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Oil-Spill Risk Analysis: Liberty Development and Production Plan

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Introduction

The proposed Liberty development and production plan (DPP) pertains to Outer Continental Shelf (OCS) activities on lease OCS-Y-1650 (Sale 144) in the Beaufort Sea. The estimated amount of oil reserves likely to be discovered and produced at the Liberty development project is assumed to be 0.12 billion barrels (Bbbl). This report examines the probabilities of occurrence and contact of hypothetical oil spills if the Liberty DPP proceeds and commercial quantities of oil are produced.

Because oil spills may occur from activities associated with offshore oil production and transportation, the Minerals Management Service (MMS) formally assesses the risk of hypothetical oil spills. When evaluating the significance of accidental oil spills, keep in mind that the occurrence of such spills is fundamentally a matter of probability. No one can certify the volume of oil that would be produced or the size or likelihood of a spill that would occur during the assumed 16-year production life (2000-2015) of the project. Neither can anyone know for certain the factors that affect spills such as the wind, ocean current, or ice conditions. Although some of this uncertainty is due to incomplete and imperfect data, a considerable amount exists simply because future events are difficult to estimate. For example, no one can predict a probabilistic event such as an oil-spill occurrence—one can only estimate or quantify its likelihood or probability. However, analysts and decisionmakers must consider the possible effects of oil spills that could occur from oil production. To maintain perspective, each potential effect must be associated with a quantitative estimate of its probability of occurrence.

This report summarizes results of the oil-spill risk analysis (OSRA) conducted for the Liberty DPP. The objective of this analysis was to estimate the relative oil-spill risks associated with oil production and transportation from the proposed pipeline alternatives. The MMS will analyze these oil-spill risks in the environmental impact statement (EIS) being prepared for the proposed Liberty DPP. A description of the OSRA model used in this analysis can be found in previous papers (Smith et al., 1982; LaBelle and Anderson, 1985).

The analysis for the proposed Liberty DPP was conducted in three parts, corresponding to different aspects of the overall situation.

- The first part addressed the probability of oil-spill occurrence.
- The second part addressed trajectory simulations of oil spills from hypothetical spill sites to various environmental resource areas or land segments.
- The third part combined the results of the first two to estimate the combined probability of oil-spill risk if there is oil production.

Summary of the Proposed Action

The Liberty development project is located on lease OCS-Y-1650 in Foggy Island Bay. The OSRA study area extends from latitude 68.5° N. to 73° N. and from longitude 134° W. to 160° W. (fig. 1). The proposed Liberty development project will use a self-contained offshore drilling/production facility located on a conventional gravel island with

subsea pipeline to shore (fig. 2). This island will be built in Foggy Island Bay, in approximately 22 feet (6.7 m) of water about 1.5 miles (2.4 km) west of the abandoned Tern Island.

Trajectories were simulated from the proposed platform site (launch site LI) in Foggy Island Bay to represent hypothetical platform spill occurrences (figs. 1 and 2). The proposed transportation scenario assumes that the crude oil produced at hypothetical launch site LI will be transported by pipeline to shore, with potential landfall at approximately 1.9 miles (3.1 km) west of the Kadleroshilik River (fig. 2). The analysts use these hypothetical offshore pipeline route segments (PP1-PP2) to represent spill risks from oil transportation. An alternative pipeline scenario (pipeline route segments AP1-AP2) assumes that the pipeline makes landfall approximately 2 miles (3.2 km) east of the Kadleroshilik River (fig.2). This scenario assumes that the oil is then transported by the Badami onshore pipeline to Pump Station #1 of the Trans-Alaska Pipeline System.

Framework of the Analysis

The oil-spill risk analysis depends not only on the meteorologic, oceanographic, geographic, and sea-ice conditions of the study area, but also on the environmental resource areas at risk from oil spills and the estimated volume of oil reserves assumed to be discovered, produced, and transported.

Environmental Resource Areas

The MMS analysts in the Alaska OCS Region, who will prepare the EIS for the Liberty DPP, selected 53 environmental resource areas to be analyzed. Appendix A (figs. A-1 through A-6) contains maps showing the locations of these areas. These environmental resource areas were digitized in the same coordinate system, or base map, used for the trajectory simulations; they comprise Ice/Sea Segments 1-7 and 46 other areas of concern. Each environmental resource area that is typically present year-round was treated as being vulnerable to oil all year. This method assumes that the environmental resource area is sensitive to oil-spill effects throughout the entire year rather than seasonally. Each environmental resource area not usually present year-round was treated as vulnerable to contact from oil spills only during the months it is likely to be present. The digitized environmental resource areas, their months of vulnerability, and the illustration depicting their locations are listed below.

Because the trajectory model simulates an oil spill as a point, each environmental resource area was digitized with an areal extent slightly greater than it actually occupies. For example, the digitized shoreline environmental resource areas extend a short distance offshore. This extension allows the OSRA model to simulate a spill that approaches and partially contacts the environmental resource area (or boundary segment), then withdraws and continues along its path. For this analysis, the model calculated trajectory simulations over two seasons—winter (October-June) and summer (July-September).

Environmental Resource Area	Months Assumed Vulnerable	Figure
Ice/Sea Segments 1-7; Flaxman Island (15); and Boulder Patch 1 (37)	January-December	A-3
Jones Island (8); West Dock Causeway (10); Environmental Resource Area 29, and Boulder Patch 3 (30)	January-December	A-4
Return and Jones Islands (9) and McClure and Karluk Islands (12)	January-December	A-5
Endicott Causeway (11)	January-December	A-1
Stockton Islands (13)	June-September	A-4
Maguire Islands (14)	January-December	A-2
Environmental Resource Areas 16-21, 42-44, and 49-50	May-October	A-1
Prudhoe Bay (22)	May-September	A-2
Midway Island (23); Boulder Patch 2 (31); and Environmental Resource Areas 24-25, 32-34, and 46-47	May-October	A-2
Whaling Area/Cross Island (26) and Whaling Area/Narwhal Area (41)	August-October	A-5
Cross Island (27)	August-October	A-3
Whaling Area (28)	August-October	A-1
Tigvariak Island (35)	April-October	A-5
Newport Entrance (36) and Arey Lagoon (52)	May-October	A-5
Narwhal Island (38)	August-October	A-4
Environmental Resource Areas 39-40	May-October	A-4
Bullen Point (45) and Simpson Cove (51)	May-October	A-3
Canning River (48)	May-September	A-4
Whaling Area/Kaktovik (53)	August-October	A-2

Note: Numbers in parentheses (#) indicate the number used for identification in Appendix A.

The locations of 19 *boundary segments* (B1-B19) located along the edges of the study area were also digitized in the same coordinate system to quantify spill trajectories that may travel out of the study area (fig. A-6). Each boundary segment was treated as being vulnerable all year.

Also included in the analysis was an additional environmental resource area, Land, which comprised the entire study area coastline. Upon contacting land, the trajectory simulation is ended. Land was further analyzed by dividing the study area coastline into 51 land segments (fig. 3), most of approximately equal lengths (24 km) except for land segments 20-31, which were approximately half that length.

Estimated Volume of Oil Reserves

For this analysis, both benefits and risks are functions of the volume of oil and are mutually dependent. For example, greater volumes of oil are associated with greater economic benefits as well as greater risks. If the benefits are evaluated by assuming production of a specific amount of oil, then the corresponding risks should be stated conditionally, such as "the risks are . . . , given that the volume is . . . ." Any statements about the likelihood of a particular volume of oil being present apply equally to the likelihood of the corresponding benefits and risks.

The oil-spill risk calculations in this report use the same estimated volumes of oil reserves that will be used in the draft EIS for the Liberty DPP. The hypothetical development and transportation scenario for the proposed action is contingent on an assumed 0.12 Bbbl of oil reserves (Liberty Development Project Environmental Report, BP Exploration (Alaska) Inc., February 17, 1998).

It should be emphasized that these estimates and the following analyses assume that geologically recoverable quantities of oil are present. If no economically recoverable quantities of oil are present, no oil-spill risks exist from OCS production.

Oil-Spill Risk Analysis (OSRA)

The OSRA consists of three parts:

(1) the **probability of oil spills occurring,**
(2) the **oil-spill trajectory simulation,** and
(3) the **combination of oil-spill occurrence and trajectory simulations.**

The analysis assumes that exploration and development will take place over 5 years (1998-2002) and production will span a period of 16 years (2000-2015).

(1) Probability of Oil Spills Occurring

Outer Continental Shelf Spill Rates: Anderson and LaBelle (1994) examined oil-spill occurrence rates applicable to the U.S. Outer Continental Shelf (hereafter referred to as OCS). Their results were adjusted for recent experience and based upon more complete databases than those available for earlier analyses (Anderson and LaBelle, 1990; Lanfear and Amstutz, 1983); the results indicated some significant changes in the spill rates for platforms and pipelines. This report uses these updated spill occurrence rates. Based on the spill data examined, Anderson and LaBelle (1994) found the spill rates for spills greater than or equal to 1,000 bbl are as follows:

- OCS platforms—0.45 spills/Bbbl of produced oil
- OCS pipelines—1.32 spills/Bbbl of transported oil

Estimating Spill Rates: The probability of oil spills occurring (given that economically recoverable quantities of oil are present) assumes that spills occur independently of each other as a Poisson process. The Poisson process is a statistical distribution commonly used to model random events. The probability of oil spills occurring is based on a spill rate

derived from past OCS platform and pipeline experience in U.S. waters and depends on the volume of oil produced and transported. This analysis considers all types of accidental oil spills greater than or equal to 1,000 barrels (bbl). These spills include not only well blowouts but also other accidents that occur on platforms and during transportation of oil to shore. These accidents were classified as either platform or pipeline spills. This classification allows the analyst to compare the risks from each spill source between the proposed action and any alternatives.

Spill rates are expressed as number of spills per billion barrels (spills/Bbbl) of oil produced or transported. Only spills greater than or equal to 1,000 bbl are addressed because smaller spills may not persist long enough to be simulated by trajectory modeling. Another reason is that a large spill is likely to be identified and reported; therefore, these records are more comprehensive than those of smaller spills. (Other MMS environmental analyses address small, chronic spillage without the use of trajectory modeling.)

Two basic criteria were used in selecting the risk exposure variable:

- the exposure variable should be simple to define and
- it should be a quantity that can be estimated.

The volume of oil produced or transported was the chosen exposure variable primarily for the following reasons:

- historic volumes of oil produced or transported are well documented,
- using these volumes makes the calculation of the estimated oil-spill occurrence rate simple—the ratio of the number of historic spills to volume of oil produced or transported, and
- future volumes of oil production and transportation are routinely estimated.

British Petroleum Exploration (Alaska) Inc. (BPXA) provided MMS with estimates of the oil reserves at Liberty. The MMS reviewed BPXA's estimates and found them to be reasonable, given the current mapping and knowledge of the reservoir stratigraphy.

Anderson and LaBelle (1994) analyzed platform and pipeline spills that occurred on the OCS from 1964 through 1992. In these analyses, they examined and verified all spill records to the furthest extent possible. They classified each spill according to its applicability to the analysis for size, product spilled, and spill source.

Earlier, Anderson and LaBelle (1990) applied nonparametric tests to determine whether OCS platform and pipeline spills from 1964 through 1987 were random and independent. The volume of oil produced and transported during these spill events appeared to be nonrandom, increasing over time. Extending the data through 1992, Anderson and LaBelle (1994) showed that the OCS platform spill rate continued to decline. However, with the occurrence of four pipeline spills between 1988 and 1992, there was no longer any evidence of a corresponding decrease in the estimated OCS pipeline spill occurrence rate.

The platform spill rate reflects the observed decline in spill occurrence mentioned above. This rate is based on the most recent 73 percent of the production record, which includes only 27 percent of the historic platform spills (3 spills/6.6 Bbbl). The pipeline spill rate, however, is based on the entire OCS production (transportation) and pipeline spill records (12 spills/9.1 Bbbl).

As mentioned at the beginning of this section, oil-spill occurrences (spills ≥1,000 bbl) are considered to be governed by a Poisson process (Smith et al., 1982; Lanfear and Amstutz, 1983). The probability of a specific number of spills $p(n)$ occurring is described by the Poisson distribution:

$$p(n) = \frac{e^{-\lambda} * \lambda^{n}}{n!}$$

where n is the specific number of spills (0, 1, 2, ..., n), e is the base of the natural logarithm, and λ is the parameter of the Poisson distribution. For oil spills, the Poisson parameter (λ) is equal to the spill rate multiplied by the volume of oil to be produced or transported. The spill rate has dimensions of number of spills/Bbbl, and the volume is expressed in Bbbl. Therefore, λ denotes the mean number of spills estimated to occur as a result of production or transportation of a specific volume of oil.

Oil-spill occurrence estimates for spills greater than or equal to 1,000 bbl were calculated for production and transportation of oil during the assumed production life of the proposed action (2000-2015). As shown in table 1, the mean number of spills estimated to occur and the probability of one or more spills occurring **in the study area** over the assumed production life of the proposed project are as follows:

Mean Number of Spills:	0.21
Probability of One or More Spills:	19%

This analysis addresses only the risk of platform and pipeline spills from the production of oil reserves from the Liberty development project and the transportation (via offshore subsea pipeline) of these reserves to the Trans-Alaska Pipeline System. Historically, North Slope crude transported via the Trans-Alaska Pipeline System is loaded onto tankers at Valdez, Alaska (the pipeline terminus), and shipped to the U.S. west coast and other destinations. These crude oil movements have a historic spill rate of 1.10 spills (≥ 1,000 bbl) per billion barrels handled (Anderson and LaBelle, 1994). Using this rate and assuming the Liberty development project reserves are transported by tanker from Valdez, the mean number of spills and the probability of one or more spills associated with the movement of the Liberty crude from Valdez occurring **outside the study area** are estimated to be as follows:

Mean Number of Spills:	0.13
Probability of One or More Spills:	12%

(2) Oil-Spill Trajectory Simulations

The trajectory simulation portion of the model consists of many hypothetical oil-spill trajectories that collectively represent the mean surface transport and the variability of the surface transport as a function of time and space. The trajectories represent the Lagrangian motion that a particle on the surface might take under given wind, ice, and ocean current conditions. Multiple trajectories are simulated to give a statistical representation, over time and space, of possible transport under the range of wind, ice, and ocean current conditions that exist in the area.

Trajectories are constructed from simulations of wind-driven and density-induced ocean flow fields, and the ice motion field. The basic approach is to simulate these time and spatially dependent currents separately, then to combine them through linear superposition to produce an oil-transport vector. This vector is then used to create a trajectory. Simulations are performed for two seasons, winter (October-June) and summer (July-September). The choice of this seasonal division was based on meteorological, climatological, and biological cycles, as well as consultation with Alaska Region EIS analysts. Hedström et al. (1995), and Hedström (1994) detail the modeling of each ice motion field and ocean current component. Brief summaries of the methods and assumptions follow.

