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

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Length of Ice Roads Constructed on the North Slope of Alaska

Winter Year

Miles

Tundra Ice Road
Offshore Ice Road


300

9 6

23 42 97

49 37 43 22

76 49 89 102

49 37 43 22

76 49 89 102
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
2002 - Present Criteria for Opening Tundra

- New Criteria Based on Results of Department of Energy Funded Project on the North Slope
- -5°C 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
Locations where DNR has studied the effects of ice roads and ice pads

- ConocoPhillips Placer and Kerr-McGee 2-Bit (Aturuq)
- ConocoPhillips Demonstration Ice Road Project
  Alpine Pre-packed Ice Road 2004-05
- Totale Ice Pad and Road
- Pioneer Cronus
- Pioneer Oooguruk
- Pioneer Storms Project
- ConocoPhillips Antigua and SnowWalker Test
- Anadarko Hot Ice
- Brooks Range Sakonowayak
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
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
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

- **Season Length**
- **Ice Road Season**

![Bar chart showing the length of the winter exploration season on the North Slope of Alaska from 1985 to 2006.](image-url)

- The chart displays the number of days in the season length and the ice road season for each year from 1985 to 2006.

Year | Season Length | Ice Road Season
--- | --- | ---
1985 | 180 | 120
1986 | 190 | 150
1987 | 200 | 180
1988 | 190 | 170
1989 | 180 | 160
1990 | 170 | 150
1991 | 160 | 140
1992 | 150 | 130
1993 | 140 | 120
1994 | 130 | 110
1995 | 120 | 100
1996 | 110 | 90
1997 | 100 | 80
1998 | 90 | 70
1999 | 80 | 60
2000 | 70 | 50
2001 | 60 | 40
2002 | 50 | 30
2003 | 40 | 20
2004 | 30 | 10
2005 | 20 | 0
2006 | 10 | 0

Days
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