Dan Gullickson

Minnesota Department of Transportation

Morning Speaker August 2

Drift Free Road and Ditch Design

SALT SYMPOSIUM

Drift Free Road and Ditch Design
August 2, 2023 Bolton & Menk Salt Symposium

Daniel Gullickson

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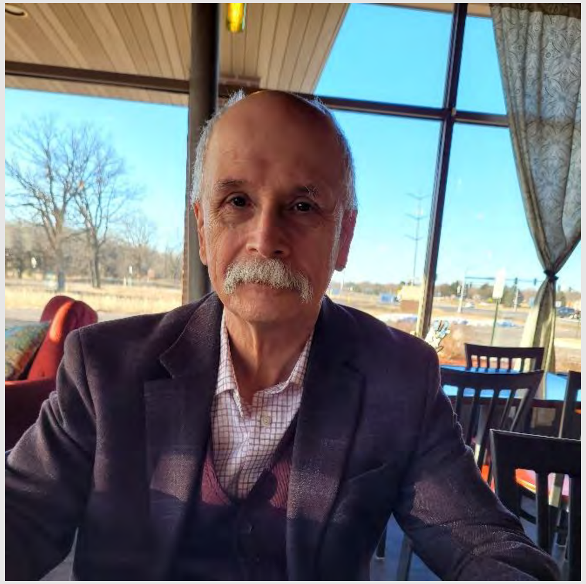

Controlling Blowing and Drifting Snow with Snow Fences and Road Design-
NCHRP Project 20-7(147)
August 2003

Chapter 15D Design for Blowing Snow Control
MnDOT Facility Design Guide
https://roaddesign.dot.state.mn.us/facilitydesign.aspx
Center for Transportation Studies Snow Control Tool website
https://snowcontroltools.umn.edu/

Dan Gullickson
Dennis Moline
Ron Tabler
May 2 and 3, 2006

Introductions

Operations Division - Shared Services
Blowing Snow Control Unit

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Why is Blowing Snow Control Important.

Design Considerations.

Blowing Snow Control Design Solutions.

Questions.

Agenda

What are we going to talk about today

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White-Outs

- Wind blown snow reduces visibility
- Closes Roads

Why is Snow Control so Important.

White-out Problems

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Snowdrifts

- Snow sculpted by wind
- Groves cause snow drifts

Why is Snow Control so Important.

Snowdrifting Problems

Why is Snow Control so Important.

Blow ice Problems

Blow ice

- Blowing snow adhering to the road surface
- Road Closures due Blow Ice

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MnDOT is averaging approximately 100 snow plow hits per year

Why is Snow Control so Important.

Think about drift free road design from the perspective of where a snow plow casts its snow.

More iron on snow combined with preventative blowing snow control treatments helps reduce chlorides.

Mechanical Snow Removal

Drift Free Road and Ditch Design

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Snow Removal Obstacles

Identify Obstacles to Casting the Snow from the Road

Where will the plowed snow go?

Lighting Placement

Sidewalks/Trails

Utilities

Sign Placement

These obstacles may result in plow berms.

