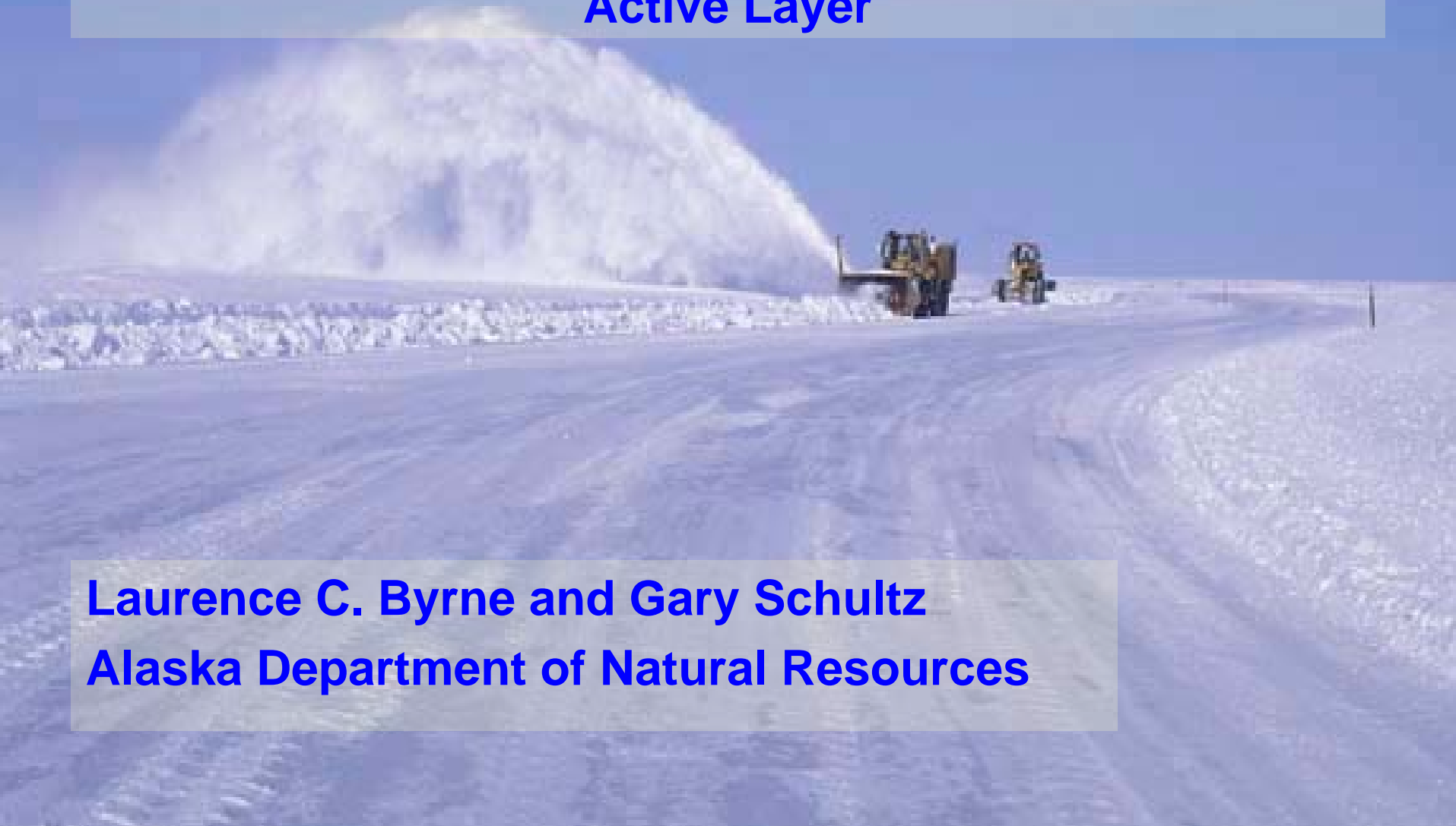


# **Recommended Methods of Ice Road Construction Based on Analysis of Disturbance to Vegetation and Active Layer**



**Laurence C. Byrne and Gary Schultz  
Alaska Department of Natural Resources**