For cases where the ice concentration is below 80 percent, each trajectory is constructed using vector addition of the ocean current field and 3.5 percent of the instantaneous wind field—a method based on work done by Huang and Monastero (1982), Smith et al. (1982), and Stolzenbach et al. (1977). For cases where the ice concentration is 80 percent or greater, the model ice velocity is used to transport the oil. Equations 1 and 2 show the components of motion that are simulated and used to describe the oil transport:

$$U_{oil} = U_{current} + 0.035\, U_{wind} \qquad (1)$$

or

$$U_{oil} = U_{ice} \qquad (2)$$

where: U_{oil} = oil drift vector
$U_{current}$ = current vector (when ice concentration < 80%)
U_{wind} = wind speed at 10 m above the sea surface
U_{ice} = ice vector (when ice concentration ≥ 80%)

The wind drift factor was estimated to be 0.035, with a variable drift angle ranging from 0° to 25° clockwise. The drift angle was computed as a function of wind speed according to the formula in Samuels et al. (1982). (The drift angle is inversely related to wind speed.)

For each trajectory simulation, the start time for the first trajectory was the first day of the season (winter or summer) of the first year of wind data (1978) at 6 a.m. Greenwich Mean Time (GMT). Each subsequent trajectory was started every 1.5 days on average, at 6 a.m. GMT. A total of 2,000 trajectories (1,500 in winter, 500 in summer) was

launched from proposed gravel island LI over the 9 years of wind data (1978-1986), and results of these trajectory simulations were combined to represent platform risk (fig. 2). Transportation risks were represented by 2,000 trajectories launched uniformly along each hypothetical pipeline route segments (PP1, PP2, AP1, and AP2—fig.2).

For the Beaufort/Chukchi Sea, the $U_{current}$ and U_{ice} are simulated using a three-dimensional coupled ice-ocean hydrodynamic model (Hedström et al., 1995; Hedström, 1994). This model is based on the ocean model of Haidvogel et al. (1991) and the ice model of Hibler (1979). The location of each trajectory at each time interval is used to select the appropriate ice concentration. Depending on the ice concentration, either the ice or water velocity with wind drift from the stored results of the Haidvogel et al. (1991) coupled ice-ocean model is used (see eq. 1 and 2 above). Surface transport of the oil slick for each spill was simulated as a series of straight-line displacements in 3-hour increments of a point governed by the U_{oil} vectors.

The trajectories age while they are in the water/on the ice. For each day that the hypothetical spill is in the water, the spill ages—up to a total of 30 days. While the spill is in the ice (≥80% concentration), the aging process is suspended. The maximum time allowed for the transport of oil in the ice is 180 days after which the trajectory is terminated. The 30-day limit is maintained for spill trajectories in open water.

Summer trajectories are those that start between the beginning of July and the end of September. Therefore, any trajectory contact to an environmental resource area, land segment, or boundary segment beginning at the end of September is considered a *summer contact* and is counted along with the rest of the contacts from spills launched in the summer.

The wind data set used came from the National Weather Service Limited Fine Mesh (LFM) model (Gerrity, 1977), and the 9-year simulation covered both the low-frequency variability and interannual variability. A major assumption used in this analysis is that the ice motion velocities and the ocean daily flows calculated by the coupled ice-ocean model adequately represent the flow components. Sensitivity tests and comparisons with data illustrate that the model captures the first-order transport and the dominant flow (Hedström et al., 1995).

After quality assurance checks (performed by MMS) were passed, the trajectories were used in the OSRA model structure. The OSRA model was run, given the land/boundary segments and environmental resource areas specified for this analysis. Plots of trajectories and overlays of land/sea segments and environmental resource areas were examined to ensure that contacts were properly established and tabulated. The quality assurance checks provide an important means of gaining information and insight into the behavior of the simulated trajectories. The conditional probabilities of contact (tables 2 through 13 and appendices B and C) offer the analyst much oceanographic information. Some summary information is provided below to help identify the particular trajectory behavior.

When examining any one trajectory, it is important to be aware of the relative scales or sizes of the flow components that have been combined to produce the final U_{oil} vector. The wind-induced surface drift is the dominant component of U_{oil} except where the density-induced circulation is very strong or where the ice concentration is greater than or equal to 80 percent. In addition, the wind-driven flow component contains seasonal trends as well as a large degree of variability. Because many other factors are related to wind forcing (such as mixing in the surface layer and biological, chemical, and physical processes), it is useful to compare the envelopes of the trajectories to seasonal mixing regimes and processes. Some information can be gained by comparing trajectories from winter versus summer (when wind speeds and ice concentration are high versus low).

The second dominant transport factor is the density-induced flow. This forcing results in well-organized, coherent envelopes that follow the general trend of the coastline. The degree to which wind forcing plays a role in the nearshore areas has been studied as part of the Beaufort Mesoscale Circulation Study (Aagaard et al., 1990), and there is often a reinforcement of the wind-driven component by the density-driven component.

An important test is to compare observed drifter tracks with trajectories. Some historic data exist (Colony and Thorndike, 1984; Aagaard et al., 1990), but comparing drifter tracks with trajectories must be done carefully, especially considering the ice station trajectories. Ice stations on large flows that are at the ice edge move differently than ice stations in the pack ice. In general, the results of the coupled ice-ocean hydrodynamic model show these features at the correct location and magnitude, meeting the zero-th order test of the basic model. As expected, the simulated trajectories appear more variable than these drifter tracks. To a large degree, the U_{oil} transport vector has components of wind-driven and surface-driven motion. Thus, the observations and simulations contain similar trends, but an exact match should not be expected.

In conclusion, the spill trajectories for the Liberty development project show distinct variations in response to the seasonal wind patterns and the strength of density-driven currents. Hypothetical spills on the shelf show the wind-induced variability and the relatively important density-driven current along the Beaufort Sea coast. Landfall or trajectory contact is generally highest year-round for points located west of hypothetical launch site LI, with contacts east of this site occurring in the summer.

As the simulated oil spills moved, any contacts with environmental resource area were recorded. Spill movement continued until the spill contacted land, moved out of the study area, or aged more than 30 days in open water or 180 days in ice conditions.

The trajectories simulated by the model represent hypothetical pathways of oil slicks; they do not directly consider cleanup, dispersion, or weathering processes that could determine the quantity or properties of the oil that might eventually contact environmental resource areas or land segments. An implicit analysis of weathering and decay can be considered by noting the age of simulated trajectories when they contact environmental resource areas. For this analysis, the periods selected were 3, 10, and 30 days (60, 90, and 180

days in ice conditions) to represent implicit measures of oil weathering as well as matters relating to containment and cleanup.

***Conditional Probabilities*:** The probability that an oil spill will contact a specific environmental resource area, land, or boundary segment within a given time of travel from a certain location or spill site is termed a *conditional probability*, the condition being that a spill is assumed to have occurred. Conditional probabilities of contact for 3, 10, and 30 days (60, 90, and 180 days in ice conditions) were calculated for the gravel island (referred to as LI—figs. 1 and 2) and for the pipeline route segments (referred to as PP1, PP2, AP1, and AP2—fig. 2). These conditional probabilities of contact with environmental resource areas and land segments are presented on an annual basis in tables 2 through 13 and, on a seasonal basis in appendices B and C.

(3) Combined Analysis of Oil-Spill Occurrence and Oil-Spill Trajectory Simulations

A critical difference exists between the conditional probabilities and the combined probabilities calculated in this part of the OSRA. *Conditional probabilities* assume that a spill has occurred and, thus, depend only on the winds, ice, and ocean currents in the study area. *Combined probabilities*, on the other hand, depend not only on the physical conditions, but also on the chance of spill occurrence, the estimated volume of oil to be produced or transported, and the oil transportation scenario. The annual combined probabilities for this analysis are presented in tables 14 -17.

In calculating the combined probabilities, those that represent probabilities of both oil-spill occurrence and contact, the following steps are performed.

1. For a set of n_t environmental resource areas and n_l spill sites, the conditional probabilities can be represented in a matrix form. Let [C] be an $n_t \times n_l$ matrix, where each element $c_{i,j}$ is the probability that an oil spill will contact environmental resource area i, given that a spill occurs at hypothetical spill site j. Note that spill sites can represent potential spill starting points at production areas or transportation routes.

2. Spill occurrence can be represented by another matrix [S]. With n_l spill sites and n_s production sites, the dimensions of [S] are $n_l \times n_s$. Let each element $s_{j,k}$ be the estimated mean number of spills occurring at spill site j owing to production of a unit volume (1 Bbbl) of oil at site k. These spills can result from either production or transportation. The $s_{j,k}$ can be determined as a function of the volume of oil (spills/Bbbl). Each column of [S] corresponds to one production site and one transportation route. If alternative and mutually exclusive transportation routes are considered for the same production site, they can be represented by additional columns of [S], thus increasing n_s.

3. Matrix [U] is defined as:

$$[U] = [C] \times [S]$$

Matrix [U]—which has dimensions $n_t \times n_s$—is termed the *unit risk matrix*. Each element $u_{i,k}$ corresponds to the estimated mean number of spills occurring and contacting environmental resource area i, owing to the production of a unit volume (1 Bbbl) of oil at site k.

4. With [U], the mean number of contacts to each environmental resource area is estimated, given a set of oil volumes at each site. Let [V] be a vector of dimension n_s, where each element v_k corresponds to the volume of oil expected to be found at production site k. Then, if [L] is a vector of dimension n_t, where each element λ_i corresponds to the mean number of contacts to environmental resource area i, the formula is:

$$[L] = [U] \times [V]$$

Thus, estimates of the mean number of oil spills (≥ 1,000 bbl) that will both occur and contact environmental resource areas (or land segments) can be calculated. (Note: As a statistical parameter, the mean number can assume a fractional value even though fractions of oil spills have no physical meaning.)

Using Bayesian techniques, Devanney and Stewart (1974) showed that the probability of n oil-spill contacts can be described by a negative binomial distribution. However, Smith et al. (1982) noted that when actual exposure is much less than historic exposure, as is the case here, the negative binomial distribution can be approximated by a Poisson distribution. The Poisson distribution has a significant advantage in calculations because it is defined by only one parameter, the assumed number of spills. Thus, the matrix [L] contains all the information needed to use the Poisson distribution—if $P(n,i)$ is the probability of exactly n contacts to environmental resource area i, then:

$$P(n,i) = \frac{\lambda_i^n * e^{-\lambda i}}{n!}$$

Discussion

The Liberty development project, which assumes production and transportation of 0.12 Bbbl of oil, has an estimated mean number of 0.21 spills greater than or equal to 1,000 bbl occurring (0.05 from platforms and 0.16 from pipelines), as shown in table 1. Also, there is an estimated 19-percent probability that one or more spills (≥1,000 bbl) may occur as a result of this action (see table 1).

Annual Conditional Probabilities

The estimated annual conditional probabilities (expressed as percent chance) that a spill originating at a particular location will contact the environmental resource area **Land** are as follows:

Source of Spill	3-day Prob.	10-day Prob.	30-day Prob.	60-day Prob.(1)	90-day Prob.(1)	180-day Prob.(1)
LI	33	40	49	56	62	71
PP2(2)	63	68	73	77	81	85
AP2(2)	77	79	82	85	88	90

Note: (1) These contacts are considered to occur under ice conditions.

(2) Transportation sites with the highest estimated probabilities of contact to land. The other transportation sites (pipeline route segments PP1 and AP1) have conditional probabilities of contacting land that are approximately 10-20 percentage points lower than their associated landfall segments (i.e., PP2 and AP2).

In general, only **environmental resource areas** located immediately south of the Liberty development project have a 10-percent or greater probability of being contacted by a spill from the proposed project site or its related transportation segments within 3 days (table 2). For example, the 3-day probabilities of contact that are greater than 8 percent from launch site LI are as follows:

Boulder Patch 1(31):	11%
Environmental Resource Area 34:	14%
Boulder Patch 1 (37):	29%

Tables 8 through 13 list the annual conditional probabilities of one or more spills contacting a specific land segment (fig. 3) within a 3-, 10-, and 30-day period (the longest period that spills were assumed to persist in open water) and a 60-, 90-, and 180-day period (in ice conditions).

The highest probabilities of contact to **land segments** within 30 days are to land segments 25 and 26, which are located south and slightly west of the Liberty development project. These probabilities (expressed as percent chance) are as follows (table 10):

	Spill Source				
Land Segment	LI	PP1	PP2	AP1	AP2
25	13	12	6	11	3
26	20	29	59	28	71
All Others	n-6	n-6	n-3	n-7	n-3

Note: n = < 0.5% probability

Within 180 days (in ice conditions), the maximum probabilities of contact to land segments were to land segments 25 and 26 as follows (table 13):

	Spill Source				
Land Segment	LI	PP1	PP2	AP1	AP2
25	23	21	11	19	7
26	22	31	60	30	72
All Others	n-7	n-7	n-5	n-8	n-7

Note: n = < 0.5% probability

Seasonal Conditional Probabilities

Tables B-1 through B-12 provide seasonal conditional probabilities of contact to environmental resource areas over a 3-, 10-, 30-, 60-, 90-, and 180-day period (B-1 through B-6, winter; B-7 through B-12, summer). The seasonal conditional probabilities of contacting land segments over these time periods are shown in tables C-1 through C-12 (C-1 through C-6, winter; C-7 through C-12, summer). Spills during the winter season (representative of October-June) move slowly southwestward towards land. However, spills during the summer season (July-September) generally move more quickly towards land.

For example, the seasonal conditional probabilities of contact (expressed as percent chance) from the launch site (LI) to land segment 26 during a 3-, 10-, and 30-day period are as follows (tables C1-C6):

Land Segment	3-day		10-day		30-day	
	winter	summer	winter	summer	winter	summer
25	1	6	1	7	3	8
26	5	14	5	15	5	17
All Others	n-2	n-4	n-2	n-7	n-2	n-10

Note: n = < 0.5% probability

Under ice conditions (60-, 90-, and 180-day periods), these probabilities are as follows (tables C7-C12):

Land Segment	60-day		90-day		180-day	
	winter	summer	winter	summer	winter	summer
25	5	9	8	9	9	9
26	6	18	7	18	7	18
All Others	n-3	n-12	n-4	n-12	n-4	n-12

Note: n = < 0.5% probability

Annual Combined Probabilities

Table 14 presents the estimated annual combined probabilities of one or more spills greater than or equal to 1,000 bbl occurring and contacting **environmental resource areas within 3, 10, and 30 days** as a result of the proposed production and transportation scenarios. The combined probabilities that one or more spills (≥1,000 bbl) will occur and contact land within 3 days are 10 percent for either pipeline scenario, increasing to 11-12 percent within 10 days and 12-13 percent within 30 days (the longest period that spills were assumed to persist in open water) for the proposed and alternative pipeline scenarios respectively. The chance of one or more spills occurring and contacting an environmental resource area from either pipeline scenario within 3 days is greatest for Environmental Resource Area 32 (6%). Most of the combined probabilities of a spill contacting an environmental resource area do not increase at all for 10 and 30 days (maximum time in open water), and none increase by more than 2 percentage points.

Table 15 presents the estimated annual combined probabilities of one or more spills greater than or equal to 1,000 bbl occurring and contacting **environmental resource areas within 60, 90, and 180 days** (in ice conditions). Within 180 days, the probabilities of a spill occurring and contacting land increase to 15 and 16 percent, respectively, for the proposed and alternative pipeline scenarios. The combined probabilities increase by no more than 3 percentage points between the 3-day and the 180-day probabilities (from a 3-percent probability to a 6-percent for Environmental Resource Area 32 and Boulder Patch 1).

