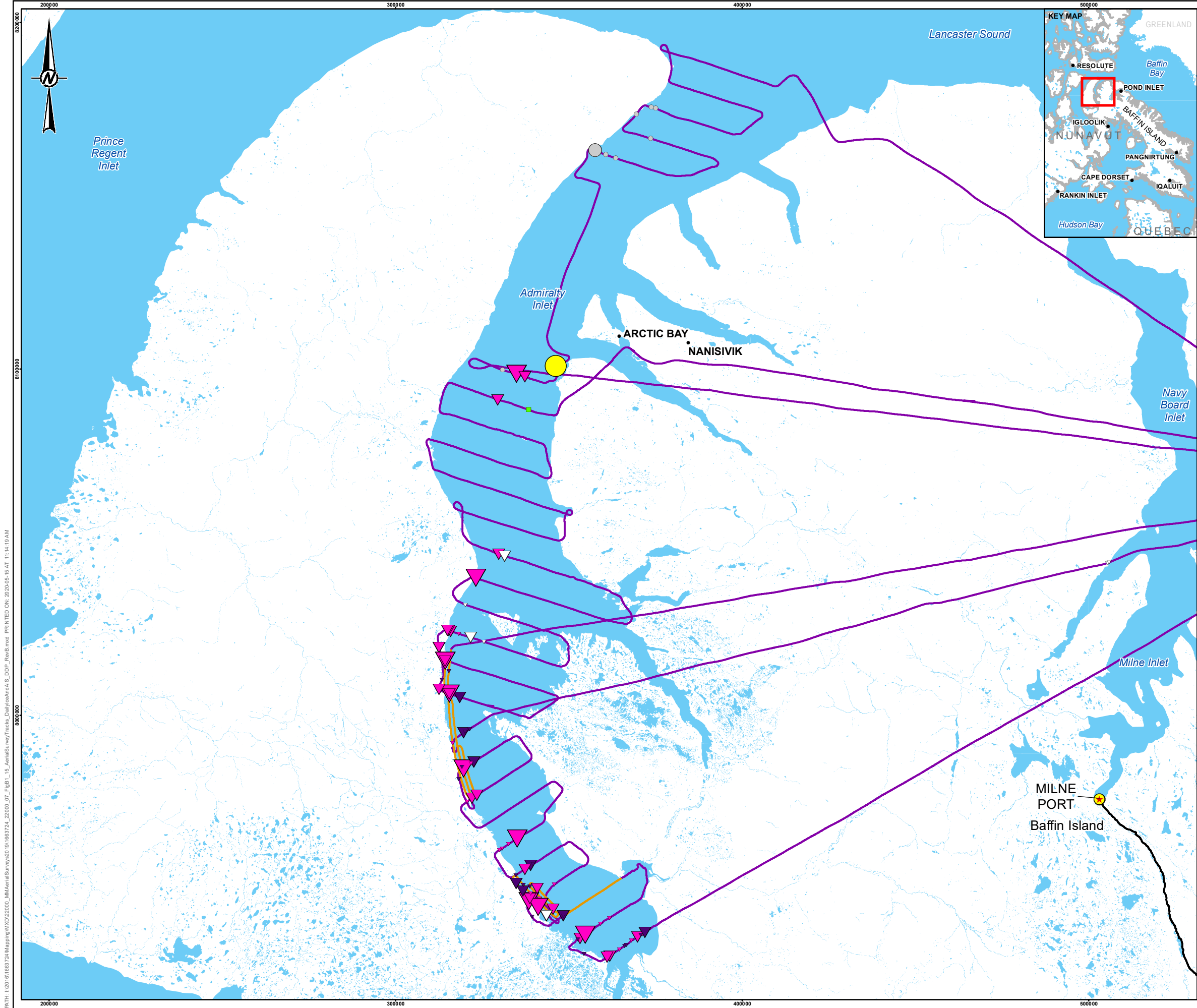
FIGURE B-10

DRAFT

0 25 50

1:900,000 KILOMETRES

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm



LEGEND

• COMMUNITY

★ MILNE PORT

□ PHOTO LOCATION

— MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

— PHOTOGRAPHIC

— VISUAL

— NUNAVUT SETTLEMENT AREA BOUNDARY

— WATERBODY

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

▼ 1

▼ 2 - 10

HARP SEAL

● 10+

NARWHAL

▼ 1

▼ 2 - 10

▼ 10+

POLAR BEAR

■ 1

UNIDENTIFIED SEAL/PINNIPED

● 1

● 2 - 10

UNIDENTIFIED WHALE/CETACEAN

▼ 1

▼ 2 - 10

NOTE(S)

CONDITIONS GOOD WITH BF 1-3 AND NO FOG IN SOUTHERN PORTION OF THE SURVEY AREA. MODERATE CONDITIONS FOR CENTRAL AND NORTHERN PORTION OF THE SURVEY AREA WITH BF 1-5 AND FOG ON NORTHERN TRANSECTS. NARWHALS CONCENTRATED IN SOUTHERN PORTION OF ADMIRALTY INLET ALONG THE WESTERN SHORE. THREE PHOTOGRAPHIC SURVEYS WERE FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT