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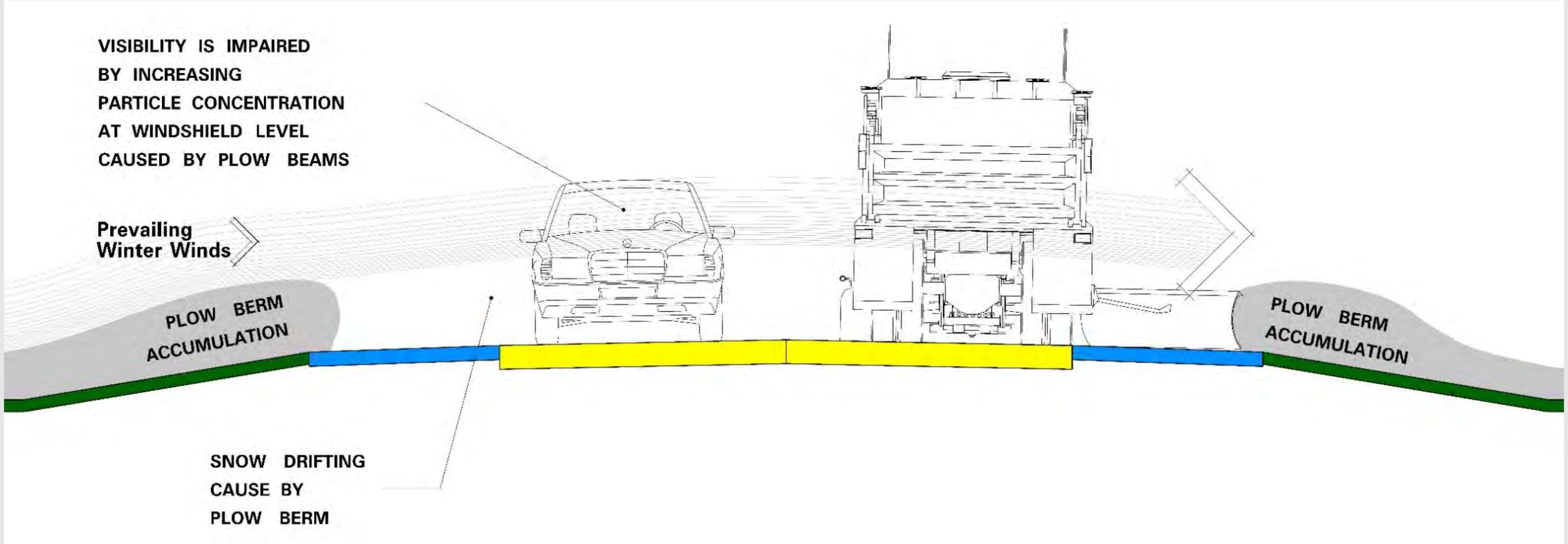
Plow Berms