Tables 16-17 show the annual estimated combined probabilities of one or more spills greater than or equal to 1,000 bbl occurring and contacting land segments as a result of the proposed production and transportation scenarios. These probabilities do not exceed 8 and 9 percent, respectively, for a spill occurring and contacting land segment 26 within a 30-day period (maximum time in open water) for the proposed and alternative pipeline scenarios. Table 17 shows that these probabilities do not increase within 180 days (in ice conditions).

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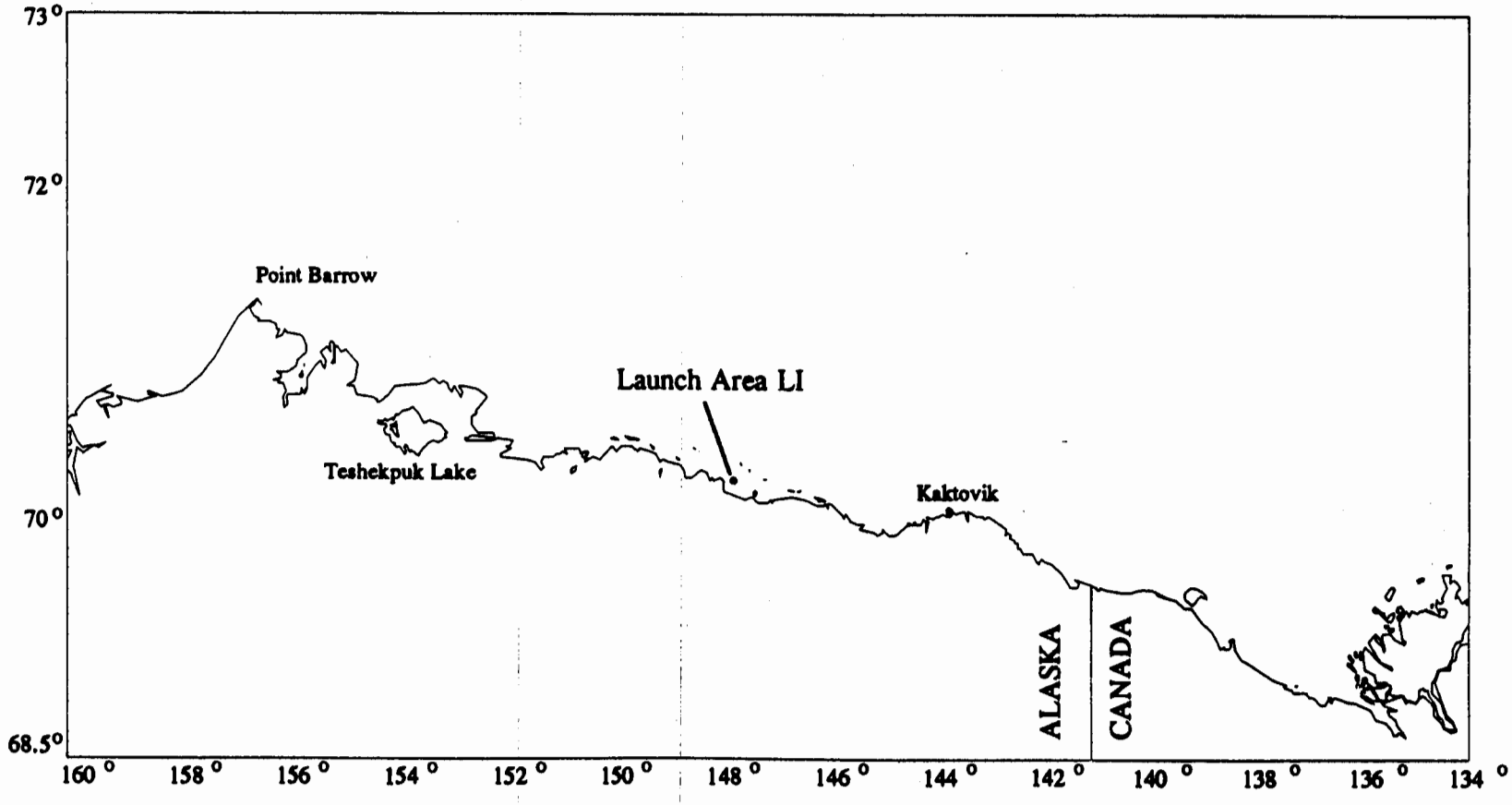

Figure 1. Location of Study Area and Launch Area LI, Liberty Gravel Island, Liberty DPP.

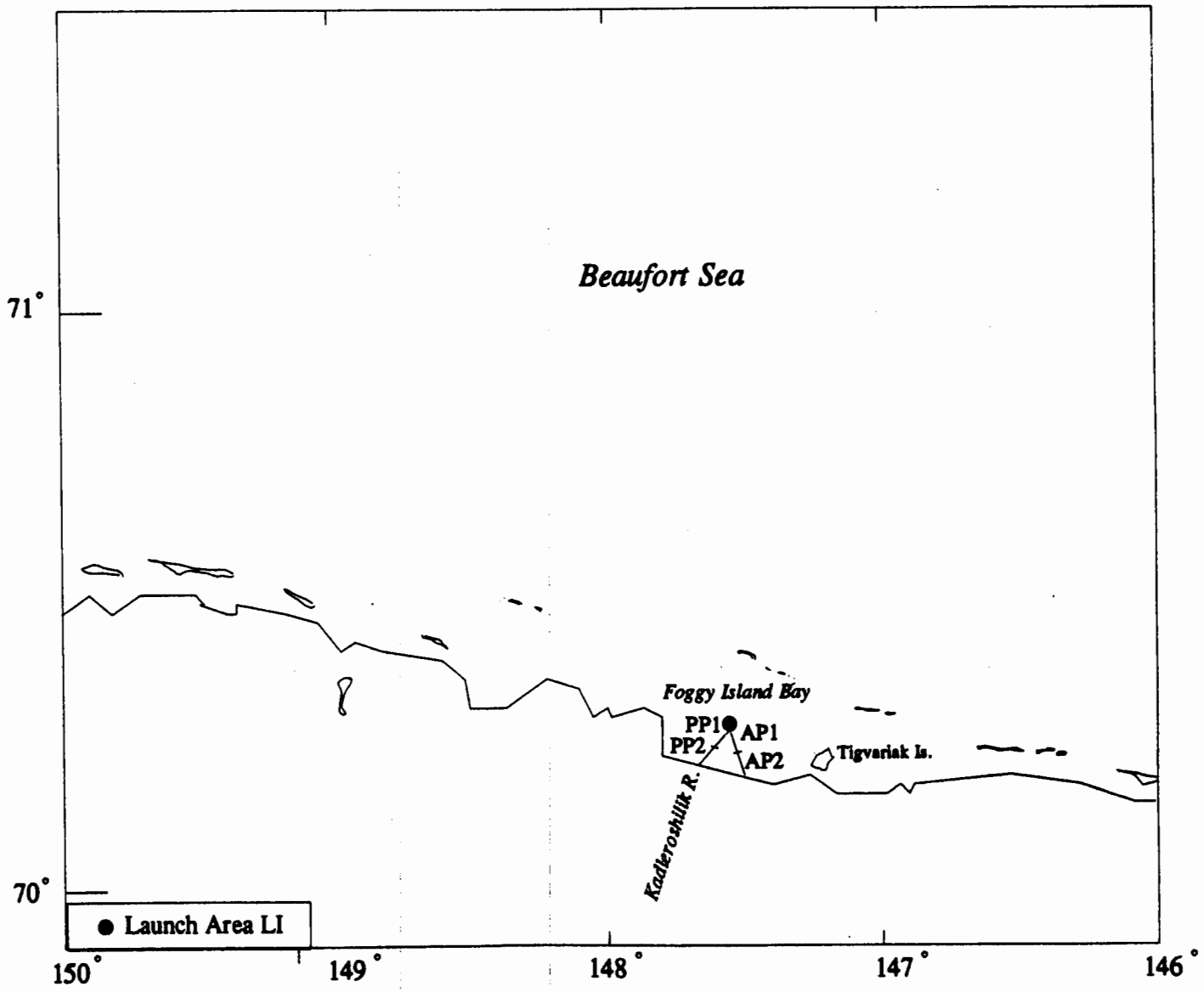

Figure 2. Enlarged Area Showing Locations of Launch Area (LI) and Pipeline Route Segments (PP1, PP2, AP1, and AP2), Liberty DPP.

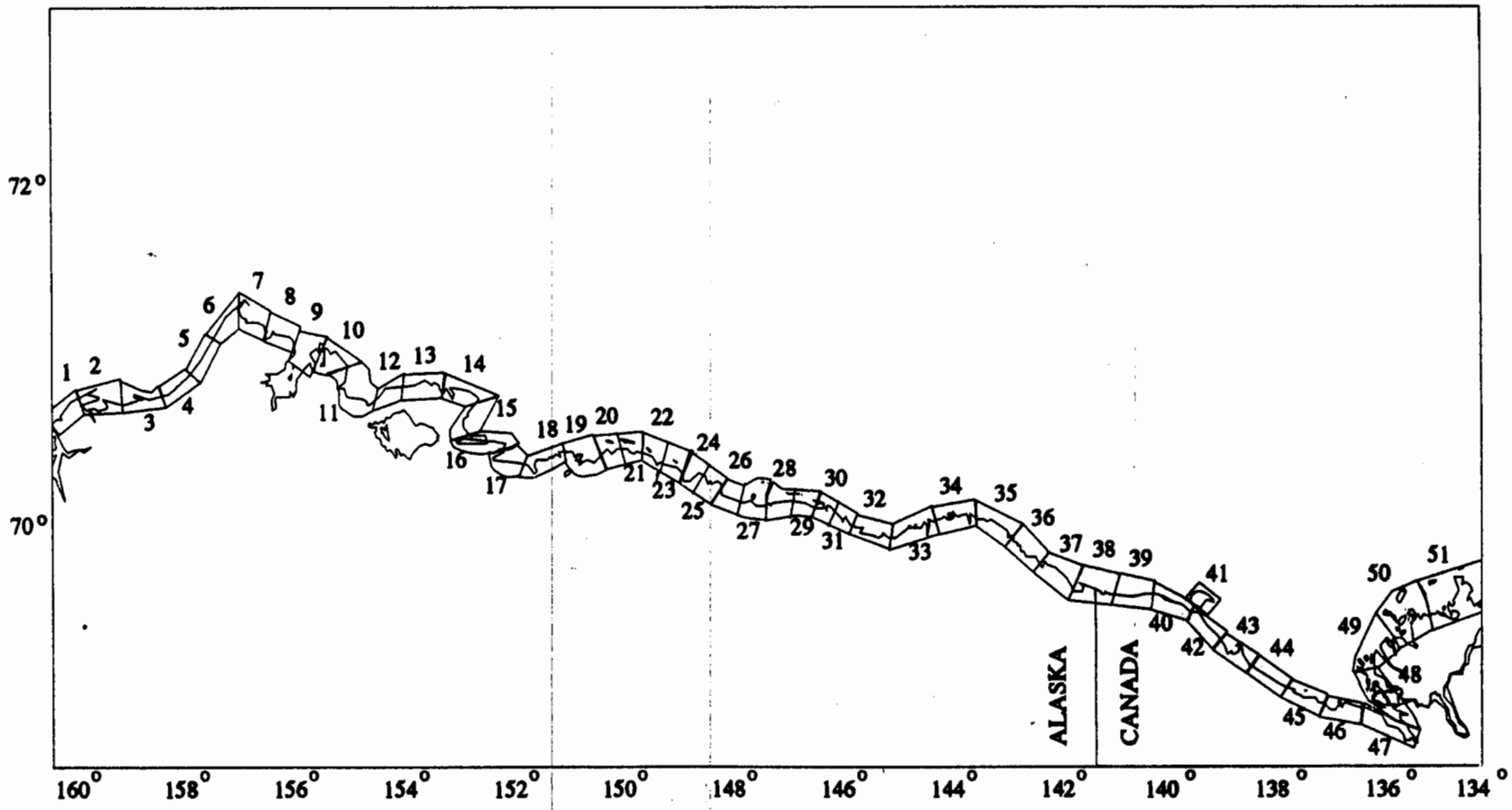

Figure 3. Study Area Coastline Divided into 51 Land Segments, Liberty DPP.

Table 1. Oil-spill occurrence estimates for spills greater than or equal to 1,000 barrels resulting from the production of 120 million barrels of oil from the Liberty project.

Source	Mean Number of Spills	Probability of One or More Spills
Platform	.05	5%
Pipeline	.16	15%
Total	.21	19%

Note: Probabilities are rounded to a whole number.

Table 2. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 3 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	33	42	63	41	77
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n
Ice/Sea Segment 4	1	n	n	n	n
Ice/Sea Segment 5	2	2	1	2	1
Ice/Sea Segment 6	2	2	1	2	1
Ice/Sea Segment 7	n	n	n	n	n
Jones Island (8)	n	n	n	n	n
Return & Jones Is.(9)	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	4	4	2	3	1
McClure & Karluk Is.(12)	4	3	2	3	1
Stockton Islands(13)	5	6	5	6	4
Maguire Islands (14)	2	2	1	2	1
Flaxman Island (15)	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	n	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n
Whaling Area/Cross Is.(26)+	1	1	n	1	n
Cross Island (27)+	1	1	n	1	n

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP
Land	33	42	63	41	77
Whaling Area (28)+	1	1	1	1	n
Env. Resource Area 29	1	1	n	1	n
Boulder Patch 3 (30)	3	3	1	3	1
Boulder Patch 2 (31)*	11	11	6	9	3
Env. Resource Area 32*	8	23	45	15	8
Env. Resource Area 33*	6	8	10	12	34
Env. Resource Area 34*	14	12	6	12	4
Tigvariak Is. (35)##	4	4	4	5	4
Newport Entrance (36)*	7	7	5	7	3
Boulder Patch 1 (37)	29	16	7	16	4
Narwhal Is. (38)+	3	2	1	2	1
Env. Resource Area 39*	1	1	1	1	n
Env. Resource Area 40*	n	n	n	n	n
Whaling Area/Narwhal+	2	1	1	1	n
Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 43*	2	1	1	2	1
Env. Resource Area 44*	4	4	3	4	2
Bullen Point (45)*	1	1	1	2	1
Env. Resource Area 46*	2	2	2	3	1
Env. Resource Area 47*	2	1	1	2	1
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	n	n	n	n	n
Env. Resource Area 50*	n	n	n	n	n
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	n	n	n	n	n