Federal  
State

NPRA

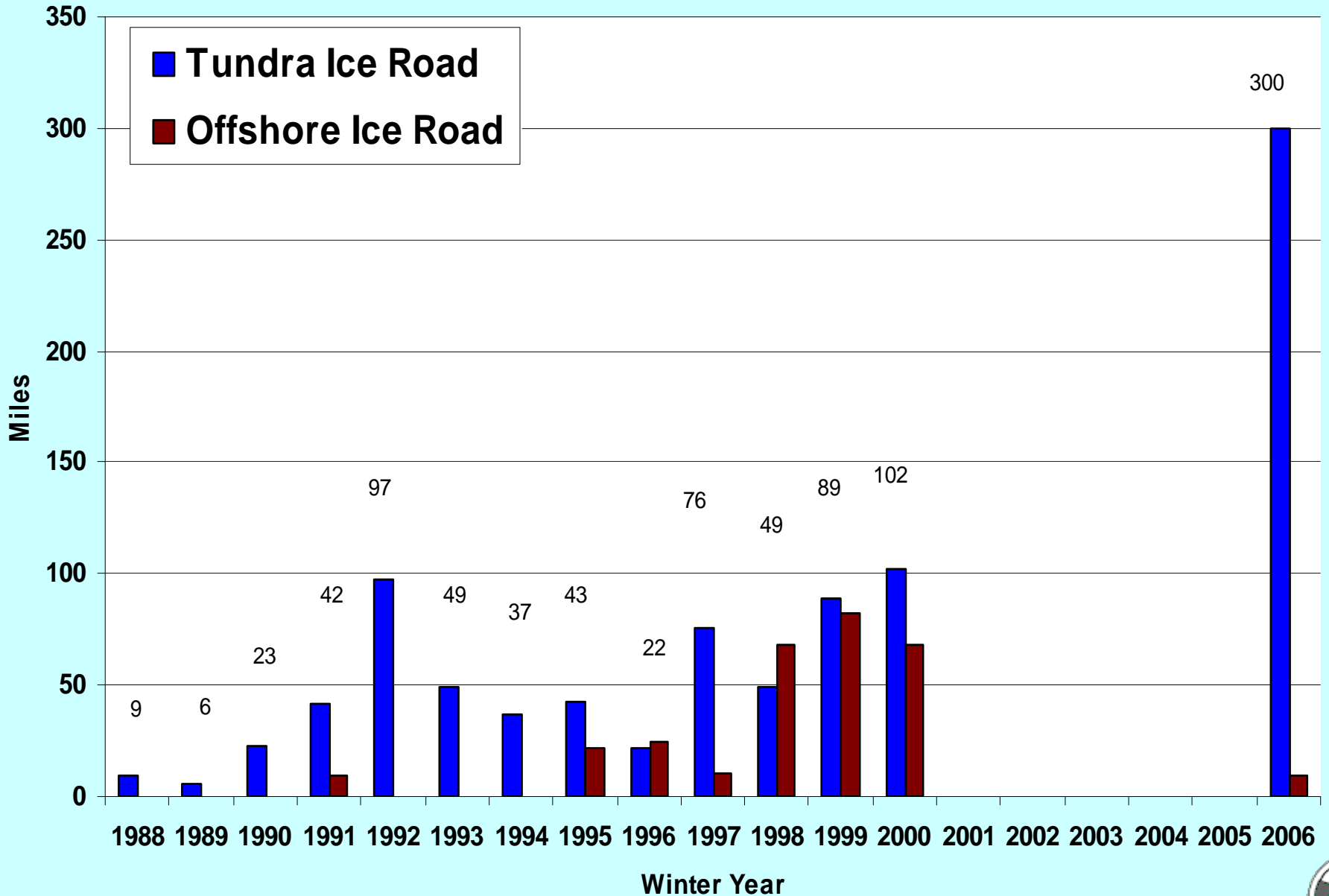
**Alaska State Land**

ANWR





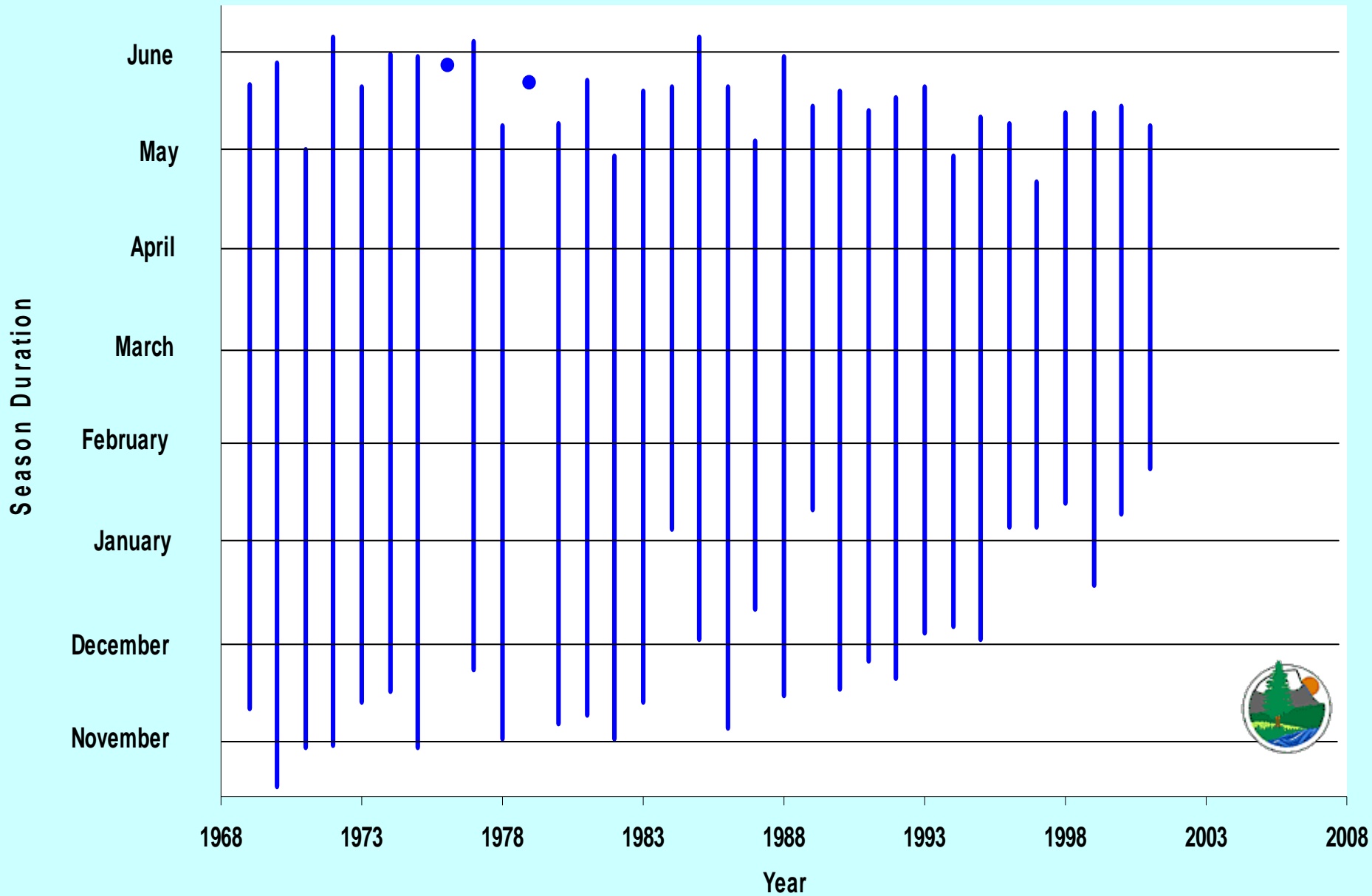
# Length of Ice Roads Constructed on the North Slope of Alaska