2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

ARCTIC BAY LEG 2 SURVEY 1 - AUGUST 17-18, 2019

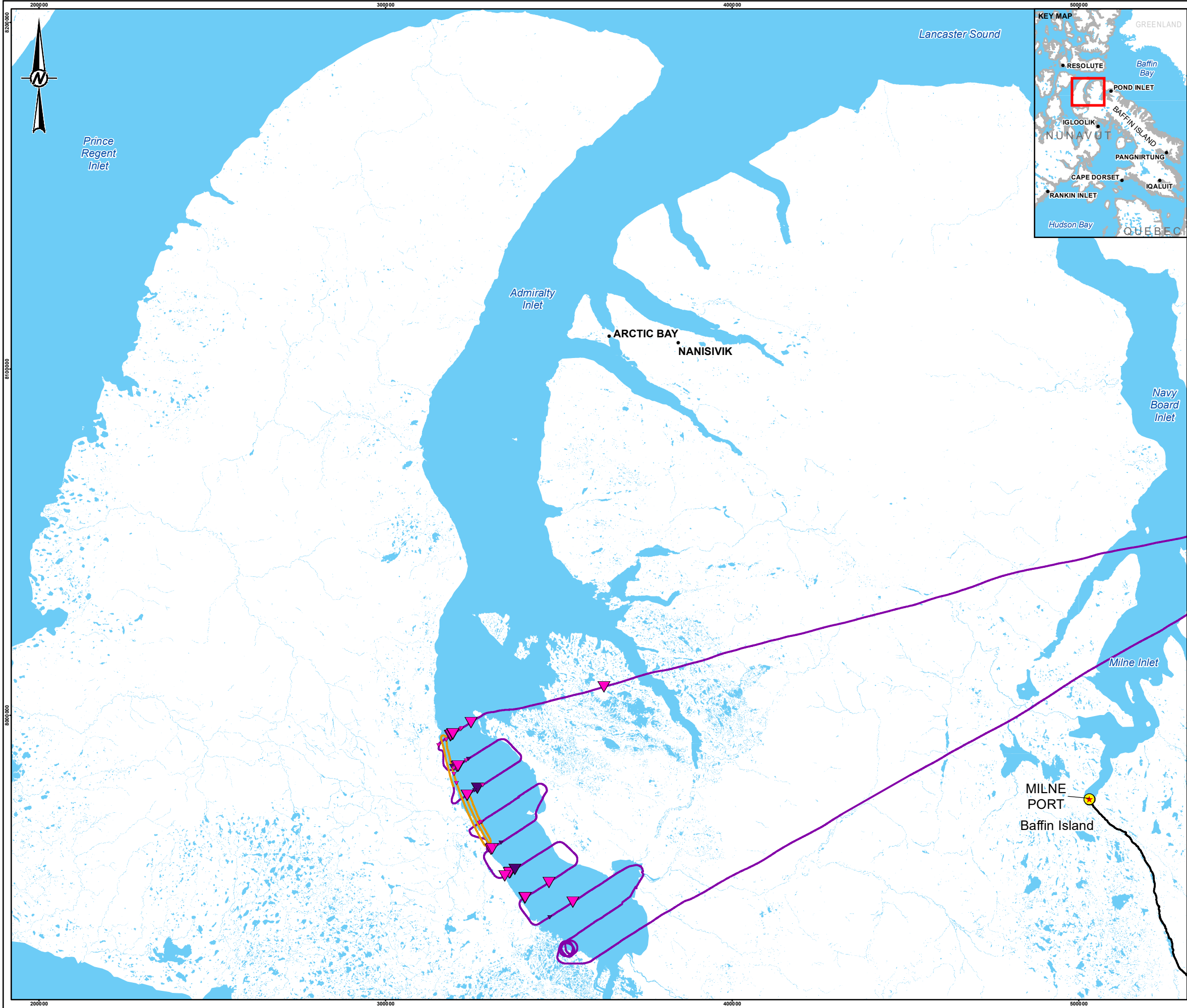
CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

GOLDER

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	22000	B	B-11

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LEGEND

• COMMUNITY

★ MILNE PORT

□ PHOTO LOCATION

— MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

— PHOTOGRAPHIC

— VISUAL

--- NUNAVUT SETTLEMENT AREA BOUNDARY

■ WATERBODY

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

▼ 1

▼ 2 - 10

NARWHAL

▼ 1

▼ 2 - 10

NOTE(S)

CONDITIONS GOOD WITH BF 1-3 AND NO FOG IN THE AREA. INCOMPLETE SURVEY DUE TO POOR CONDITIONS THE FOLLOWING DAYS. ONE PHOTOGRAPHIC SURVEY WAS FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT

2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

ARCTIC BAY LEG 2 SURVEY 2 - AUGUST 19, 2019

CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

PROJECT NO. 1663724

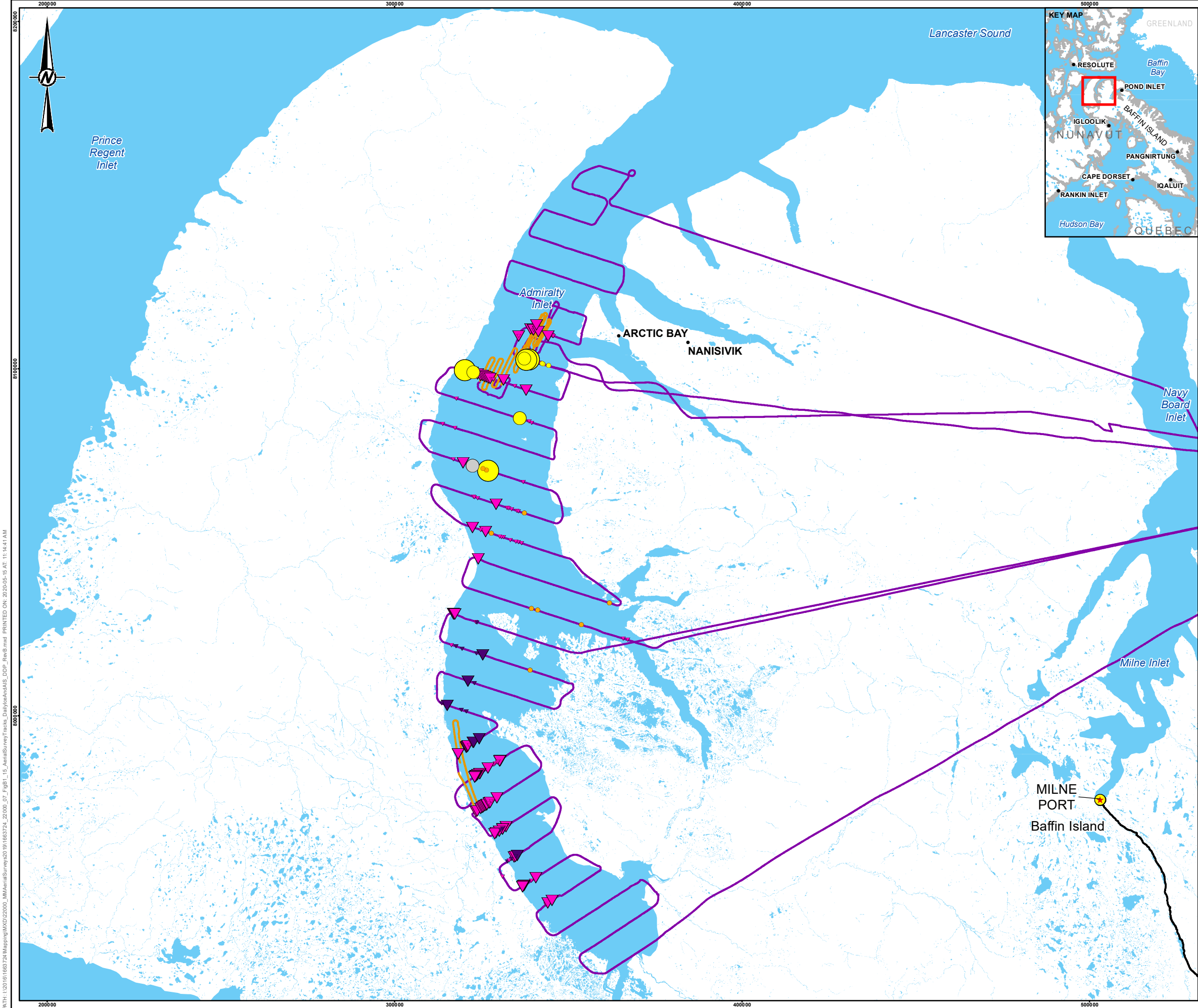
CONTROL 22000

REV. B

FIGURE B-12

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LEGEND

• COMMUNITY

★ MILNE PORT

□ PHOTO LOCATION

— MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

— PHOTOGRAPHIC

— VISUAL

— NUNAVUT SETTLEMENT AREA BOUNDARY

— WATERBODY

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

▼ 1

▼ 2 - 10

HARP SEAL

● 1

● 2 - 10

● 10+

NARWHAL

▼ 1

▼ 2 - 10

RINGED SEAL

● 1

UNIDENTIFIED SEAL/PINNIPED

● 2 - 10

NOTE(S)

CONDITIONS GOOD WITH BF 0-3 AND FOG ON THREE OF THE NORTHERN TRANSECTS. NARWHALS CONCENTRATED IN THE SOUTHERN PORTION OF ADMIRALTY INLET ALONG THE WESTERN SHORE AND IN THE CENTRAL PORTION OF THE INLET CLOSE TO ARCTIC BAY. FOUR PHOTOGRAPHIC SURVEYS WERE FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT