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 3. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 10 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
Land	40	49	68	48	79
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n
Ice/Sea Segment 3	1	1	1	1	n
Ice/Sea Segment 4	2	2	1	2	1
Ice/Sea Segment 5	4	4	2	4	2
Ice/Sea Segment 6	5	4	3	5	2
Ice/Sea Segment 7	1	1	1	1	1
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	1	1	n	1	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	7	7	3	6	2
McClure & Karluk Is. (12)	4	4	3	4	1
Stockton Islands(13)	7	7	6	8	4
Maguire Islands (14)	3	3	2	3	1
Flaxman Island (15)	1	1	n	1	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	1	1	n	1	n
Env. Resource Area 24*	1	1	n	1	n
Env. Resource Area 25*	n	n	n	n	n
Whaling Area/Cross Is.(26)+	2	2	1	2	1
Cross Island (27)+	2	1	1	1	n

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP
Land	40	49	68	48	79
Whaling Area (28)+	2	2	1	2	1
Env. Resource Area 29	1	1	1	1	n
Boulder Patch 3 (30)	5	4	2	4	1
Boulder Patch 2 (31)*	12	12	6	9	3
Env. Resource Area 32*	8	23	45	15	8
Env. Resource Area 33*	6	8	10	12	34
Env. Resource Area 34*	15	12	7	13	4
Tigvariak Is. (35)##	5	5	4	5	4
Newport Entrance (36)*	8	8	5	8	3
Boulder Patch 1 (37)	33	19	9	19	5
Narwhal Is. (38)+	3	3	2	3	1
Env. Resource Area 39*	2	1	1	1	n
Env. Resource Area 40*	1	1	n	1	n
Whaling Area/Narwhal (41)+	3	3	2	3	1
Env. Resource Area 42*	1	1	1	1	1
Env. Resource Area 43*	3	2	2	3	1
Env. Resource Area 44*	5	5	4	6	3
Bullen Point (45)*	2	2	1	2	1
Env. Resource Area 46*	3	3	2	4	2
Env. Resource Area 47*	3	2	2	3	1
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	n	n	n	n	n
Env. Resource Area 50*	1	1	1	1	n
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	1	1	n	1	n

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 4. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 30 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
Land	49	56	73	56	82
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	2	1	1	1	1
Ice/Sea Segment 3	3	3	2	3	1
Ice/Sea Segment 4	3	3	2	3	1
Ice/Sea Segment 5	5	5	3	5	2
Ice/Sea Segment 6	6	5	4	6	3
Ice/Sea Segment 7	3	2	1	2	1
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	1	1	n	1	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	12	11	7	10	4
McClure & Karluk Is. (12)	5	5	3	5	2
Stockton Islands (13)	8	8	7	9	5
Maguire Islands (14)	4	4	2	4	2
Flaxman Island (15)	1	1	1	1	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	1	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	1	1	n	1	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	1	1	1	1	n
Env. Resource Area 24*	1	1	n	1	n
Env. Resource Area 25*	1	1	n	1	n
Whaling Area/Cross Is. (26)+	4	3	2	3	1
Cross Island (27)+	3	2	1	2	n

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP
Land	49	56	73	56	82
Whaling Area (28)+	2	2	1	2	1
Env. Resource Area 29	2	2	1	2	n
Boulder Patch 3 (30)	7	6	3	6	2
Boulder Patch 2 (31)*	14	12	7	11	3
Env. Resource Area 32*	9	24	45	16	9
Env. Resource Area 33*	6	8	10	12	34
Env. Resource Area 34*	18	14	7	15	5
Tigvariak Is. (35)##	5	5	4	5	4
Newport Entrance (36)*	11	10	6	10	4
Boulder Patch 1 (37)	39	24	12	26	8
Narwhal Is. (38)+	4	4	2	4	1
Env. Resource Area 39*	3	3	1	2	1
Env. Resource Area 40*	1	1	1	2	1
Whaling Area/Narwhal (41)+	4	3	2	3	1
Env. Resource Area 42*	2	2	1	1	1
Env. Resource Area 43*	4	3	2	4	1
Env. Resource Area 44*	6	6	5	7	4
Bullen Point (45)*	2	2	2	3	1
Env. Resource Area 46*	4	4	3	4	3
Env. Resource Area 47*	4	3	2	3	1
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	1	1	n	1	n
Env. Resource Area 50*	1	1	1	1	1
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 5. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 60 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	56	62	77	62	85
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	3	2	1	2	1
Ice/Sea Segment 3	4	4	2	4	1
Ice/Sea Segment 4	5	4	2	4	1
Ice/Sea Segment 5	7	6	4	7	2
Ice/Sea Segment 6	6	6	4	7	3
Ice/Sea Segment 7	3	3	2	3	1
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	1	1	n	1	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	14	14	8	12	4
McClure & Karluk Is. (12)	7	6	4	6	3
Stockton Islands(13)	11	11	9	12	6
Maguire Islands (14)	6	5	3	5	2
Flaxman Island (15)	1	1	1	1	1
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	1	1	n	1	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	1	1	n	1	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	2	2	1	2	n
Env. Resource Area 24*	1	1	1	1	n
Env. Resource Area 25*	1	1	n	1	n
Whaling Area/Cross Is.(26)+	5	5	3	4	1
Cross Island (27)+	4	3	2	3	1

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP
Land	56	62	77	62	85
Whaling Area (28)+	2	2	1	2	1
Env. Resource Area 29	2	2	1	2	1
Boulder Patch 3 (30)	10	8	4	8	2
Boulder Patch 2 (31)*	15	13	7	11	3
Env. Resource Area 32*	10	25	45	16	9
Env. Resource Area 33*	7	9	10	12	34
Env. Resource Area 34*	22	18	9	18	5
Tigvariak Is. (35)##	6	6	5	6	4
Newport Entrance (36)*	15	13	8	14	5
Boulder Patch 1 (37)	46	31	16	31	10
Narwhal Is. (38)+	5	5	3	5	1
Env. Resource Area 39*	4	4	2	4	1
Env. Resource Area 40*	2	2	1	2	1
Whaling Area/Narwhal (41)+	4	4	2	3	1
Env. Resource Area 42*	2	2	2	2	1
Env. Resource Area 43*	5	4	3	5	2
Env. Resource Area 44*	8	8	6	8	4
Bullen Point (45)*	3	3	2	3	2
Env. Resource Area 46*	6	6	4	6	4
Env. Resource Area 47*	5	4	3	4	2
Canning River (48)#	n	1	n	n	n
Env. Resource Area 49*	1	1	n	1	n
Env. Resource Area 50*	1	1	1	1	1
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 6. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 90 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
Land	62	69	81	68	88
Ice/Sea Segment 1	1	1	1	1	n
Ice/Sea Segment 2	4	3	2	3	1
Ice/Sea Segment 3	5	4	3	4	1
Ice/Sea Segment 4	6	5	3	5	2
Ice/Sea Segment 5	9	7	4	8	3
Ice/Sea Segment 6	8	7	5	8	3
Ice/Sea Segment 7	4	4	2	4	2
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	1	1	n	1	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	19	17	10	16	6
McClure & Karluk Is. (12)	8	7	5	7	3
Stockton Islands (13)	13	12	10	13	7
Maguire Islands (14)	7	6	4	6	2
Flaxman Island (15)	1	1	1	2	1
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	1	1	n	1	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	1	1	n	1	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	3	3	1	2	1
Env. Resource Area 24*	1	1	1	1	n
Env. Resource Area 25*	2	1	n	1	n
Whaling Area/Cross Is. (26)+	7	5	3	5	1
Cross Island (27)+	5	4	2	3	1

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP
Land	62	69	81	68	88
Whaling Area (28)+	3	3	1	3	1
Env. Resource Area 29	3	3	2	2	1
Boulder Patch 3 (30)	13	10	5	10	2
Boulder Patch 2 (31)*	15	13	7	11	3
Env. Resource Area 32*	10	25	45	16	9
Env. Resource Area 33*	7	9	10	12	34
Env. Resource Area 34*	25	19	10	19	6
Tigvariak Is. (35)##	6	6	5	6	4
Newport Entrance (36)*	18	15	9	16	6
Boulder Patch 1 (37)	46	32	17	33	11
Narwhal Is. (38)+	6	5	3	5	1
Env. Resource Area 39*	5	5	3	5	1
Env. Resource Area 40*	3	3	2	3	1
Whaling Area/Narwhal (41)+	5	4	3	4	1
Env. Resource Area 42*	2	2	2	2	1
Env. Resource Area 43*	5	4	3	5	2
Env. Resource Area 44*	9	8	6	9	5
Bullen Point (45)*	4	3	2	3	2
Env. Resource Area 46*	7	7	5	7	4
Env. Resource Area 47*	6	5	3	5	2
Canning River (48)#	n	1	n	n	n
Env. Resource Area 49*	1	1	n	1	n
Env. Resource Area 50*	1	1	1	1	1
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 7. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 180 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
Land	71	75	85	75	90
Ice/Sea Segment 1	1	1	1	1	n
Ice/Sea Segment 2	7	6	3	6	2
Ice/Sea Segment 3	7	6	3	6	2
Ice/Sea Segment 4	9	8	5	8	3
Ice/Sea Segment 5	13	11	6	11	4
Ice/Sea Segment 6	10	9	6	9	4
Ice/Sea Segment 7	7	6	3	6	2
Jones Island (8)	n	n	n	n	n
Return & Jones Is.(9)	2	2	1	2	1
West Dock Causeway (10)	1	1	n	1	n
Endicott Causeway (11)	23	20	12	19	8
McClure & Karluk Is. (12)	9	8	5	8	3
Stockton Islands(13)	14	13	10	14	7
Maguire Islands (14)	8	7	4	7	2
Flaxman Island (15)	2	2	1	2	1
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	1	n	n	n	n
Env. Resource Area 19*	3	2	1	2	n
Env. Resource Area 20*	2	1	n	1	n
Env. Resource Area 21*	1	1	1	1	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	6	5	3	5	2
Env. Resource Area 24*	3	3	1	2	n
Env. Resource Area 25*	2	2	1	2	n
Whaling Area/Cross Is.(26)+	9	8	5	8	2
Cross Island (27)+	9	7	4	6	2

Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP
Land	71	75	85	75	90
Whaling Area (28)+	5	4	2	4	1
Env. Resource Area 29	5	4	2	3	2
Boulder Patch 3 (30)	15	12	6	12	3
Boulder Patch 2 (31)*	15	13	7	11	4
Env. Resource Area 32*	10	25	45	17	9
Env. Resource Area 33*	7	9	10	12	34
Env. Resource Area 34*	25	20	10	20	6
Tigvariak Is. (35)##	6	6	5	6	4
Newport Entrance (36)*	18	15	10	16	6
Boulder Patch 1 (37)	47	33	18	33	11
Narwhal Is. (38)**	6	5	3	5	2
Env. Resource Area 39*	9	8	4	8	2
Env. Resource Area 40*	4	3	2	4	1
Whaling Area/Narwhal (41)+	10	8	5	8	3
Env. Resource Area 42*	7	6	4	6	2
Env. Resource Area 43*	6	5	3	6	2
Env. Resource Area 44*	10	9	7	10	5
Bullen Point (45)*	4	4	3	4	2
Env. Resource Area 46*	8	8	5	8	4
Env. Resource Area 47*	6	6	3	6	2
Canning River (48)#	1	1	1	1	1
Env. Resource Area 49*	1	1	1	1	n
Env. Resource Area 50*	1	1	1	2	1
Simpson Cove (51)*	n	1	n	1	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 8. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 3 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	7	7	2	6	2
26	18	27	57	26	70
27	5	5	2	6	2
28	2	3	2	3	2

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 9. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 10 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	10	9	4	8	2
26	19	27	58	27	71
27	5	5	2	6	3
28	3	4	3	4	2
29	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 10. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 30 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	13	12	6	11	3
26	20	29	59	28	71
27	6	6	2	7	3
28	4	5	3	5	3
29	2	1	1	1	1
30	1	n	n	n	n
33	n	n	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 11. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 60 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	16	14	7	13	4
26	21	30	60	29	72
27	6	6	3	7	3
28	6	6	4	6	3
29	2	2	1	2	1
30	1	n	n	n	n
33	n	n	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 12. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 90 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	19	18	9	17	5
26	22	31	60	30	72
27	7	7	3	8	3
28	7	7	5	7	4
29	3	2	1	3	1
30	1	n	n	n	1
33	n	n	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 13. Annual conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 180 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
22	2	2	1	1	1
23	n	1	1	n	n
25	23	21	11	19	7
26	22	31	60	30	72
27	7	7	3	8	3
28	7	7	5	7	4
29	4	3	1	3	1
30	2	1	1	1	1
31	1	n	1	1	n
32	1	1	1	1	n
33	n	n	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.% are not shown.

Table 14. Annual combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain environmental resource area within 3, 10, and 30 days over the assumed production life of the Liberty project, Liberty DPP.

Environmental Resource Area	Within 3 days				Within 10 days				Within 30 days			
	Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	10	0.1	10	0.1	11	0.1	12	0.1	12	0.1	13	0.1
Ice/Sea Segment 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 2	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 4	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0
Ice/Sea Segment 5	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Ice/Sea Segment 6	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Ice/Sea Segment 7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Jones Island (8)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Return & Jones Is. (9)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
West Dock Causeway (10)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Endicott Causeway (11)	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	2	0.0
McClure & Karluk Is. (12)	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Stockton Islands(13)	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	2	0.0
Maguire Islands (14)	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Flaxman Island (15)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 16*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 17*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 18*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 19*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 20*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 21*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Prudhoe Bay (22)#	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Midway Island (23)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 24*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 25*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area/Cross Is.(26)+	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Cross Island (27)+	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area (28)+	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 29	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Boulder Patch 3 (30)	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Boulder Patch 2(31)*	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
Env. Resource Area 32*	6	0.1	2	0.0	6	0.1	2	0.0	6	0.1	2	0.0
Env. Resource Area 33*	2	0.0	4	0.0	2	0.0	4	0.0	2	0.0	4	0.0
Env. Resource Area 34*	2	0.0	2	0.0	2	0.0	2	0.0	3	0.0	2	0.0
Tigvariak Is. (35)##	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Newport Entrance(36)*	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	2	0.0
Boulder Patch 1 (37)	3	0.0	3	0.0	4	0.0	4	0.0	5	0.1	5	0.0
NarwhalIsland(38)+	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0	1	0.0
Env. Resource Area 39*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 40*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area/Narwhal (41)+	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0	1	0.0
Env. Resource Area 42*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 43*	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Env. Resource Area 44*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Bullen Point (45)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 46*	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 47*	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Canning River (48)#	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 49*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 50*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Simpson Cove (51)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Arey Lagoon (52)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area/Kaktovik (53)+	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability of one or more contacts within 30 days are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 15. Annual combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain environmental resource area within 60, 90, and 180 days over the assumed production life of the Liberty project, Liberty DPP.