## 1969 -2001 Criteria for Opening Tundra

- **6” Snow Depth**
- **12” Frost Penetration**
- **Frost Depth Determined by Use a Slidehammer Penetrometer**
- **Same Tool Highway Departments Use To Determine if Roadbed is Hard Enough to Pave**

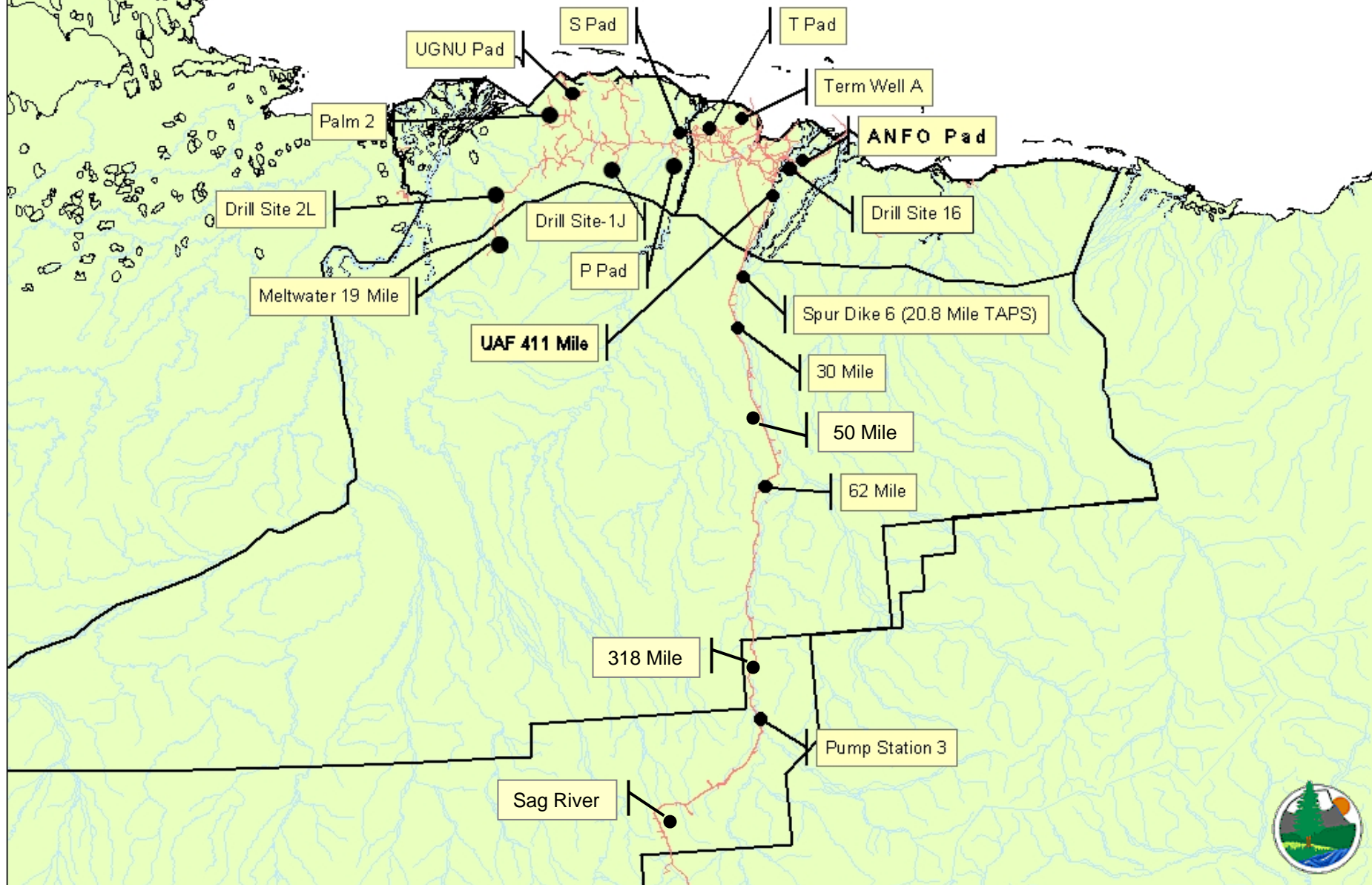
# Tundra Travel Seasons North Slope 1969-2001