2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

ARCTIC BAY LEG 2 SURVEY 3 - AUGUST 21-22, 2019

CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

PROJECT NO. 1663724

CONTROL 22000

REV. B

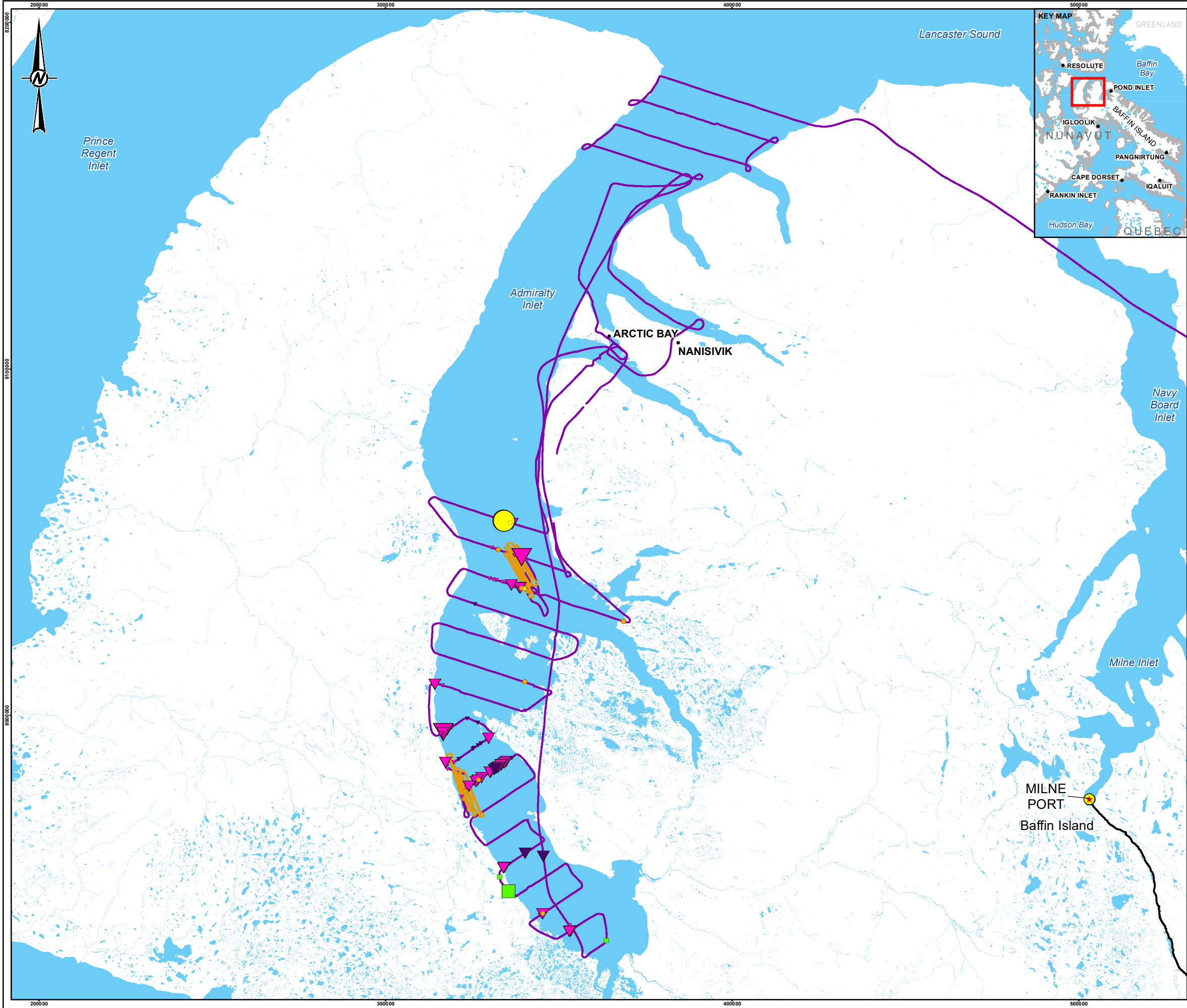
FIGURE B-13

DRAFT

0 30 60

1:1,100,000 KILOMETRES

25mm



LEGEND

● COMMUNITY

★ MILNE PORT

□ PHOTO LOCATION

— MILNE INLET TOTE ROAD

AERIAL SURVEY TRACK TYPE

— PHOTOGRAPHIC

— VISUAL

— NUNAVUT SETTLEMENT AREA BOUNDARY

— WATERBODY

MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)

BOWHEAD WHALE

▼ 1

▼ 2 - 10

HARP SEAL

● 1

● 10+

NARWHAL

▼ 1

▼ 2 - 10

▼ 10+

POLAR BEAR

■ 1

■ 2 - 10

RINGED SEAL

● 1

NOTE(S)

CONDITIONS MODERATE WITH BF 0-5 AND NO FOG. NARWHALS CONCENTRATED IN THE SOUTHERN PORTION OF ADMIRALTY INLET ALONG THE WESTERN SHORE AND IN THE CENTRAL PORTION OF THE INLET NORTH OF YEOMAN ISLAND. TWO PHOTOGRAPHIC SURVEYS WERE FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT

2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

ARCTIC BAY LEG 2 SURVEY 4 - AUGUST 25-27, 2019

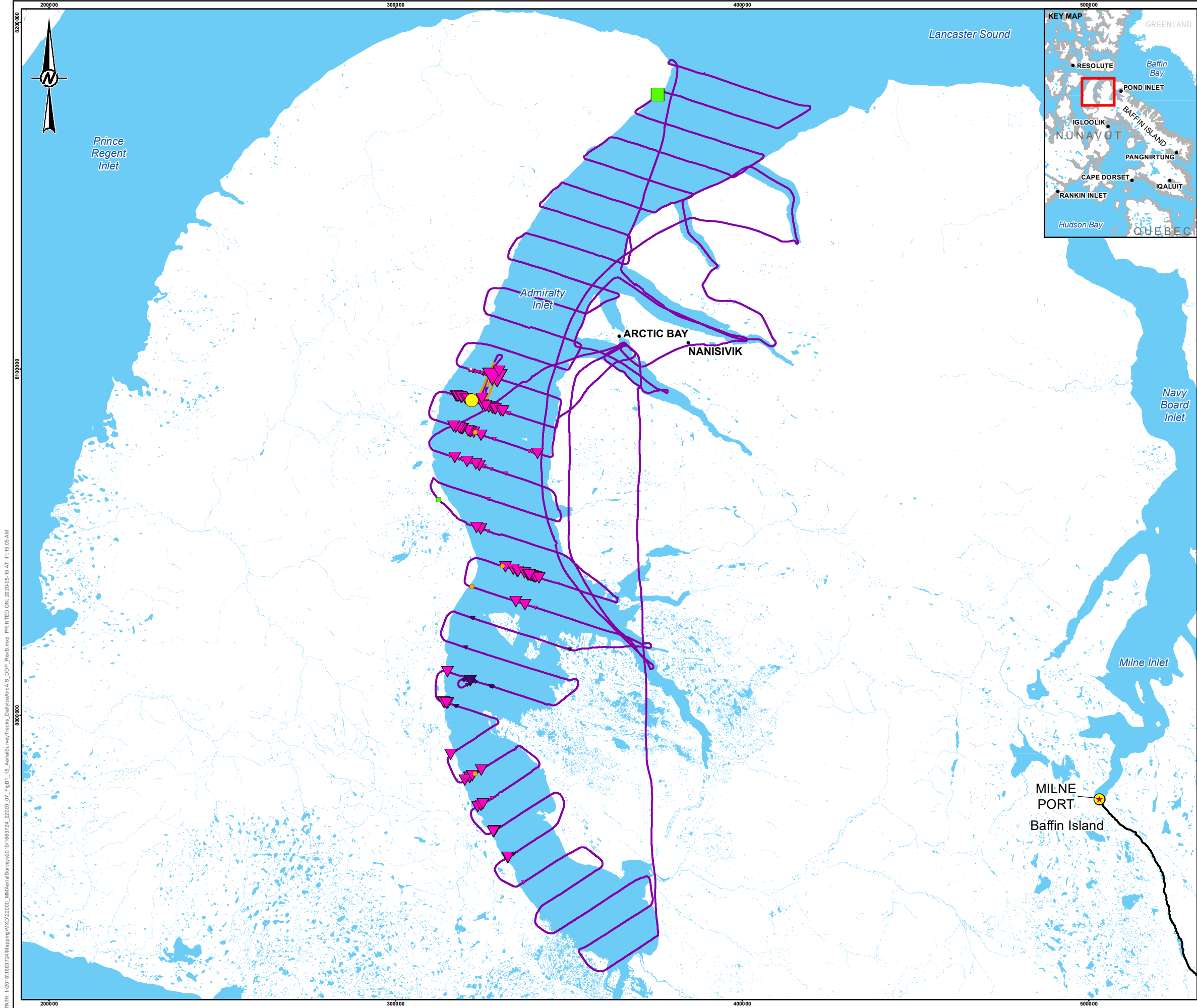
CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