Environmental Resource Area	Within 60 days				Within 90 days				Within 180 days			
	Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	13	0.1	14	0.1	14	0.2	14	0.2	15	0.2	16	0.2
Ice/Sea Segment 1	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 2	n	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Ice/Sea Segment 3	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Ice/Sea Segment 4	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	1	0.0
Ice/Sea Segment 5	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	2	0.0
Ice/Sea Segment 6	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	2	0.0
Ice/Sea Segment 7	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Jones Island (8)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Return & Jones Is. (9)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
West Dock Causeway (10)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Endicott Causeway (11)	3	0.0	2	0.0	3	0.0	3	0.0	4	0.0	3	0.0
McClure & Karluk Is. (12)	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Stockton Islands(13)	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
Maguire Islands (14)	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Flaxman Island (15)	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 16*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 17*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 18*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 19*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 20*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 21*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Prudhoe Bay (22)#	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Midway Island (23)*	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Env. Resource Area 24*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 25*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area/Cross Is.(26)+	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Cross Island (27)+	1	0.0	n	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Whaling Area (28)+	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0	1	0.0
Boulder Patch 2 (29)	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0	1	0.0
Boulder Patch 3 (30)	2	0.0	1	0.0	2	0.0	2	0.0	2	0.0	2	0.0
Env. Resource Area 31*	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0	2	0.0
Env. Resource Area 32*	6	0.1	2	0.0	6	0.1	2	0.0	6	0.1	3	0.0
Env. Resource Area 33*	2	0.0	4	0.0	2	0.0	4	0.0	2	0.0	4	0.0
Env. Resource Area 34*	3	0.0	3	0.0	4	0.0	3	0.0	4	0.0	3	0.0
Tigvariak Is. (35)##	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Newport Entrance(36)*	2	0.0	2	0.0	3	0.0	3	0.0	3	0.0	3	0.0
Boulder Patch 1 (37)	6	0.1	6	0.1	6	0.1	6	0.1	6	0.1	6	0.1
NarwhalIsland(38)+	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 39*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 40*	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Whaling A./Narwhal (41)+	1	0.0	1	0.0	1	0.0	1	0.0	2	0.0	1	0.0
Env. Resource Area 42*	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0
Env. Resource Area 43*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 44*	1	0.0	1	0.0	2	0.0	2	0.0	2	0.0	2	0.0
Bullen Point (45)*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 46*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Env. Resource Area 47*	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Canning River (48)#	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 49*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Env. Resource Area 50*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Simpson Cove (51)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Arey Lagoon (52)*	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Whaling Area/Kaktovik (53)+	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability of one or more contacts within 180 days are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table 16. Annual combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain land segment within 3, 10, and 30 days over the assumed production life of the Liberty project, Liberty DPP.

	Within 3 days				Within 10 days				Within 30 days			
	Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario	
Land Segment	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
25	1	0.0	1	0.0	2	0.0	1	0.0	2	0.0	2	0.0
26	7	0.1	8	0.1	7	0.1	8	0.1	8	0.1	9	0.1
27	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0

Note: n = Less than 0.5%. Segments with all values less than 0.5% probability of one or more contacts within 30 days are not shown.

Table 17. Annual combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain land segment within 60, 90, and 180 days over the assumed production life of the Liberty project, Liberty DPP.

	Within 60 days				Within 90 days				Within 180 days			
	Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario		Proposed Pipeline Scenario		Alternative Pipeline Scenario	
Land Segment	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
25	3	0.0	2	0.0	3	0.0	3	0.0	4	0.0	3	0.0
26	8	0.1	9	0.1	8	0.1	9	0.1	8	0.1	9	0.1
27	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
28	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0	1	0.0
29	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0

Note: n = Less than 0.5%. Segments with all values less than 0.5% probability of one or more contacts within 180 days are not shown.

Appendix A

Locations of Environmental Resource Areas

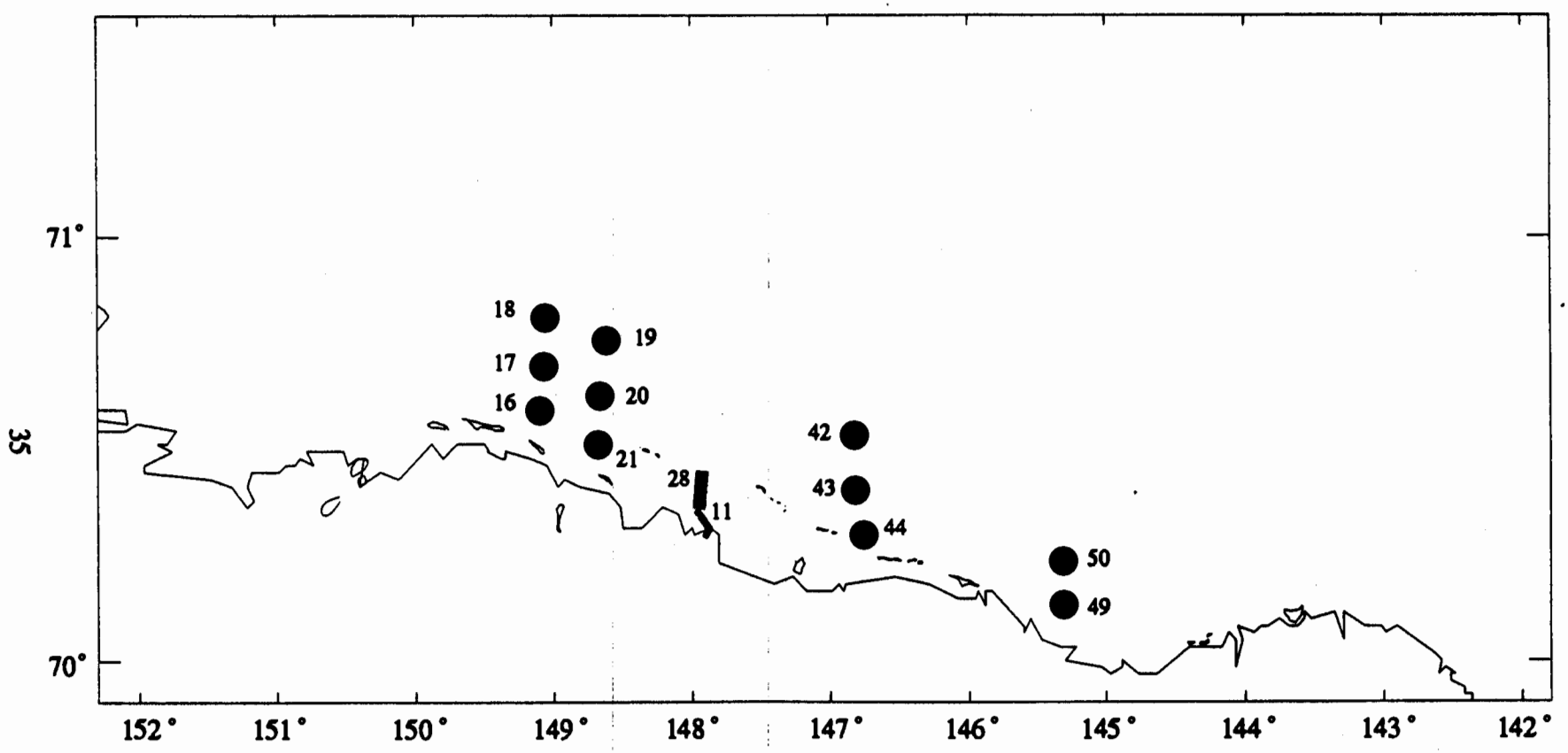

Figure A-1. Locations of Endicott Causeway (11), Whaling Area (28), and Environmental Resource Areas 16-21, 42-44, and 49-50.

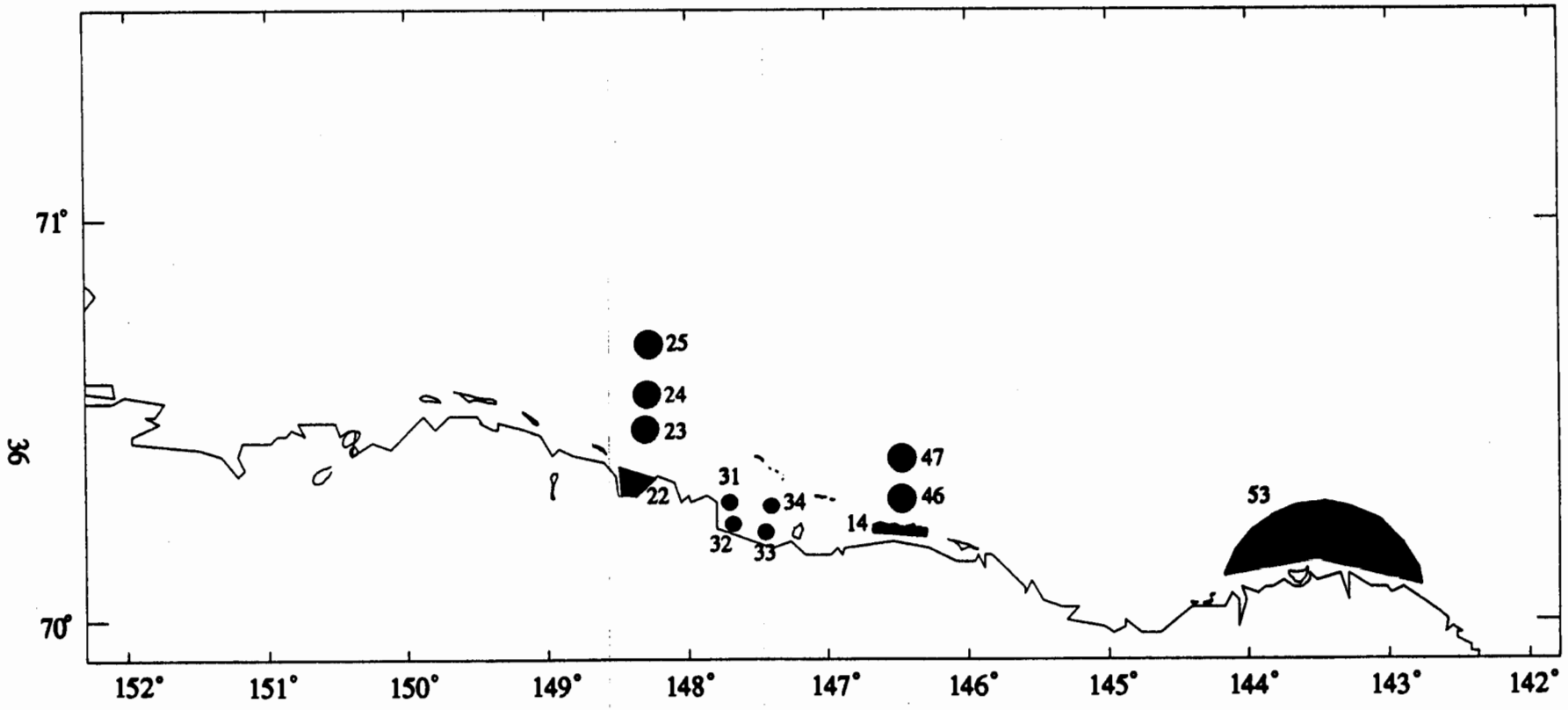

Figure A-2. Locations of Maguire Islands (14); Prudhoe Bay (22); Midway Island (23); Environmental Resource Areas 24-25, 32-34, and 46-47; Boulder Patch 2 (31); and Whaling Area/Kaktovik (53).

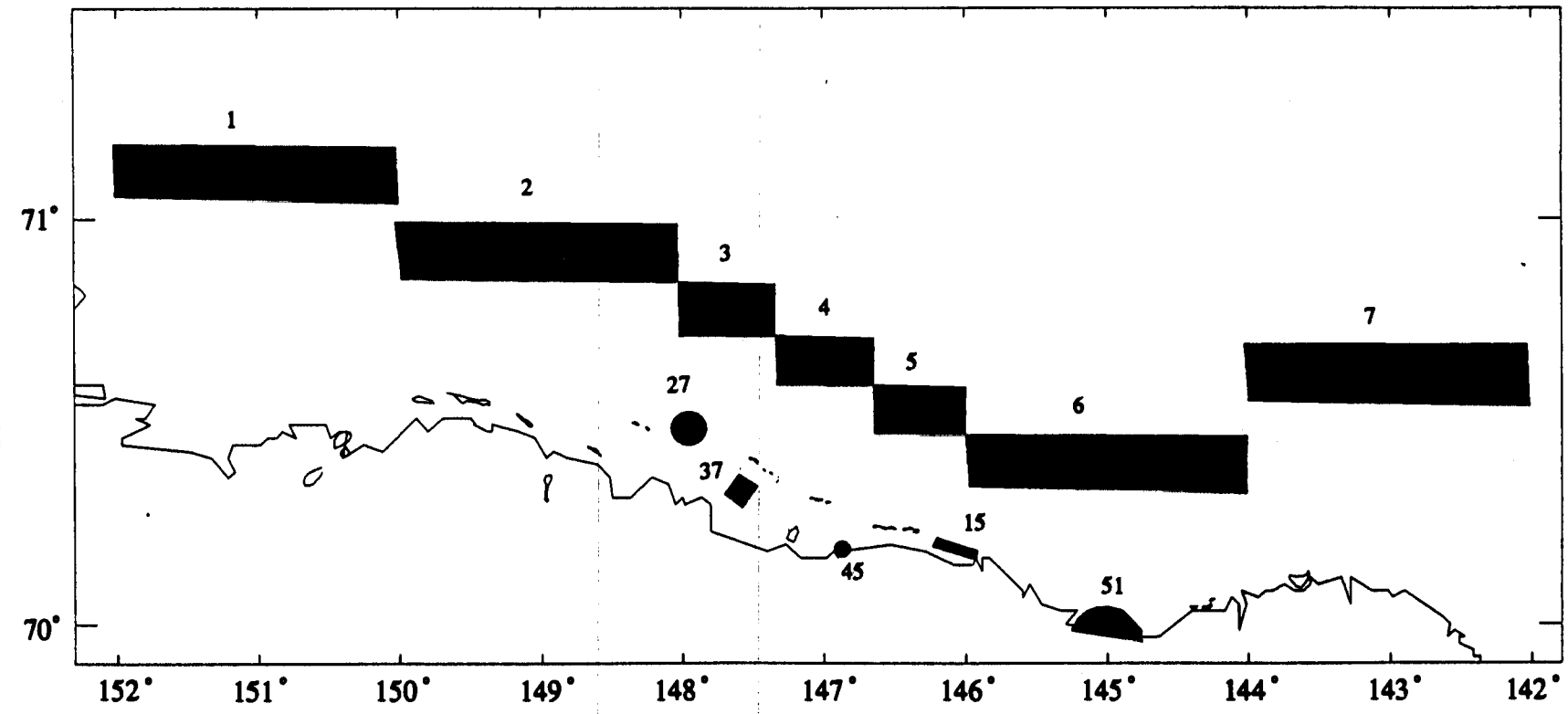

Figure A-3. Ice/Sea Segments 1-7, Flaxman Island (15), Cross Island (27), Boulder Patch 1 (37), Bullen Point (45), and Simpson Cove (51).