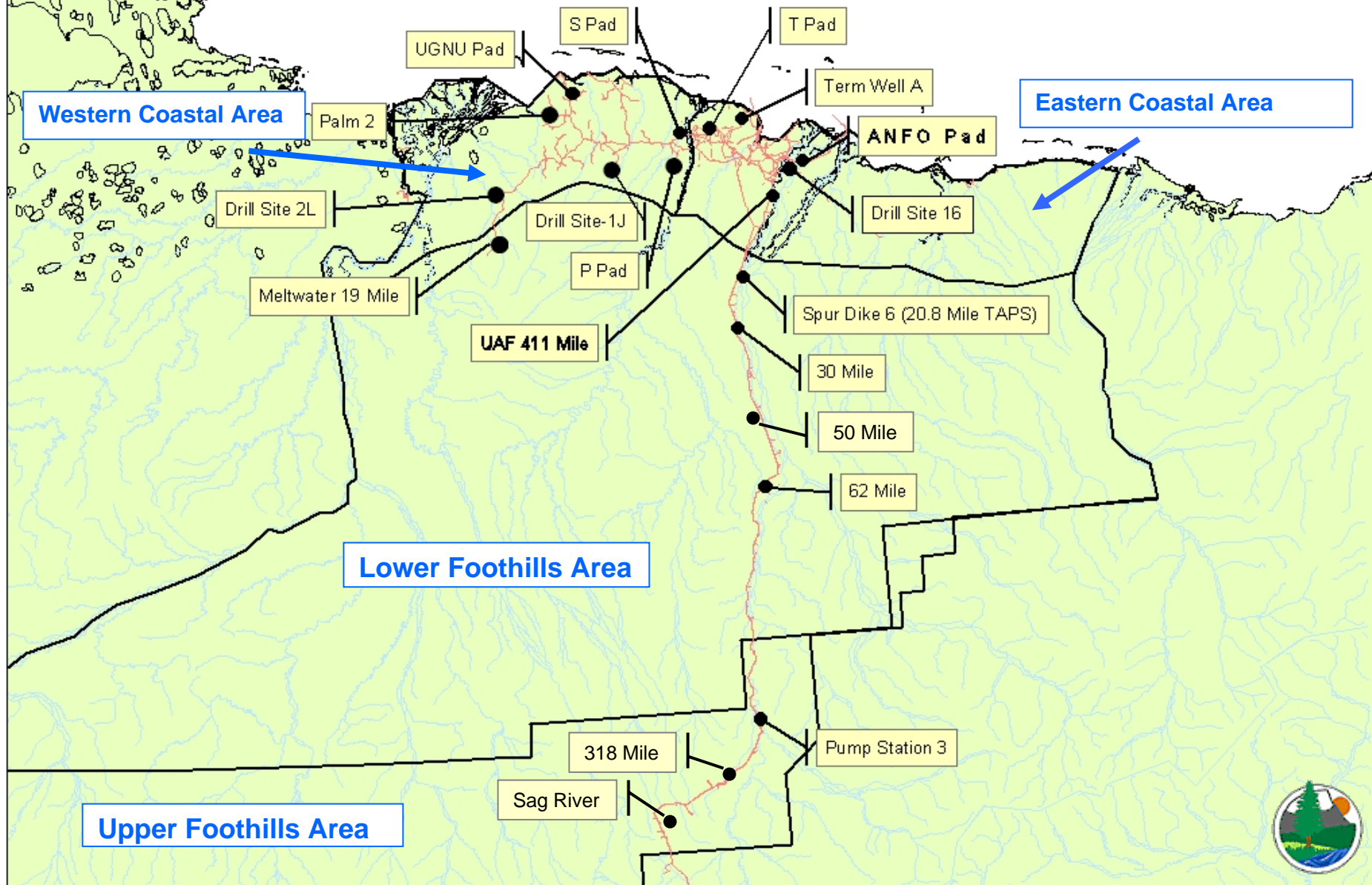
## **2002 - Present Criteria for Opening Tundra**

- **New Criteria Based on Results of Department of Energy Funded Project on the North Slope**
- **-5C Soil Temperature at 30 cm Depth Instead of Using the Slidehammer Penetrometer**
- **6” or 9” of Snow Depth Depending On Location On The North Slope**
- **Divided State Lands into 4 Tundra Opening Areas That Could Be Opened Independently Depending on Conditions**

Alaska Department of Natural Resources  
Soil Temperature and Soil Moisture Stations  
Winter 2005-06

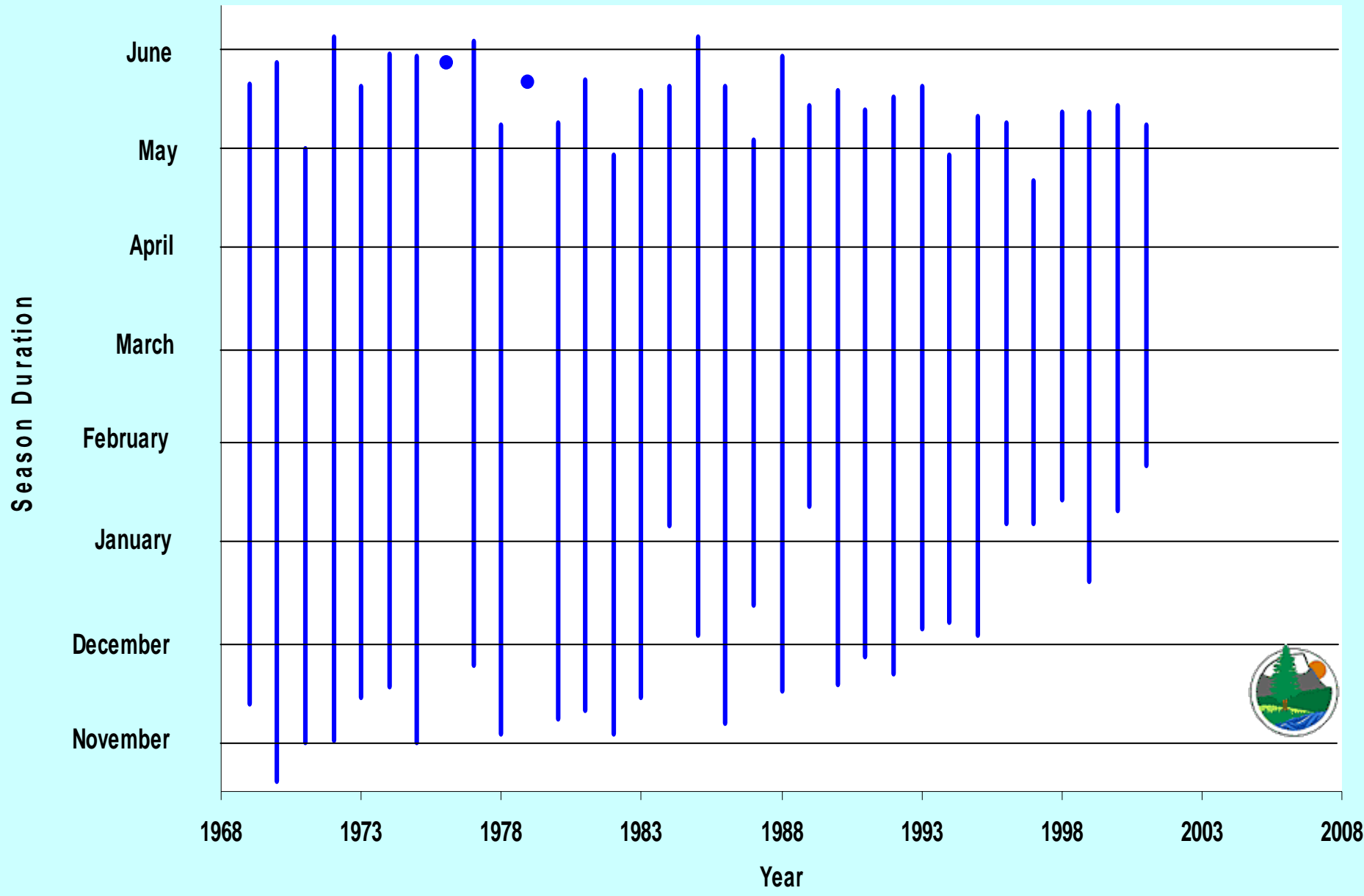


Alaska Department of Natural Resources  
Soil Temperature and Soil Moisture Stations  
Winter 2005-06