Public Enemy # 1

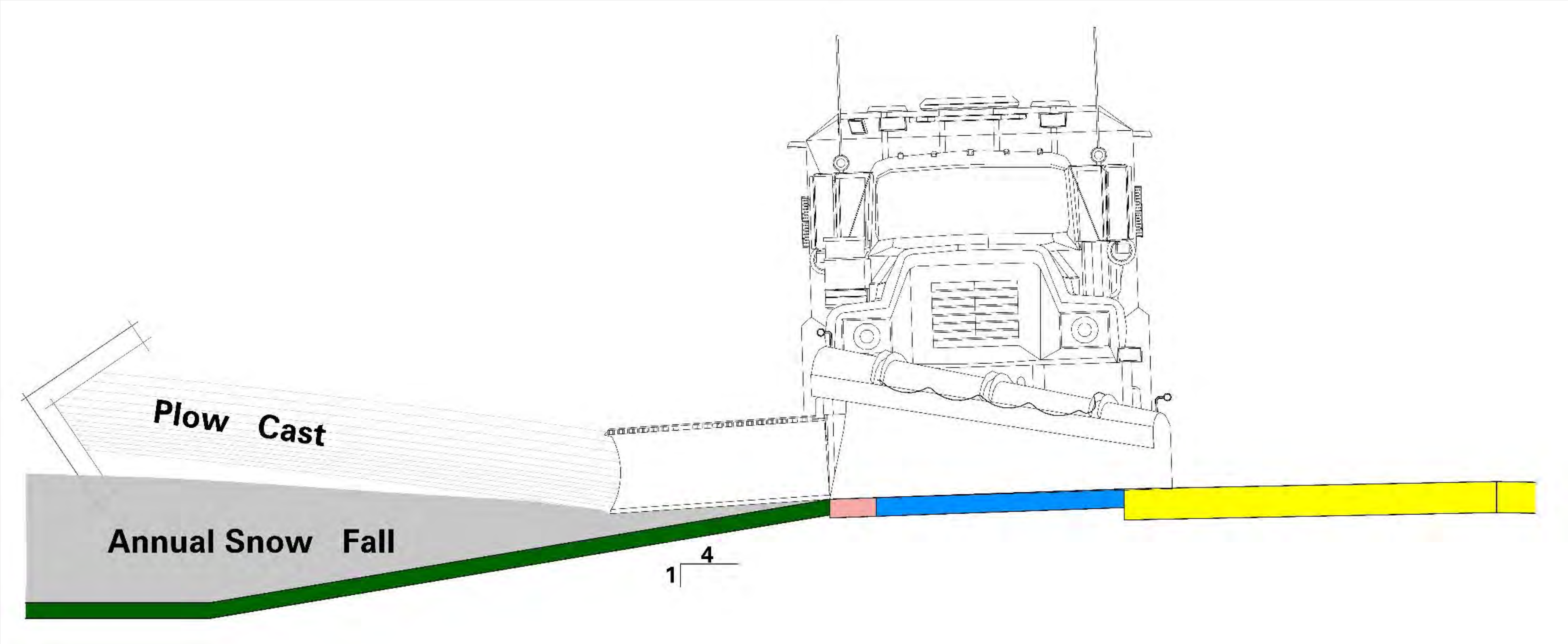
Snow Drifting

Impaired Visibility



Design Considerations

Operations



Snow Solution

- 1 to 4 inslopes
- Road Profile 3’ higher than surrounding topography
- Cleanup Operations

Design Considerations

Operations

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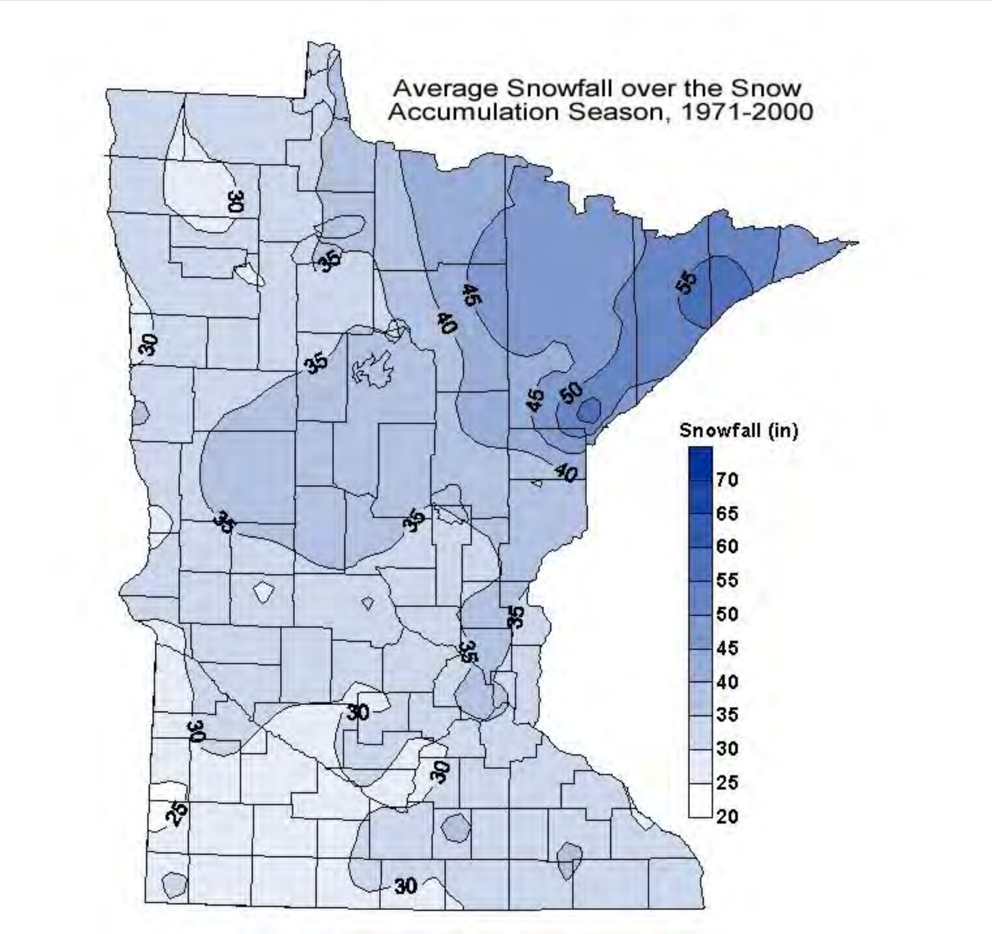
Why the road profile should be 3 feet higher than surrounding topography?



Snow accumulation season is delimited by the dates when the average air temperature reaches 32 degrees F and defines the period in which blowing snow events result in persistent drifting.