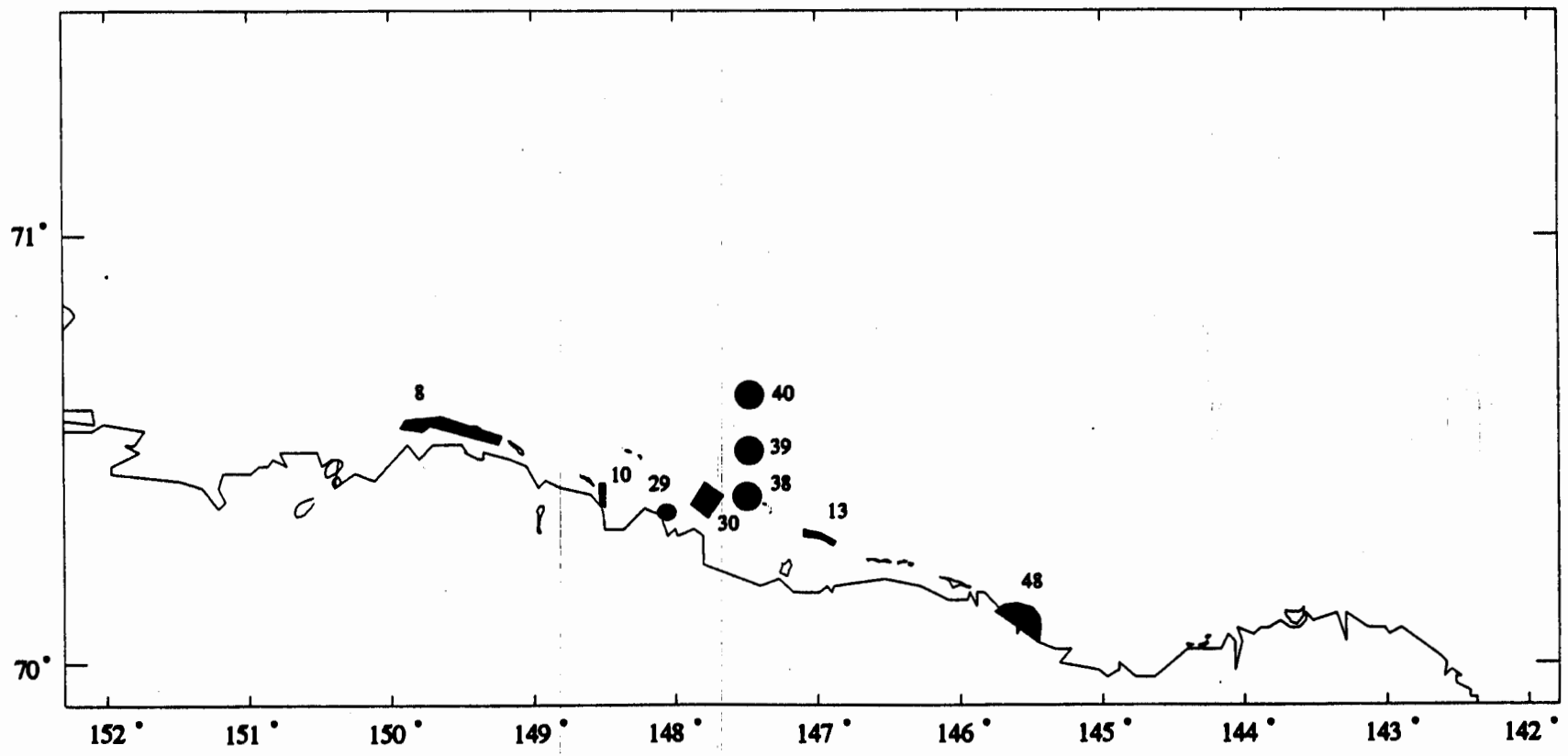

Figure A-4. Locations of Jones Island (8), West Dock Causeway (10), Stockton Islands (13), Environmental Resource Areas 29 and 39-40, Boulder Patch 3 (30), Narwhal Island (38), and Canning River (48).

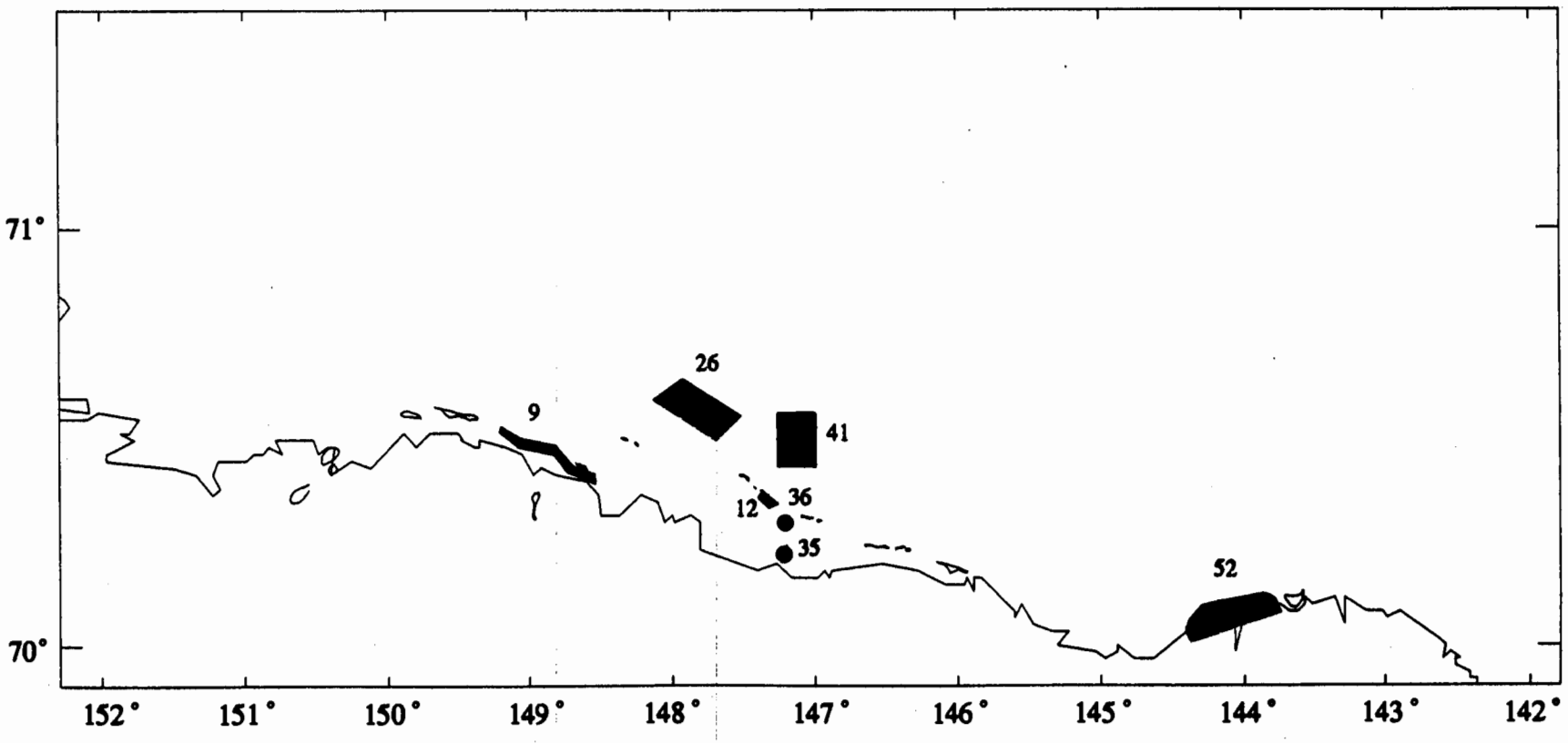

Figure A-5. Locations of Return and Jones Islands (9), McClure and Karluk Islands (12), Whaling Area/Cross Island (26), Tigvariak Island (35), Newport Entrance (36) Whaling Area/Narwhal Area (41), and Arey Lagoon (52).

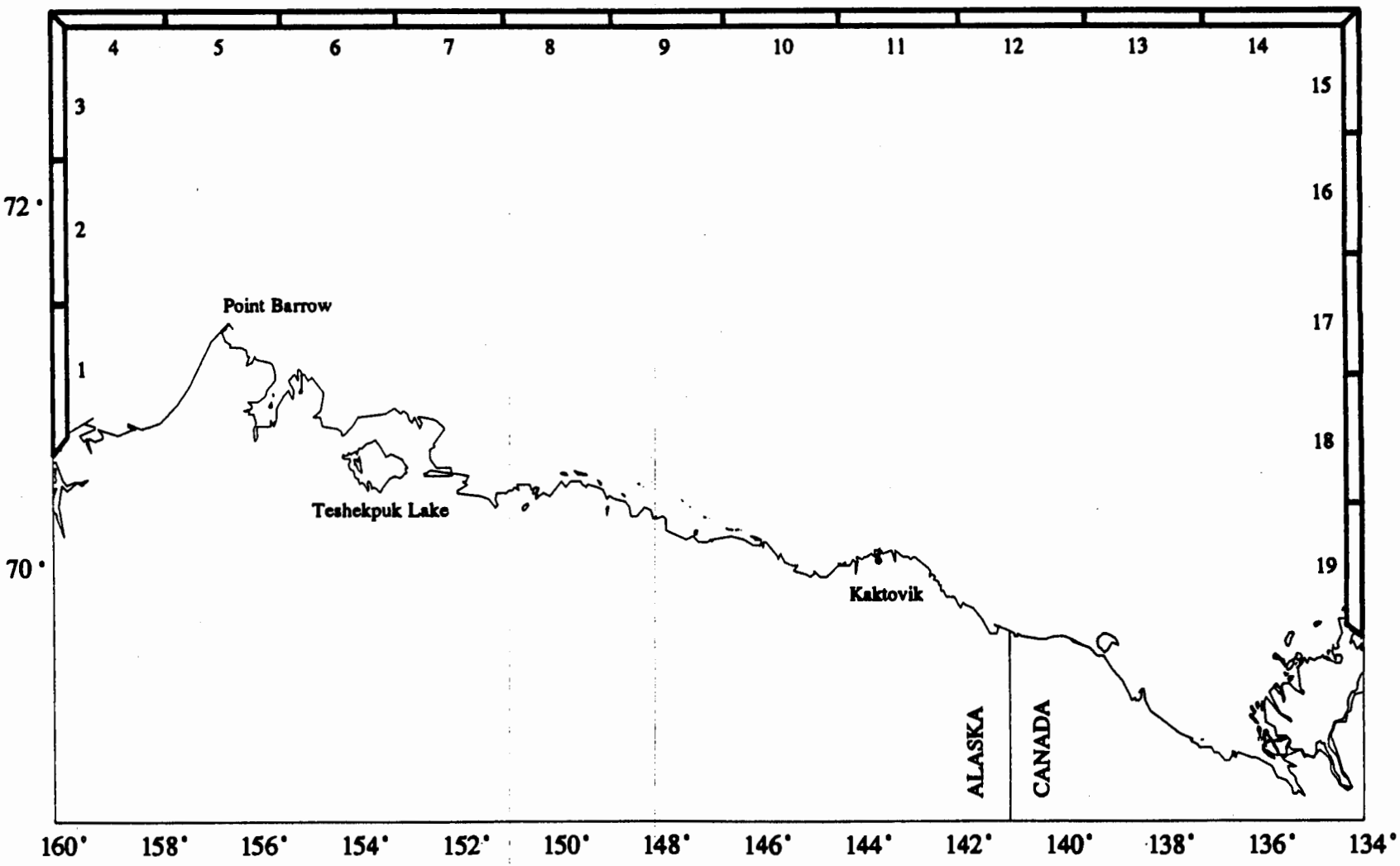

Figure A-6. Locations of Boundary Segments 1-19 for Liberty DPP.

Appendix B

Seasonal Conditional Probabilities of Contact to Environmental Resource Areas

Table B-1. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 3 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2	Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	9	12	20	12	24	Land	9	12	20	12	24
Ice/Sea Segment 1	n	n	n	n	n	Whaling Area (28) +	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n	Env. Resource Area 29	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n	Boulder Patch 3 (30)	n	n	n	n	n
Ice/Sea Segment 4	n	n	n	n	n	Boulder Patch 2 (31)*	n	n	n	n	n
Ice/Sea Segment 5	n	n	n	n	n	Env. Resource Area 32*	n	n	n	n	n
Ice/Sea Segment 6	n	n	n	n	n	Env. Resource Area 33*	n	n	n	n	n
Ice/Sea Segment 7	n	n	n	n	n	Env. Resource Area 34*	n	n	n	n	n
Jones Island (8)	n	n	n	n	n	Tigvariak Is. (35)+	n	n	n	n	n
Return & Jones Is. (9)	n	n	n	n	n	Newport Entrance(36)*	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n	Boulder Patch 1 (37)	10	4	2	5	1
Endicott Causeway (11)	n	n	n	n	n	Narwhal Is. (38)+	n	n	n	n	n
McClure & Karluk Is. (12)	n	n	n	n	n	Env. Resource Area 39*	n	n	n	n	n
Stockton Islands (13)	n	1	1	1	1	Env. Resource Area 40*	n	n	n	n	n
Maguire Islands (14)	n	n	n	n	n	Whaling Area/Narwhal (41)+	n	n	n	n	n
Flaxman Island (15)	n	n	n	n	n	Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n	Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n	Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n	Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n	Env. Resource Area 47*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n	Canning River (48)#	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n	Env. Resource Area 49*	n	n	n	n	n
Midway Island (23)*	n	n	n	n	n	Env. Resource Area 50*	n	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n	Simpson Cove (51)*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n	Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Cross Is.(26)+	n	n	n	n	n	Whaling Area/Kaktovik (53)+	n	n	n	n	n
Cross Island (27) +	n	n	n	n	n						

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areass are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-2. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 10 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	9	13	21	13	25
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n
Ice/Sea Segment 4	n	n	n	n	n
Ice/Sea Segment 5	n	n	n	n	n
Ice/Sea Segment 6	n	n	n	n	n
Ice/Sea Segment 7	n	n	n	n	n
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	n	1	1	1	n
McClure & Karluk Is. (12)	n	n	n	n	n
Stockton Islands (13)	n	1	1	1	1
Maguire Islands (14)	n	n	n	n	n
Flaxman Island (15)	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	n	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n
Whaling Area/Cross Is. (26)+	n	n	n	n	n
Cross Island (27)+	n	n	n	n	n

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	9	13	21	13	25
Whaling Area (28)+	n	n	n	n	n
Env. Resource Area 29	n	n	n	n	n
Boulder Patch 3 (30)	n	n	n	n	n
Boulder Patch 2 (31)*	n	n	n	n	n
Env. Resource Area 32*	n	n	n	n	n
Env. Resource Area 33*	n	n	n	n	n
Env. Resource Area 34*	n	n	n	n	n
Tigvariak Is. (35)##	n	n	n	n	n
Newport Entrance (36)*	n	n	n	n	n
Boulder Patch 1 (37)	12	5	2	6	2
Narwhal Is. (38)+	n	n	n	n	n
Env. Resource Area 39*	n	n	n	n	n
Env. Resource Area 40*	n	n	n	n	n
Whaling Area/Narwhal (41)+	n	n	n	n	n
Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 44*	n	n	n	n	n
Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 47*	n	n	n	n	n
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	n	n	n	n	n
Env. Resource Area 50*	n	n	n	n	n
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area./Kaktovik (53)+	n	n	n	n	n