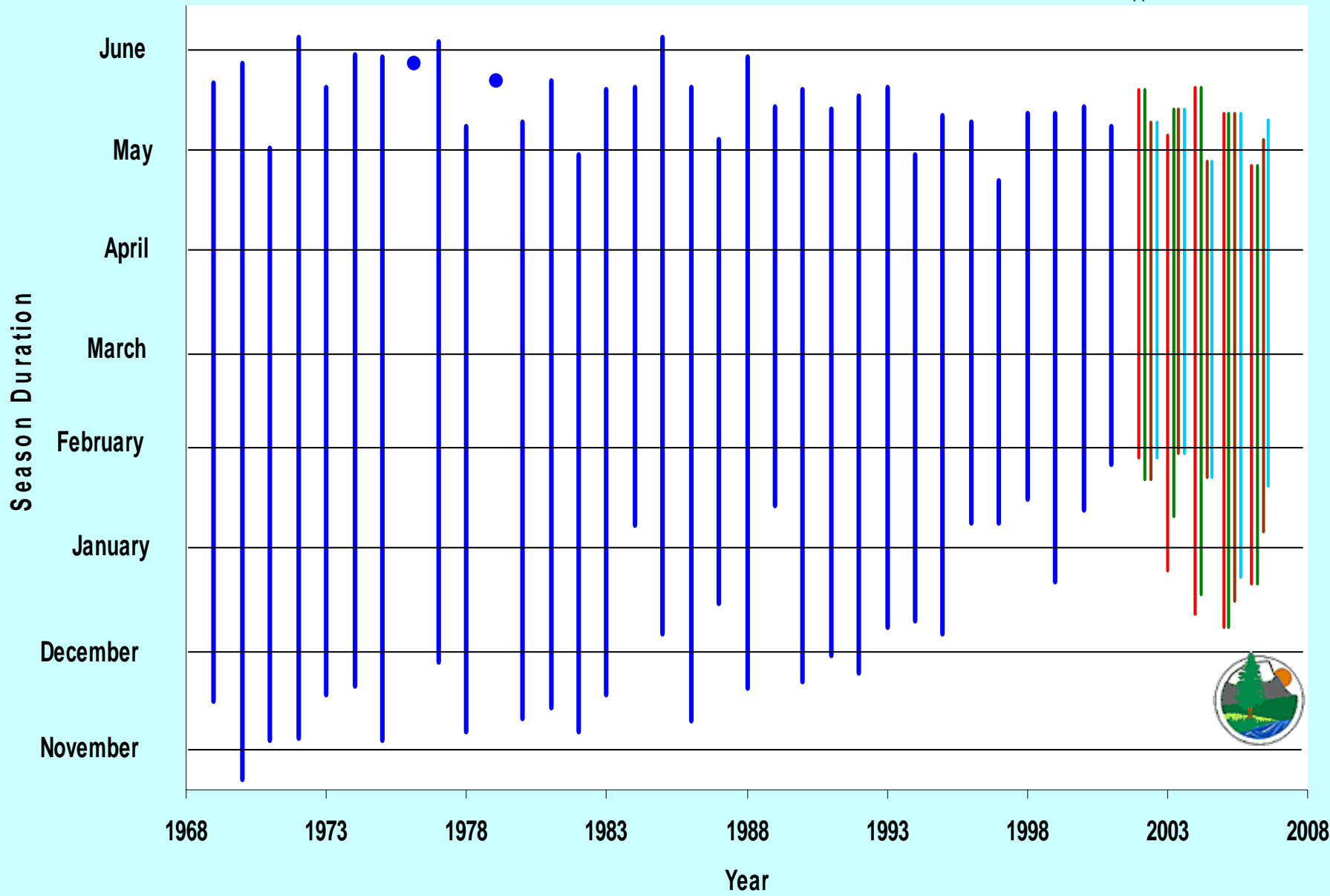
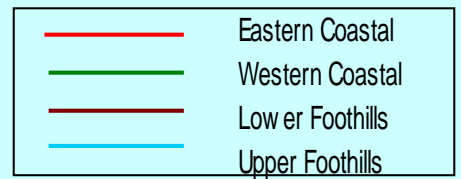