GOLDER

PROJECT NO.	CONTROL	REV.	FIGURE
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LEGEND

- COMMUNITY
 - MILNE PORT
- PHOTO LOCATION
- MARINE MAMMAL SPECIES OBSERVATIONS (GROUP SIZE)
 - BOWHEAD WHALE**
 - 1
 - 2 - 10
 - HARP SEAL**
 - 1
 - 2 - 10
 - NARWHAL**
 - 1
 - 2 - 10
 - 10+
 - POLAR BEAR**
 - 1
 - 2 - 10
 - RINGED SEAL**
 - 1
 - UNIDENTIFIED WHALE/CETACEAN**
 - 1
- AERIAL SURVEY TRACK TYPE**
 - PHOTOGRAPHIC
 - VISUAL
- NUNAVUT SETTLEMENT AREA BOUNDARY
- WATERBODY

NOTE(S)

CONDITIONS MODERATE WITH BF 0-5 AND FOG ON PORTIONS OF THE NORTHERN FOUR TRANSECTS. NARWHALS CONCENTRATED IN THE CENTRAL PORTION OF ADMIRALTY INLET. ONE PHOTOGRAPHIC SURVEY WAS FLOWN.

REFERENCE(S)

MILNE PORT INFRASTRUCTURE DATA BY HATCH, JANUARY 25, 2017, RETRIEVED FROM KNIGHT PIESOLD LTD. FULCRUM DATA MANAGEMENT SITE MAY 19, 2017. ICE CONCENTRATION OBTAINED FROM CANADIAN ICE SERVICE, GOVERNMENT OF CANADA. DAILY ICE CHARTS – APPROACHES TO RESOLUTE BAY. ACCESSED SEPTEMBER 19, 2019. HYDROGRAPHY, POPULATED PLACE, AND PROVINCIAL BOUNDARY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. PROJECTION: UTM ZONE 17 DATUM: NAD 83

CLIENT

BAFFINLAND IRON MINES CORPORATION

PROJECT

MARY RIVER PROJECT
2019 MARINE MAMMAL AERIAL SURVEYS

TITLE

ARCTIC BAY LEG 2 SURVEY 5 - AUGUST 29-30, 2019

CONSULTANT	YYYY-MM-DD	2020-05-15
DESIGNED	TT	
PREPARED	AA	
REVIEWED	PR	
APPROVED	PR	

PROJECT NO.	CONTROL	REV.	FIGURE
1663724	22000	B	B-15

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25mm

DRAFT

APPENDIX C

Power Analysis

1.0 POWER ANALYSIS - METHODS

In statistics two types of outcome errors are possible and can mislead conclusions about the presence of detectable effects. A Type I error is concluding there is a significant effect when none exists (i.e., a false positive). Alpha (α) is the probability of committing a Type I error (Zar 1999). A Type II error is the probability of concluding there is no significant effect when there is a real effect of some specified magnitude (i.e., a false negative) (Zar 1999). Beta (β) is the probability of committing a Type II error. Effect sizes are the magnitude of the change or difference in the response variables, which in this report were the estimates of narwhal abundance. The power of a statistical test ($1 - \beta$) is the probability of detecting a valid statistical effect. The power of a statistical test depends on the alpha level, the effect size, the sample size, and the variability in the data. In this analysis, the Type I error-rate (α), also referred to as the significance level, was set to 0.05. The desired minimum statistical power was 80%, which corresponds to a Type II error-rate of 0.2.

The starting point for the power analysis were the narwhal abundance estimates from the 2019 aerial survey data (hereafter reference). Specifically, the two 2019 estimates used were the averages of the survey 3 and 4 (leg 2) estimates for the Eclipse Sound region and the combined Eclipse Sound and Admiralty Inlet regions (Table 1). Two power analyses were completed to evaluate the ability of the aerial survey program to track changes in narwhal abundance for Eclipse Sound and for combined surveys of Eclipse Sound and Admiralty Inlet completed in the same year.

Table 1: Reference narwhal survey abundance estimates for power analysis.