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-3. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 30 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location					Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2		LI	PP1	PP2	AP1	AP2
Land	11	15	22	15	25	Land	11	15	22	15	25
Ice/Sea Segment 1	n	n	n	n	n	Whaling Area (28)+	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n	Boulder Patch 2 (29)	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n	Boulder Patch 3 (30)	1	1	n	1	n
Ice/Sea Segment 4	n	n	n	n	n	Env. Resource Area 31*	n	n	n	n	n
Ice/Sea Segment 5	n	n	n	n	n	Env. Resource Area 32*	n	n	n	n	n
Ice/Sea Segment 6	n	n	n	n	n	Env. Resource Area 33*	n	n	n	n	n
Ice/Sea Segment 7	n	n	n	n	n	Env. Resource Area 34*	n	n	n	n	n
Jones Island (8)	n	n	n	n	n	Tigvariak I. (35)##	n	n	n	n	n
Return & Jones Is. (9)	n	n	n	n	n	Newport Entrance(36)*	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n	Boulder Patch 1 (37)	15	9	4	10	3
Endicott Causeway (11)	3	3	3	3	1	Narwhal Is. (38)+	n	n	n	n	n
McClure & Karluk Is. (12)	n	n	n	n	n	Env. Resource Area 39*	n	n	n	n	n
Stockton Islands(13)	n	1	1	1	1	Env. Resource Area 40*	n	n	n	n	n
Maguire Islands (14)	n	n	n	n	n	Whaling Area/Narwhal (41)+	n	n	n	n	n
Flaxman Island (15)	n	n	n	n	n	Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n	Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n	Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n	Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n	Env. Resource Area 47*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n	Canning River (48)#	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n	Env. Resource Area 49*	n	n	n	n	n
Midway Island (23)*	n	n	n	n	n	Env. Resource Area 50*	n	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n	Simpson Cove (51)*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n	Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Cross Is. (26)+	n	n	n	n	n	Whaling Area/Kaktovik (53)+	n	n	n	n	n
Cross Island (27)+	n	n	n	n	n						

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-4. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 60 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	16	18	25	18	28
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n
Ice/Sea Segment 4	n	n	n	n	n
Ice/Sea Segment 5	n	n	n	n	n
Ice/Sea Segment 6	n	n	n	n	n
Ice/Sea Segment 7	n	n	n	n	n
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	5	5	4	4	2
McClure & Karluk Is. (12)	1	2	1	2	1
Stockton Islands(13)	1	1	1	1	1
Maguire Islands (14)	1	n	n	n	n
Flaxman Island (15)	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	1	1	n	1	n
Env. Resource Area 24*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n
Whaling Area/Cross Is. (26)+	n	n	n	n	n
Cross Island (27)+	n	n	n	n	n

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	16	18	25	18	28
Whaling Area (28)+	n	n	n	n	n
Boulder Patch 2 (29)	1	n	n	n	n
Boulder Patch 3 (30)	3	2	1	2	n
Boulder Patch 2 (31)*	n	n	n	n	n
Env. Resource Area 32*	n	n	n	n	n
Env. Resource Area 33*	n	n	n	n	n
Env. Resource Area 34*	n	n	n	n	n
Tigvariak I. (35)##	n	n	n	n	n
Newport Entrance(36)*	n	n	n	n	n
Boulder Patch 1 (37)	19	12	6	13	5
Narwhal Is. (38)+	n	n	n	n	n
Env. Resource Area 39*	1	1	n	1	n
Env. Resource Area 40*	n	n	n	n	n
Whaling Area/Narwhal (41)+	n	n	n	n	n
Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 44*	n	n	n	n	n
Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 47*	n	n	n	n	n
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	n	n	n	n	n
Env. Resource Area 50*	n	n	n	n	n
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)	n	n	n	n	n

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-5. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 90 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location					Environmental Resource Area	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2		LI	PP1	PP2	AP1	AP2
Land	20	23	27	22	29	Land	20	23	27	22	29
Ice/Sea Segment 1	n	n	n	n	n	Whaling Area (28)+	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n	Boulder Patch 2 (29)	2	1	1	1	1
Ice/Sea Segment 3	n	n	n	n	n	Boulder Patch 3 (30)	4	3	1	3	n
Ice/Sea Segment 4	n	n	n	n	n	Boulder Patch 2 (31)*	n	n	n	n	n
Ice/Sea Segment 5	n	n	n	n	n	Env. Resource Area 32*	n	n	n	n	n
Ice/Sea Segment 6	n	n	n	n	n	Env. Resource Area 33*	n	n	n	n	n
Ice/Sea Segment 7	n	n	n	n	n	Env. Resource Area 34*	n	n	n	n	n
Jones Island (8)	n	n	n	n	n	Tigvariak Is. (35)##	n	n	1	n	1
Return & Jones Is. (9)	n	n	n	n	n	Newport Entrance(36)*	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n	Boulder Patch 1 (37)	19	12	6	14	5
Endicott Causeway (11)	9	9	6	8	3	Narwhal Is. (38)+	n	n	n	n	n
McClure & Karluk Is. (12)	2	2	1	2	1	Env. Resource Area 39*	3	2	1	2	1
Stockton Islands(13)	1	1	2	1	1	Env. Resource Area 40*	n	n	n	n	n
Maguire Islands (14)	1	n	n	n	n	Whaling Area/Narwhal (41)+	n	n	n	n	n
Flaxman Island (15)	n	n	n	n	n	Env. Resource Area 42*	n	n	n	n	n
Env. Resource Area 16*	n	n	n	n	n	Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n	Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n	Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n	Env. Resource Area 47*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n	Canning River (48)#	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n	Env. Resource Area 49*	n	n	n	n	n
Midway Island (23)*	2	2	1	1	1	Env. Resource Area 50*	n	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n	Simpson Cove (51)*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n	Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Cross Is.(26)+	n	n	n	n	n	Whaling Area/Kaktovik (53)+	n	n	n	n	n
Cross Island (27)+	n	n	n	n	n						

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-6. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 180 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2	Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	25	27	30	26	31	Land	25	27	30	26	31
Ice/Sea Segment 1	n	n	n	n	n	Whaling Area (28)+	1	n	n	n	n
Ice/Sea Segment 2	1	1	n	1	n	Boulder Patch 2 (29)	2	1	1	1	1
Ice/Sea Segment 3	n	n	n	n	n	Boulder Patch 3 (30)	5	3	2	4	1
Ice/Sea Segment 4	2	2	1	2	1	Boulder Patch 2 (31)*	n	n	n	n	n
Ice/Sea Segment 5	2	2	1	2	n	Env. Resource Area 32*	n	n	n	n	n
Ice/Sea Segment 6	1	1	n	1	n	Env. Resource Area 33*	n	n	n	n	n
Ice/Sea Segment 7	1	1	n	1	1	Env. Resource Area 34*	n	n	n	n	n
Jones Island (8)	n	n	n	n	n	Tigvariak Is. (35)##	n	n	1	n	1
Return & Jones Is. (9)	2	1	1	1	n	Newport Entrance(36)*	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n	Boulder Patch 1 (37)	19	12	6	14	5
Endicott Causeway (11)	11	10	7	9	4	Narwhal Is. (38)+	n	n	n	n	n
McClure & Karluk Is. (12)	2	2	1	2	1	Env. Resource Area 39*	6	4	2	4	1
Stockton Islands(13)	1	1	2	1	1	Env. Resource Area 40*	n	n	n	n	n
Maguire Islands (14)	1	1	n	n	n	Whaling Area/Narwhal (41)+	4	3	1	3	1
Flaxman Island (15)	n	n	n	n	n	Env. Resource Area 42*	4	3	1	3	1
Env. Resource Area 16*	n	n	n	n	n	Env. Resource Area 43*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n	Bullen Point (45)*	n	n	n	n	n
Env. Resource Area 19*	1	1	n	1	n	Env. Resource Area 46*	n	n	n	n	n
Env. Resource Area 20*	1	1	n	1	n	Env. Resource Area 47*	n	n	n	n	n
Env. Resource Area 21*	1	1	n	1	n	Canning River (48)#	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n	Env. Resource Area 49*	n	n	n	n	n
Midway Island (23)*	5	4	2	4	1	Env. Resource Area 50*	n	n	n	n	n
Env. Resource Area 24*	1	1	n	n	n	Simpson Cove (51)*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n	Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Cross Is. (26)+	1	1	1	1	n	Whaling Area/Kaktovik (53)+	n	n	n	n	n
Cross Island (27)+	3	2	1	2	n						

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-7. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 3 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	29	35	57	35	73
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	n	n	n	n	n
Ice/Sea Segment 3	n	n	n	n	n
Ice/Sea Segment 4	1	1	1	1	n
Ice/Sea Segment 5	5	5	3	5	2
Ice/Sea Segment 6	6	6	4	6	3
Ice/Sea Segment 7	n	n	n	n	n
Jones Island (8)	n	n	n	n	n
Return & Jones Is. (9)	n	n	n	n	n
West Dock Causeway (10)	n	n	n	n	n
Endicott Causeway (11)	6	6	2	4	2
McClure & Karluk Is. (12)	10	9	5	8	3
Stockton Islands(13)	14	13	12	15	8
Maguire Islands (14)	5	4	2	5	2
Flaxman Island (15)	1	1	1	1	n
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	n	n	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	n	n	n	n	n
Prudhoe Bay (22)#	n	n	n	n	n
Midway Island (23)*	1	n	n	n	n
Env. Resource Area 24*	n	n	n	n	n
Env. Resource Area 25*	n	n	n	n	n
Whaling Area/Cross Is. (26)+	2	2	1	1	1
Cross Island (27)+	2	1	1	1	1

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	29	35	57	35	73
Whaling Area (28)**	3	3	1	2	1
Env. Resource Area 29	2	1	1	1	n
Boulder Patch 3 (30)	5	5	3	4	1
Boulder Patch 2 (31)*	17	18	11	14	6
Env. Resource Area 32*	12	39	92	19	11
Env. Resource Area 33*	13	19	27	28	71
Env. Resource Area 34*	42	34	17	35	9
Tigvariak Is. (35)##	9	10	9	11	10
Newport Entrance(36)*	22	20	14	22	8
Boulder Patch 1 (37)	27	20	8	18	4
Narwhal Is. (38)+	7	7	4	7	2
Env. Resource Area 39*	2	2	2	2	1
Env. Resource Area 40*	1	1	1	1	n
Whaling Area/Narwhal (41)+	6	5	3	5	1
Env. Resource Area 42*	2	1	1	1	n
Env. Resource Area 43*	6	4	3	5	3
Env. Resource Area 44*	12	12	9	13	8
Bullen Point (45)*	3	5	3	5	3
Env. Resource Area 46*	7	9	6	9	5
Env. Resource Area 47*	6	4	3	5	2
Canning River (48)#	n	n	n	n	n
Env. Resource Area 49*	n	n	n	n	n
Env. Resource Area 50*	n	n	n	1	n
Simpson Cove (51)*	n	n	n	n	n
Arey Lagoon (52)*	n	n	n	n	n
Whaling Area/Kaktovik (53)+	n	n	n	n	n

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-8. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 10 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	41	47	66	47	78
Ice/Sea Segment 1	n	n	n	n	n
Ice/Sea Segment 2	2	2	1	1	1
Ice/Sea Segment 3	4	3	2	4	1
Ice/Sea Segment 4	6	5	4	5	2
Ice/Sea Segment 5	12	12	8	12	5
Ice/Sea Segment 6	15	13	9	15	7
Ice/Sea Segment 7	6	5	4	5	3
Jones Island (8)	1	1	n	n	n
Return & Jones Is. (9)	1	1	n	1	1
West Dock Causeway (10)	1	1	n	1	n
Endicott Causeway (11)	7	7	3	5	2
McClure & Karluk Is. (12)	12	11	7	9	3
Stockton Islands (13)	18	17	15	20	10
Maguire Islands (14)	8	7	4	8	3
Flaxman Island (15)	2	2	1	2	1
Env. Resource Area 16*	n	n	n	n	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	n	n	n	n	n
Env. Resource Area 19*	1	1	n	n	n
Env. Resource Area 20*	n	n	n	n	n
Env. Resource Area 21*	1	1	n	1	n
Prudhoe Bay (22)#	1	1	1	1	n
Midway Island (23)*	1	1	1	1	n
Env. Resource Area 24*	2	2	1	2	n
Env. Resource Area 25*	1	1	n	1	n
Whaling Area/Cross Is. (26)+	6	5	3	5	2
Cross Island (27)+	4	4	2	3	1

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	41	47	66	47	78
Whaling Area (28)+	5	5	2	4	1
Env. Resource Area 29	2	2	1	2	n
Boulder Patch 3 (30)	9	8	5	7	2
Boulder Patch 2 (31)*	19	19	11	16	6
Env. Resource Area 32*	12	39	92	20	11
Env. Resource Area 33*	14	20	27	29	71
Env. Resource Area 34*	46	37	19	37	9
Tigvariak Is. (35)##	11	12	10	13	10
NewportEntrance(36)*	27	25	17	27	9
Boulder Patch 1 (37)	30	22	10	20	5
Narwhal Is. (38)+	11	10	6	10	2
Env. Resource Area 39*	5	5	2	4	1
Env. Resource Area 40*	3	2	1	2	1
Whaling Area/Narwhal (41)+	11	9	6	9	3
Env. Resource Area 42*	5	4	3	4	2
Env. Resource Area 43*	9	7	5	9	4
Env. Resource Area 44*	17	17	13	18	10
Bullen Point (45)*	6	7	4	8	4
Env. Resource Area 46*	12	12	8	13	8
Env. Resource Area 47*	10	7	5	8	3
Canning River (48)#	1	1	1	1	1
Env. Resource Area 49*	2	1	1	2	1
Env. Resource Area 50*	3	3	2	4	2
Simpson Cove (51)*	1	1	n	1	n
Arey Lagoon (52)*	1	1	1	1	n
Whaling Area/Kaktovik (53)+	3	3	2	3	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-9. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *summer* season will contact a certain environmental resource area within 30 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	59	63	75	62	86
Ice/Sea Segment 1	1	1	1	1	1
Ice/Sea Segment 2	6	6	3	5	2
Ice/Sea Segment 3	10	9	5	10	2
Ice/Sea Segment 4	11	9	6	9	3
Ice/Sea Segment 5	18	16	10	17	6
Ice/Sea Segment 6	19	17	12	20	9
Ice/Sea Segment 7	10	9	5	9	4
Jones Island (8)	1	1	n	1	n
Return & Jones Is. (9)	2	2	1	2	1
West Dock Causeway (10)	1	1	n	1	n
Endicott Causeway (11)	8	8	4	7	2
McClure & Karluk Is. (12)	13	12	7	11	3
Stockton Islands(13)	23	23	18	26	11
Maguire Islands (14)	13	11	6	12	4
Flaxman Island (15)	3	4	2	4	2
Env. Resource Area 16*	1	1	n	1	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	1	1	1	1	n
Env. Resource Area 19*	2	2	1	1	n
Env. Resource Area 20*	1	1	n	1	n
Env. Resource Area 21*	2	2	1	2	n
Prudhoe Bay (22)#	1	1	1	1	n
Midway Island (23)*	2	1	1	1	n
Env. Resource Area 24*	2	3	2	3	n
Env. Resource Area 25*	4	3	1	3	n
Whaling Area/Cross Is.(26)+	13	11	6	11	2
Cross Island (27)+	8	6	4	6	1