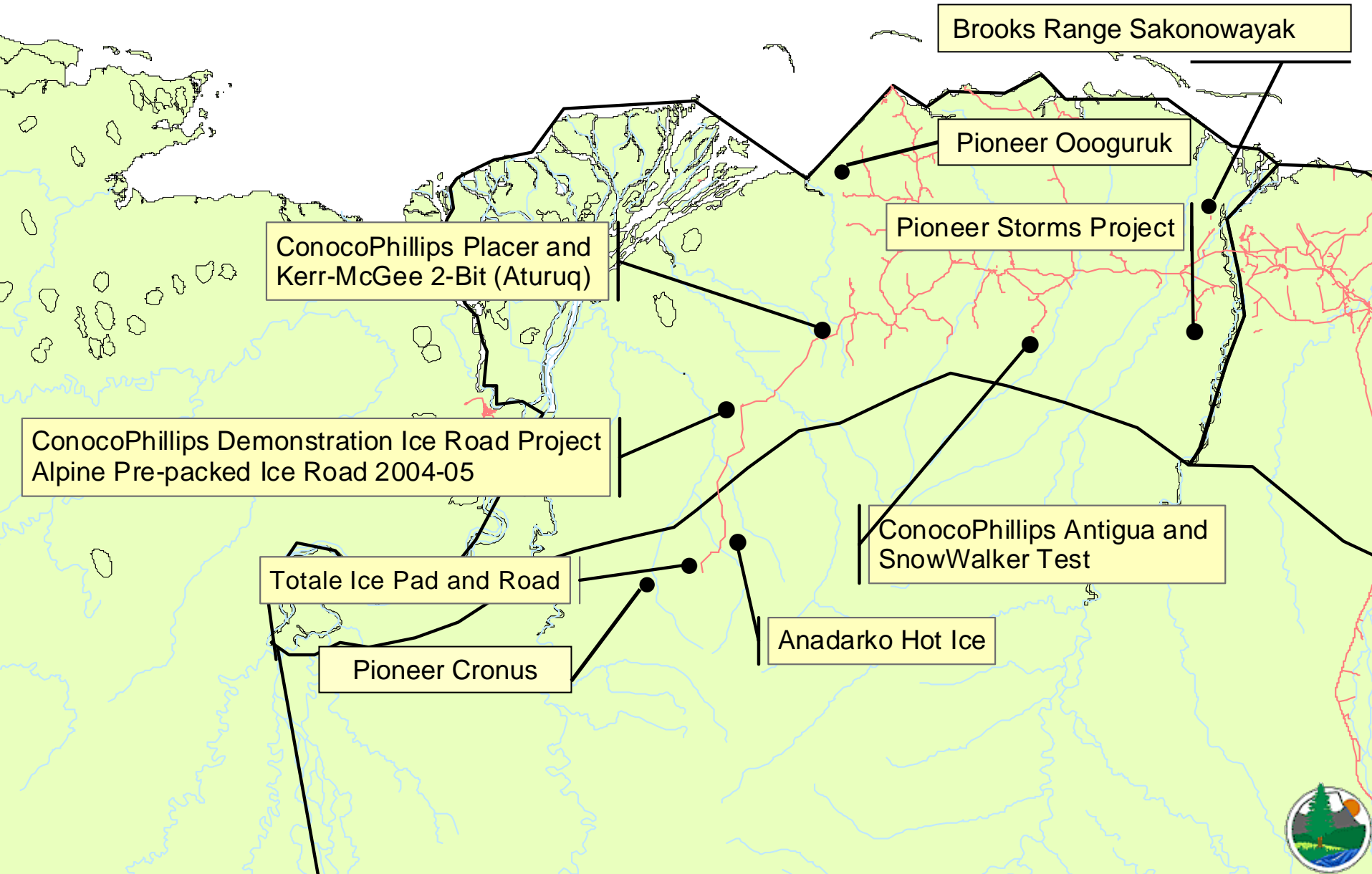
Tundra Travel Seasons  
North Slope, Alaska  
1969-2001



# Tundra Travel Seasons North Slope, Alaska 1969-2006



# Locations where DNR has studied the effects of ice roads and ice pads





## **2002 DNR – ConocoPhillips Cooperative Demonstration Ice Road Project**

- **Using their own techniques ConocoPhillips determined when they thought the tundra should be opened (Dec 22, 2002)**
- **DNR allowed them to build a 1-mile section of the Alpine Ice Road before tundra opening**
- **Rest of Alpine Ice Road was finished when DNR opened the tundra (Jan 22, 2003)**
- **DNR went back to sample along the ice road route the following four summers**

# Demonstration Ice Road Project Study Area

Standard Section  
1 Mile Long  
Built Jan 22, 2003

Demonstration Section  
1 Mile Long  
Built Dec 22, 2002

Drill Site 2L





# 1 m x 5 m Sample Plot





# Variables Sampled

## % Cover

- Litter / Dead
- Bare Ground
- Moss
- Canopy
- Deciduous Shrub
- Forb
- Water
- Lichen

## Active Layer (5 per Plot)

- **Depth Measurement (inches)**

## Disturbance Rated (0-3 Scale)

- Litter / Moss (5 1-meter Transects and Per Plot as a Whole)
- Exposed Soil (5 1-meter Transects and Per Plot as a Whole)
- **Tussock (Individual and Per Plot as a Whole)**
- Hummock (Individual and Per Plot as a Whole)