Average estimate for Leg 2, Surveys 3 and 4	Abundance	% coefficient of variation (CV)	Degrees of freedom
Eclipse Sound	9,931	4.97	6.45
combined Eclipse Sound and Admiralty Inlet	38,771	12.01	19.18

The power to detect statistically significant effects was estimated using the formula for comparing two abundance values in R v. 3.6.2 (R 2019), following the approach of Buckland et al. (2001). If two abundance estimates are independent, the difference in abundance by $\hat{N}_1 - \hat{N}_2$ can be estimated with variance

$$\widehat{var}(\hat{N}_1 - \hat{N}_2) = \widehat{var}(N_1) + \widehat{var}(N_2)$$

Distance provides the approximate degrees of freedom df_1 for \hat{N}_1 and df_2 for \hat{N}_2 , based on Satterthwaite's approximation. The degrees of freedom are used to obtain an approximate t -statistic:

$$T = \frac{(\hat{N}_1 - \hat{N}_2) - (N_1 - N_2)}{\sqrt{\widehat{var}(\hat{N}_1 - \hat{N}_2)}} \sim t_{df}$$

where

$$df \approx \frac{\{\widehat{var}(\hat{N}_1) + \widehat{var}(\hat{N}_2)\}^2}{\{\widehat{var}(\hat{N}_1)\}^2/df_1 + \{\widehat{var}(\hat{N}_2)\}^2/df_2}$$

The null hypothesis $H_0 : N_1 = N_2$ can be tested by substituting $N_1 - N_2 = 0$ in the t-statistic equation and looking at the resulting value in a t-table. Approximate $100 \cdot (1 - 2\alpha)\%$ confidence limits for $(N_1 = N_2)$ are given by:

$$(\hat{N}_1 - \hat{N}_2) \pm t_{df}(\alpha) \cdot \sqrt{\widehat{var}(\hat{N}_1 - \hat{N}_2)}$$

Since the interest in the detection of a change in narwhal abundance is a decrease, the analysis was limited to negative effect sizes (one-tailed t-statistic).

Effect Size Application and Data Simulation

For each of the narwhal abundance estimates in Table 1 (N_1), a range of negative effect sizes (decreases) were applied to the abundance estimates ranging from 1 to 60 %, and assumed that resulting abundance values (N_2) have the same CV and df, as the original estimates (N_1).

For each N_1 estimate and effect size test, the resulting $\hat{N}_1 - \hat{N}_2$ values were simulated based on the probabilities log-normal distribution. Ten-thousand simulated values were produced for every effect size tested and the proportion of the simulated values with a lower confidence limit that was greater than zero (one-tailed; $P < 0.05$), was interpreted as the statistical power of the test (i.e. the ability to detect a decrease in narwhal abundance).

2.0 POWER ANALYSIS – RESULTS

For the Eclipse Sound estimate, the power analysis indicated that there was sufficient power (>0.8) to detect a reduction in narwhal abundance at an effect size of -17% and high power (>0.9) was attained at effect size of -19% (Figure 1).

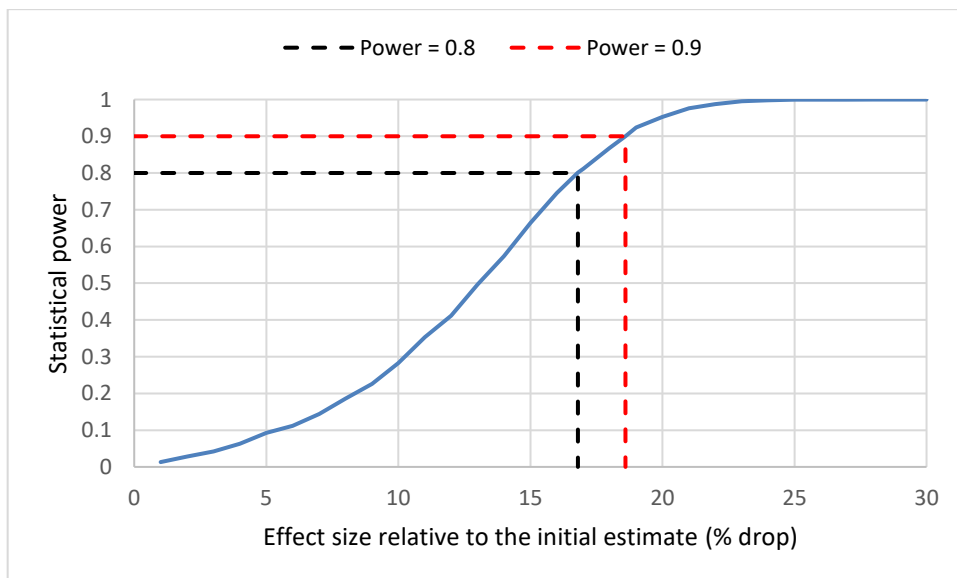


Figure 1: Statistical power to detect an effect size when using the Eclipse Sound estimate as a reference value.

For the combined Eclipse Sound and Admiralty Inlet abundance estimate, the power analysis indicated that there was sufficient power (>0.8) to detect a reduction in narwhal abundance at effect size of -36% and high power (>0.9) was attained at effect size of -39% (Figure 2).

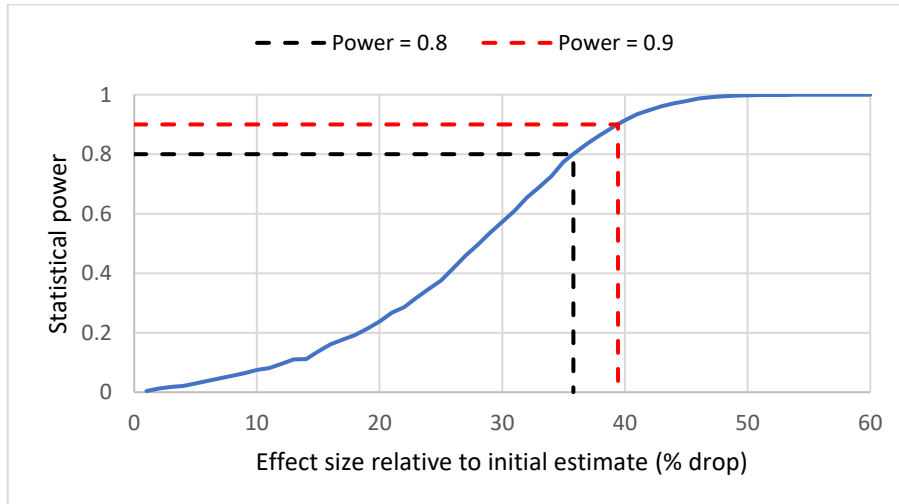


Figure 2: Statistical power to detect an effect size when using the combined Eclipse Sound and Admiralty Inlet estimate as a reference value.