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	59	63	75	62	86
Whaling Area (28)+	7	7	3	6	1
Env. Resource Area 29	3	3	1	3	n
Boulder Patch 3 (30)	14	12	7	11	2
Boulder Patch 2 (31)*	19	19	12	16	6
Env. Resource Area 32*	15	42	92	22	12
Env. Resource Area 33*	15	21	27	30	72
Env. Resource Area 34*	57	44	22	44	12
Tigvariak Is. (35)##	11	12	10	13	10
Newport Entrance(36)*	36	32	21	33	11
Boulder Patch 1 (37)	34	27	14	25	6
Narwhal Is. (38)+	13	12	7	12	2
Env. Resource Area 39*	8	8	4	7	1
Env. Resource Area 40*	5	5	3	6	2
Whaling Area/Narwhal (41)+	14	12	7	12	3
Env. Resource Area 42*	6	6	4	5	2
Env. Resource Area 43*	12	10	7	12	4
Env. Resource Area 44*	21	21	16	23	12
Bullen Point (45)*	6	8	5	8	5
Env. Resource Area 46*	15	16	11	16	9
Env. Resource Area 47*	13	10	6	11	4
Canning River (48)#	1	2	1	2	1
Env. Resource Area 49*	3	2	2	2	2
Env. Resource Area 50*	4	4	3	5	3
Simpson Cove (51)*	1	2	1	1	1
Arey Lagoon (52)*	1	1	1	2	1
Whaling Area/Kaktovik (53)+	5	5	3	5	2
Boundary Segment 17	n	1	n	1	n
Boundary Segment 18	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-10. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 60 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2	Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	62	66	78	65	89	Land	62	66	78	65	89
Ice/Sea Segment 1	1	1	1	1	1	Whaling Area (28)+	7	7	4	6	1
Ice/Sea Segment 2	10	9	5	8	2	Env. Resource Area 29	3	3	1	3	n
Ice/Sea Segment 3	13	12	7	12	3	Boulder Patch 3 (30)	15	13	8	12	2
Ice/Sea Segment 4	13	10	6	11	3	Boulder Patch 2 (31)*	19	20	12	16	6
Ice/Sea Segment 5	22	19	11	20	7	Env. Resource Area 32*	16	42	92	22	12
Ice/Sea Segment 6	20	18	12	21	9	Env. Resource Area 33*	16	21	27	30	72
Ice/Sea Segment 7	14	12	7	12	4	Env. Resource Area 34*	60	47	24	47	12
Jones Island (8)	1	1	n	1	n	Tigvariak Is. (35)##	12	13	11	13	10
Return & Jones Is. (9)	2	2	1	2	1	Newport Entrance(36)*	41	35	23	37	13
West Dock Causeway (10)	1	1	n	1	n	Boulder Patch 1 (37)	36	29	15	27	6
Endicott Causeway (11)	9	9	4	7	2	Narwhal Is. (38)+	15	13	8	13	2
McClure & Karluk Is. (12)	13	13	8	12	3	Env. Resource Area 39*	9	9	5	8	1
Stockton Islands(13)	26	25	20	29	12	Env. Resource Area 40*	7	6	4	7	2
Maguire Islands (14)	14	12	7	13	5	Whaling Area/Narwhal (41)+	15	12	7	12	3
Flaxman Island (15)	3	4	3	4	2	Env. Resource Area 42*	6	6	4	6	3
Env. Resource Area 16*	1	1	n	1	n	Env. Resource Area 43*	13	10	8	13	4
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	23	23	17	25	13
Env. Resource Area 18*	1	1	1	1	n	Bullen Point (45)*	7	9	6	9	6
Env. Resource Area 19*	3	3	1	2	n	Env. Resource Area 46*	17	17	12	18	10
Env. Resource Area 20*	1	1	n	1	n	Env. Resource Area 47*	14	10	7	12	4
Env. Resource Area 21*	2	2	1	2	n	Canning River (48)#	1	2	1	2	2
Prudhoe Bay (22)#	1	1	1	1	n	Env. Resource Area 49*	3	2	2	2	2
Midway Island (23)*	2	1	1	1	n	Env. Resource Area 50*	4	4	3	5	3
Env. Resource Area 24*	3	3	2	3	n	Simpson Cove (51)*	1	2	1	1	1
Env. Resource Area 25*	5	3	1	3	n	Arey Lagoon (52)*	1	1	1	2	1
Whaling Area/Cross Is.(26)	+16	13	7	13	2	Whaling Area/Kaktovik (53)+	5	5	3	5	2
Cross Island (27)+	8	7	5	6	1	Boundary Segment 17	n	1	n	1	n
						Boundary Segment 18	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-11. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 90 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2	Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	62	66	78	65	89	Land	62	66	78	65	89
Ice/Sea Segment 1	2	2	1	2	1	Whaling Area (28)+	7	7	4	6	1
Ice/Sea Segment 2	11	9	5	9	3	Env. Resource Area 29	3	3	1	3	n
Ice/Sea Segment 3	13	12	7	12	3	Boulder Patch 3 (30)	15	13	8	12	2
Ice/Sea Segment 4	13	10	6	11	3	Boulder Patch 2 (31)*	19	20	12	16	6
Ice/Sea Segment 5	22	19	11	20	7	Env. Resource Area 32*	16	42	92	22	12
Ice/Sea Segment 6	20	18	12	21	9	Env. Resource Area 33*	16	21	27	30	72
Ice/Sea Segment 7	14	12	7	12	4	Env. Resource Area 34*	60	47	24	47	12
Jones Island (8)	1	1	n	1	n	Tigvariak Is. (35)##	12	13	11	13	10
Return & Jones Is. (9)	2	2	1	2	1	Newport Entrance(36)*	41	35	23	37	13
West Dock Causeway (10)	1	1	n	1	n	Boulder Patch 1 (37)	36	29	15	27	6
Endicott Causeway (11)	9	9	4	7	2	Narwhal Is. (38)+	15	13	8	13	2
McClure & Karluk Is. (12)	13	13	8	12	3	Env. Resource Area 39*	9	9	5	8	1
Stockton Islands(13)	26	25	20	29	12	Env. Resource Area 40*	7	6	4	7	2
Maguire Islands (14)	14	12	7	13	5	Whaling Area/Narwhal (41)+	15	12	7	12	3
Flaxman Island (15)	3	4	3	4	2	Env. Resource Area 42*	6	6	4	6	3
Env. Resource Area 16*	1	1	n	1	n	Env. Resource Area 43*	13	10	8	13	4
Env. Resource Area 17*	n	n	n	n	n	Env. Resource Area 44*	23	23	17	25	13
Env. Resource Area 18*	1	1	1	1	n	Bullen Point (45)*	7	9	6	9	6
Env. Resource Area 19*	3	3	1	2	n	Env. Resource Area 46*	17	17	12	18	10
Env. Resource Area 20*	1	1	n	1	n	Env. Resource Area 47*	14	10	7	12	4
Env. Resource Area 21*	2	2	1	2	n	Canning River (48)#	1	2	1	2	2
Prudhoe Bay (22)#	1	1	1	1	n	Env. Resource Area 49*	3	2	2	2	2
Midway Island (23)*	2	1	1	1	n	Env. Resource Area 50*	4	4	3	5	3
Env. Resource Area 24*	3	3	2	3	n	Simpson Cove (51)*	1	2	1	1	1
Env. Resource Area 25*	5	3	1	3	n	Arey Lagoon (52)*	1	1	1	2	1
Whaling Area/Cross Is.(26)+	16	13	7	13	2	Whaling Area/Kaktovik (53)+	5	5	3	5	2
Cross Island (27)+	8	7	5	6	1	Boundary Segment 17	n	1	n	1	n
						Boundary Segment 18	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Table B-12. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 180 days, Liberty DPP.

Environmental Resource Area	Hypothetical Spill Location LI	PP1	PP2	AP1	AP2
Land	62	66	78	65	89
Ice/Sea Segment 1	2	2	2	2	1
Ice/Sea Segment 2	11	9	5	9	3
Ice/Sea Segment 3	13	12	7	12	3
Ice/Sea Segment 4	13	10	6	11	3
Ice/Sea Segment 5	22	19	11	20	7
Ice/Sea Segment 6	20	18	12	21	9
Ice/Sea Segment 7	14	12	7	12	4
Jones Island (8)	1	1	n	1	n
Return & Jones Is. (9)	2	2	1	2	1
West Dock Causeway (10)	1	1	n	1	n
Endicott Causeway (11)	9	9	4	7	2
McClure & Karluk Is. (12)	13	13	8	12	3
Stockton Islands(13)	26	25	20	29	12
Maguire Islands (14)	14	12	7	13	5
Flaxman Island (15)	3	4	3	4	2
Env. Resource Area 16*	1	1	n	1	n
Env. Resource Area 17*	n	n	n	n	n
Env. Resource Area 18*	1	1	1	1	n
Env. Resource Area 19*	3	3	1	2	n
Env. Resource Area 20*	1	1	n	1	n
Env. Resource Area 21*	2	2	1	2	n
Prudhoe Bay (22)#	1	1	1	1	n
Midway Island (23)*	2	1	1	1	n
Env. Resource Area 24*	3	3	2	3	n
Env. Resource Area 25*	5	3	1	3	n
Whaling Area/Cross Is.(26)+	16	13	7	13	2
Cross Island (27)+	8	7	5	6	1
Whaling Area (28)+	7	7	4	6	1
Env. Resource Area 29	3	3	1	3	n
Boulder Patch 3 (30)	15	13	8	12	2
Boulder Patch 2 (31)*	19	20	12	16	6
Env. Resource Area 32*	16	42	92	22	12
Env. Resource Area 33*	16	21	27	30	72
Env. Resource Area 34*	60	47	24	47	12
Tigvariak Is. (35)##	12	13	11	13	10
Newport Entrance(36)*	41	35	23	37	13
Boulder Patch 1 (37)	36	29	15	27	6
Narwhal Is. (38)+	15	13	8	13	2
Env. Resource Area 39*	9	9	5	8	1
Env. Resource Area 40*	7	6	4	7	2
Whaling Area/Narwhal (41)+	15	12	7	12	3
Env. Resource Area 42*	6	6	4	6	3
Env. Resource Area 43*	13	10	8	13	4
Env. Resource Area 44*	23	23	17	25	13
Bullen Point (45)*	7	9	6	9	6
Env. Resource Area 46*	17	17	12	18	10
Env. Resource Area 47*	14	10	7	12	4
Canning River (48)#	1	2	1	2	2
Env. Resource Area 49*	3	2	2	2	2
Env. Resource Area 50*	4	4	3	5	3
Simpson Cove (51)*	1	2	1	1	1
Arey Lagoon (52)*	1	1	1	2	1
Whaling Area/Kaktovik (53)+	5	5	3	5	2
Boundary Segment 17	n	1	n	1	n
Boundary Segment 18	1	1	1	1	1

Note: n = Less than 0.5%. Boundary segments with all values less than 0.5% probability are not shown.
Environmental resource areas are vulnerable year-round unless noted as shown below:
Seasonal Vulnerability: *May-October #May-September +August-October ##April-October

Appendix C

Seasonal Conditional Probabilities of Contact to Land Segments

Table C-1. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *winter* season will contact a certain land segment within 3 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	1	1	n	1	n
26	5	8	19	8	23
27	2	2	n	2	1
28	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-2. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *winter* season will contact a certain land segment within 10 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	1	2	1	2	1
26	5	8	19	8	23
27	2	2	n	2	1
28	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-3. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain land segment within 30 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	3	3	2	3	1
26	5	8	19	8	23
27	2	2	1	3	1
28	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-4. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *winter* season will contact a certain land segment within 60 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	5	5	4	5	2
26	6	9	20	9	24
27	3	3	1	3	1
28	1	1	1	1	1

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-5. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *winter* season will contact a certain land segment within 90 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	8	9	6	8	3
26	7	10	20	9	24
27	4	3	1	4	1
28	1	1	1	1	1

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-6. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *winter* season will contact a certain land segment within 180 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
22	1	1	1	1	n
25	9	10	6	9	4
26	7	10	20	10	24
27	4	4	1	4	2
28	1	1	1	1	1
30	1	n	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-7. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain land segment within 3 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
25	6	5	2	4	1
26	14	20	49	19	66
27	3	4	2	6	3
28	4	5	3	5	3
29	1	1	n	1	n
30	1	n	n	n	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-8. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain land segment within 10 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
22	1	n	n	n	1
24	1	1	n	1	n
25	7	6	3	5	2
26	15	21	50	20	66
27	4	5	3	6	3
28	7	9	5	8	4
29	3	2	1	3	1
30	1	n	1	n	1
32	n	1	n	1	n
33	1	1	1	1	n
34	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-9. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *summer* season will contact a certain land segment within 30 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
14	n	1	n	n	n
15	1	1	1	1	n
16	1	n	n	n	1
22	1	1	n	1	1
23	1	1	1	1	n
24	1	1	1	1	n
25	8	7	3	6	2
26	17	23	51	22	68
27	4	5	3	6	3
28	10	12	8	11	5
29	6	4	2	5	2
30	2	1	1	1	1
31	n	n	1	n	1
32	1	2	1	2	1
33	2	2	1	2	1
34	2	2	1	1	n
35	1	n	n	n	n
37	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-10. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *summer* season will contact a certain land segment within 60 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
14	n	1	n	n	n
15	1	1	1	1	n
16	1	n	n	n	1
22	1	1	n	1	1
23	1	1	1	1	n
24	1	1	1	1	n
25	9	7	3	7	2
26	18	24	52	23	68
27	4	5	3	6	3
28	12	14	9	13	6
29	6	5	2	5	3
30	2	1	1	1	1
31	n	n	1	n	1
32	1	2	1	2	1
33	2	2	1	2	1
34	2	2	1	1	n
35	1	n	n	n	n
37	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-11. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *summer* season will contact a certain land segment within 90 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
14	n	1	n	n	n
15	1	1	1	1	n
16	1	n	n	n	1
22	1	1	n	1	1
23	1	1	1	1	n
24	1	1	1	1	n
25	9	7	3	7	2
26	18	24	52	23	68
27	4	5	3	6	3
28	12	14	9	13	6
29	6	5	2	5	3
30	2	1	1	1	1
31	n	n	1	n	1
32	1	2	1	2	1
33	2	2	1	2	1
34	2	2	1	1	n
35	1	n	n	n	n
37	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.

Table C-12. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the *summer* season will contact a certain land segment within 180 days, Liberty DPP.

Land Segment	Hypothetical Spill Location				
	LI	PP1	PP2	AP1	AP2
14	n	1	n	n	n
15	1	1	1	1	n
16	1	n	n	n	1
22	1	1	n	1	1
23	1	1	1	1	n
24	1	1	1	1	n
25	9	7	3	7	2
26	18	24	52	23	68
27	4	5	3	6	3
28	12	14	9	13	6
29	6	5	2	5	3
30	2	1	1	1	1
31	n	n	1	n	1
32	1	2	1	2	1
33	2	2	1	2	1
34	2	2	1	1	n
35	1	n	n	n	n
37	1	1	n	1	n

Note: n = less than 0.5%.
Land segments with all values less than 0.5% are not shown.