# No Significant Post Ice Road Effects in Wet Sedge Tundra





# Significantly Deeper Active Layer Depths in Moist Sedge – Dwarf Shrub Tundra



7/30/2003





## 2002 Ice Road Scrape

## Recovery

2003 to 2006







**Tussock Tundra - High Levels of Disturbance  
Especially on Ice Roads That Were Not Pre-Packed**



# Tussock Disturbance Ratings



**Level 0 - Undisturbed**



**Level 1 - Scuffed**



**Level 2 – Cracked or smashed**



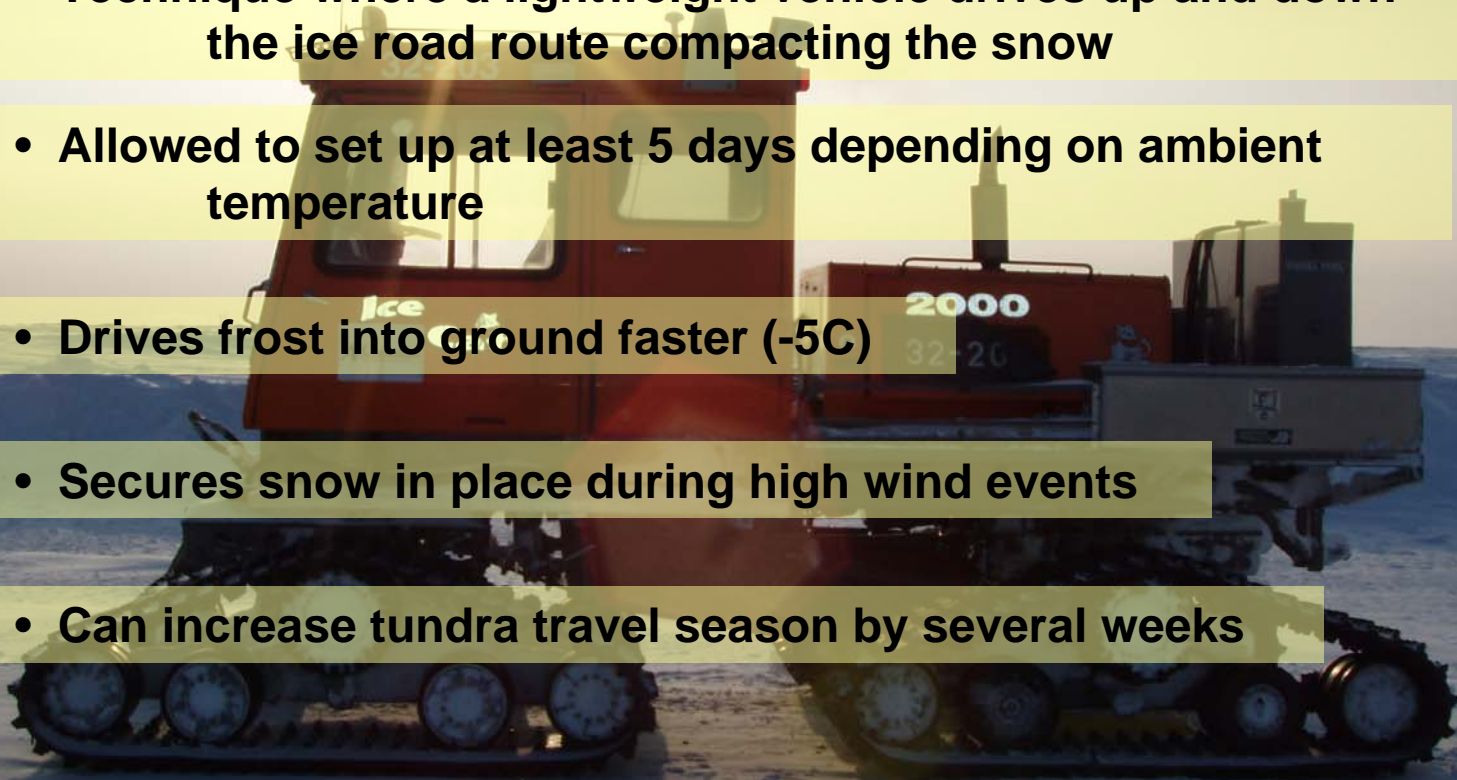
**Level 3 – Crushed or removed**





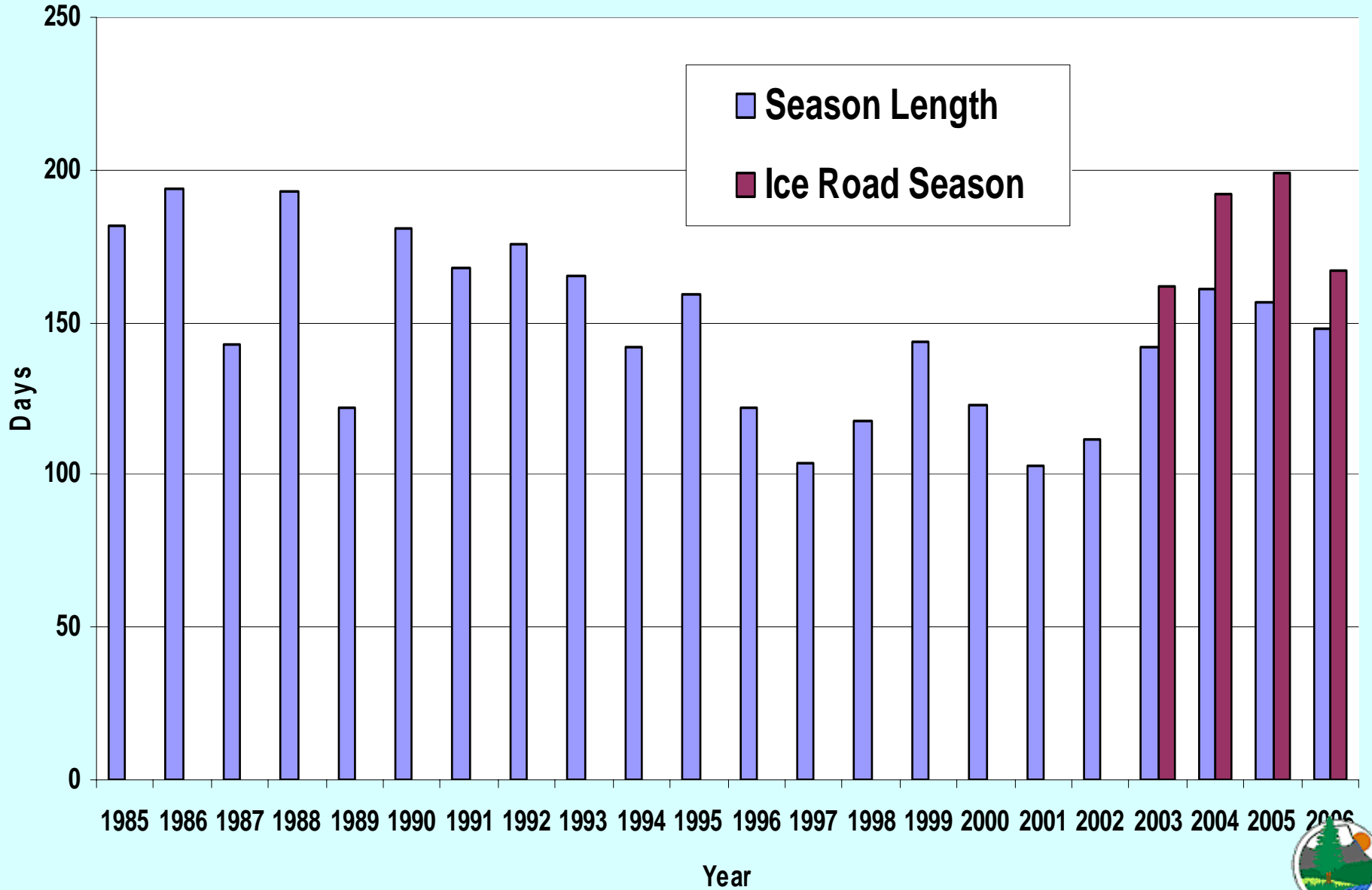
## Pre-Packing route when sufficient snow is present