Comparisons for abundance estimates more than one year apart

The statistical power calculated for these comparisons does not have a specific time scale and can be extrapolated to provide comparisons between surveys that occur more than one year apart. Assuming a constant rate of decrease, the reduction (effect size) necessary to achieve a power of 0.8 can be shared over a number of years, to provide an annual rate of decrease that achieves the same total effect size between the first and last years of the comparison. A comparison of the number of years between abundance estimates and the minimum annual rate of change that would be required to achieve a power of 0.8 is presented in Figure 3.

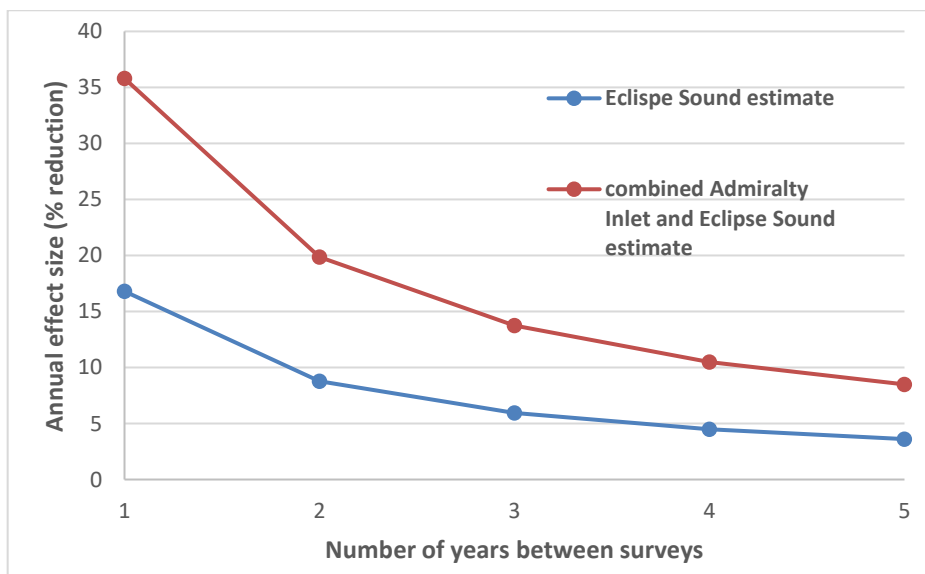


Figure 3: The annual effect size necessary to achieve a power of 0.8 (one tailed; $\alpha = 0.05$) based on increasing the number of years between survey estimates, using the two 2019 survey estimates as reference values.

3.0 POWER ANALYSIS USING THE LOG-LINEAR REGRESSION FRAMEWORK

Although this document's power analysis focused on the statistical comparison between two estimates, it is also possible to assess the statistical power for 3 or more estimates. When using the log-linear regression framework we can estimate the number of years of data required to achieve a desired power level, given a CV and alpha level. Although this method assumes a continuous time series of data at regular intervals (consecutive years of data in our example), it is still useful to assess the number of years of data required to achieve a power level in comparison to the two-sample test elaborated upon above. As described in Buckland et al. (2004), a model can be used to assess the number of years of data required to detect a log-linear population trend for a range of rates of change and CVs. Assuming the test is one-tailed (i.e. we are only interested in significant declines), the power ($1 - \tau$) of the t -test is given by

$$1 - \tau = 1 - F_t(t_{1-\alpha, v}, v, \eta)$$

Where $F_t(x, v, \eta)$ is the cumulative distribution function of the non-central t -distribution with v degrees of freedom and non-centrality parameter η , evaluated at x and $t_{\gamma, v}$ is the $100\gamma\%$ quantile from a central t distribution with v degrees of freedom. A contour map of the number of years of monitoring required to achieve a power of 0.8 at $\alpha = 0.05$ at varying CV values, is presented in Figure 4. Based on the observed CVs for Eclipse Sound and combined Eclipse Sound and Admiralty Inlet (Table 1), approximately 5 years of monitoring with a 5% CV would be required for the power to detect a 10% annual decrease in abundance while approximately 7 years of data with a 12% CV would be required for the power to also detect the same decrease in abundance. Likewise, fewer years are required for 0.8 power to detect larger annual rates of decline and more years are required for 0.8 power to detect smaller annual rates of decline. This method is not suited to short temporal time-series datasets since the degrees of freedom for the regression are calculated as the number of samples (years) minus 2 (i.e. this is why 3 years of data will not detect a decline on Figure 4, regardless of the precision of the CV or the annual rate of decrease).