- Technique where a lightweight vehicle drives up and down the ice road route compacting the snow
- Allowed to set up at least 5 days depending on ambient temperature
- Drives frost into ground faster (-5C)
- Secures snow in place during high wind events
- Can increase tundra travel season by several weeks





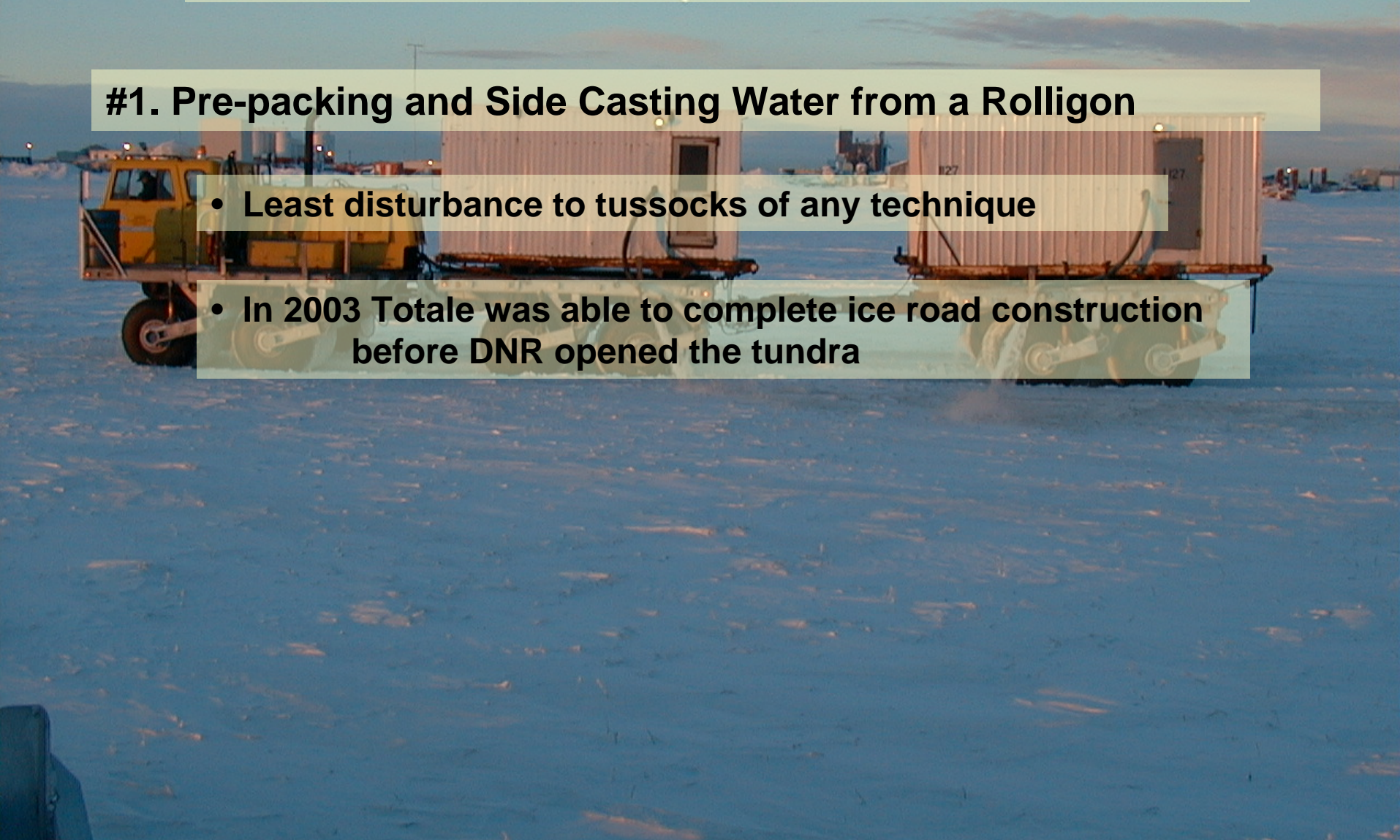
# Alaska North Slope Winter Exploration Season Length



# Methods of Ice Road Construction (In Order of Least Disturbance to the Tundra)

## #1. Pre-packing and Side Casting Water from a Rolligon

- Least disturbance to tussocks of any technique
- In 2003 Totale was able to complete ice road construction before DNR opened the tundra



# **Pre-packing ice road construction techniques (besides side-casting water)**

## **# 2. Water applied directly onto packed area**

- Useful for projects using lightweight rigs
- 2005 Pioneer Storm Project gained over 5 weeks using this technique

## **#3. Break up packed snow prior to applying water**

- Gets rid of voids in packed snow
- Used for heavy duty, thick ice roads where an assembled rig is transported
- We suspect tussocks damaged when snow is broken up

## **# 4. Pre-pack, but operate on adjacent unpacked snow**

- Problems with repeated trips and snow erodes
- Not recommended by DNR,
- Temporarily shut down one project to change their method





# No Pre-packing Ice Road Construction Techniques

## #5. Standard Ice Road Construction

- Construction after tundra is opened by DNR
- 'Walk' front end loader to break up snow slabs and consolidate snow in gullies
- Light water trucks apply first layer of ice, followed by heavier water trucks
- Tussocks are often scuffed, broken or removed

## #6. Early Season Standard Construction

- Used only once in recent years:  
CPAI Demonstration Project
- High levels of tussock disturbance due to timing



## Take Home Message

- **Prepack Prepack Prepack**
- **Extends the tundra travel season**
- **Can begin iceroad construction before DNR opens the tundra**
- **Could mean more wells drilled per season, and therefore at a lower cost per well**
- **Offers superior protection to tundra**



**End of presentation**