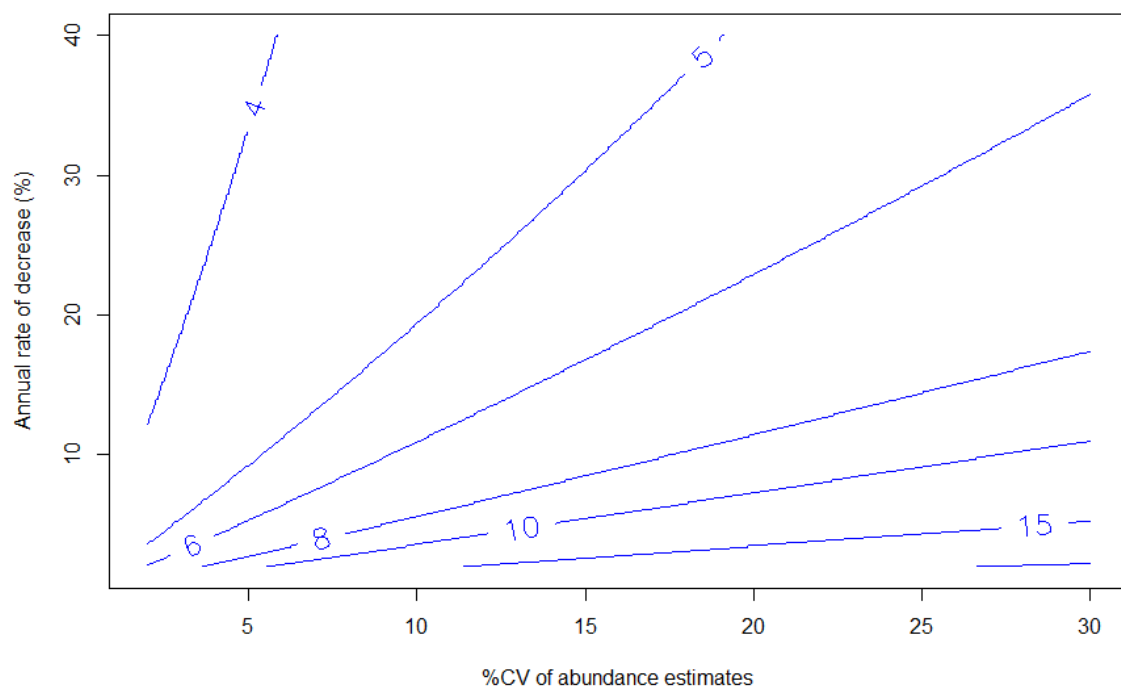


Figure 4: The number of years of monitoring required (blue values) across a variety of log-linear effect sizes and CVs at a power of 0.8 (one-tailed t-test assuming $\alpha = 0.05$).

4.0 CONCLUSION

The magnitude of effect size required to achieve a power level is dependent on the CV of the reference estimate and the assumption that CV is constant through time. Since the CV of the reference estimates was directly influenced by the percentage of sightings that occurred within the estimate's photographic surveys, the Eclipse Sound estimate had a lower CV and in turn, indicated that smaller effect sizes could be used to achieve the desired power levels when compared to the combined Admiralty and Eclipse estimate. The test statistic used in the power analysis can also be used to compare current and future abundance estimates to identify whether a decrease in abundance is statistically significant.

If future aerial surveys use the same survey methods and capture a similar percentage of narwhal by photographic surveys, then the future surveys will likely achieve a similar precision (CV) of their estimates. Thus, the results of the power analysis indicate that declines of 17% in the Eclipse Sound regional abundance estimate and 36% in the combined Eclipse Sound and Admiralty Inlet regional abundance estimate can be detected. Increasing the number of years between estimates assumes a constant rate of decline that is cumulatively equal to these effect sizes and detectable at the same power level.

Although it is possible to use a log-linear regression model to estimate the power required to detect an effect size or to detect a significant decrease in abundance, this method requires a long temporal time-series dataset to outperform the two-sample comparison, which currently precludes this analysis method for this dataset.

References

- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford, xv + 432 p.
- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L., and Thomas, L. 2004. Advanced distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford, 416 p. The companion R code used to create some the figures in this reference document, and the code which Figure 4 is based on, is available at: <http://lenthomas.org/software/rtrend.zip>.
- R Core Team. 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
- Zar, Jerrold H. 1999. Biostatistical Analysis. Prentice Hall, 663p.

[https://golderassociates.sharepoint.com/sites/11206g/technical/22000 2019 marine mammal aerial survey program/reporting/revb for wp/appendices/appendix c_power analysis/appendix c_power analysis 12may2019.docx](https://golderassociates.sharepoint.com/sites/11206g/technical/22000%2019%20marine%20mammal%20aerial%20survey%20program/reporting/revb%20for%20wp/appendices/appendix%20c_power%20analysis/appendix%20c_power%20analysis%2012may2019.docx)

APPENDIX D

MWO Questionnaire

2019 Aerial Survey Program Participant Survey

Date: _____
Name: _____
Phone Number: _____
Email Address: _____
Address: _____

Anything else to add?

Program Design

1. What was your personal experience with the aerial survey program? Explain what you did or did not like about it?
2. Is there anything you would suggest changing or modifying in the future? Is there anything you think should not change in the future?
3. Do you think that running aerial survey programs helps understand how shipping might be affecting marine mammals?
4. Do you think the transects are at a good distance from one another? Do you think that the number of transects accurately covered the area that marine mammals use? Should more transects be added? Or should some be removed?
5. When is the best time to do these aerial surveys to count narwhal?
6. What do you think of the elevations the plane flies at? Could you see marine mammals well enough to count them? Did you notice if the plane disturbed the marine mammals?
7. What did you learn working with the biologists on the aerial survey?
8. What do you think the biologists learned from you working on the aerial surveys this summer?
9. What areas do you think are most important for narwhal? For other marine mammals? Why?

Data Analysis

1. When do narwhals gather at the floe edge?
2. Do you notice marine mammals in or around the ice breakup? Where?
3. Do you think that the number of narwhal that you saw from the plane is a good indicator of the number of narwhal that hunters are seeing on the water?
4. What do you consider to be one group of narwhals?
5. Have you seen any vessels during the aerial surveys? Were there any marine mammals in the area? If so, how were they behaving?
6. Did you see anything during the program that you did not expect to see?

Reporting

1. What do you think is the best way to describe the studies that were undertaken for the aerial survey program this year?
2. What is the best way to communicate results to the residents of Pond Inlet?
3. What do you think people will be most interested in hearing about?

Adaptive Management

1. Has your opinion of the impact of shipping activities on marine mammals changed since you participated in the program?
2. Do you have any suggestions to improve how we are monitoring for shipping effects on narwhal, or marine mammals in general?

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