Design Considerations

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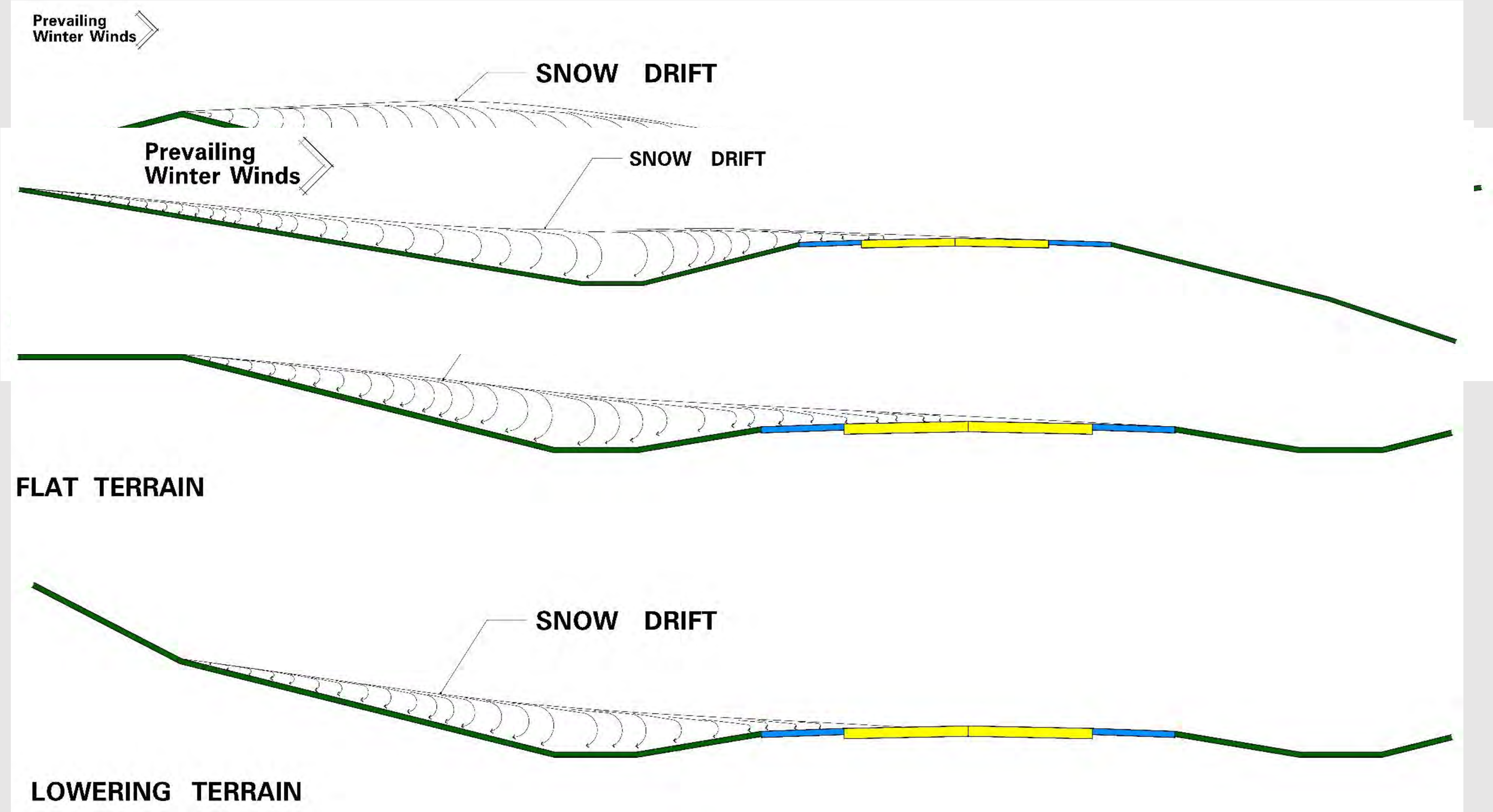

Drifting Effects

- Ditch Upwind
- Ditch Downwind
- Ditch Both Sides
- Terrain Effect

Terrain Considerations

Snowdrifting Problems

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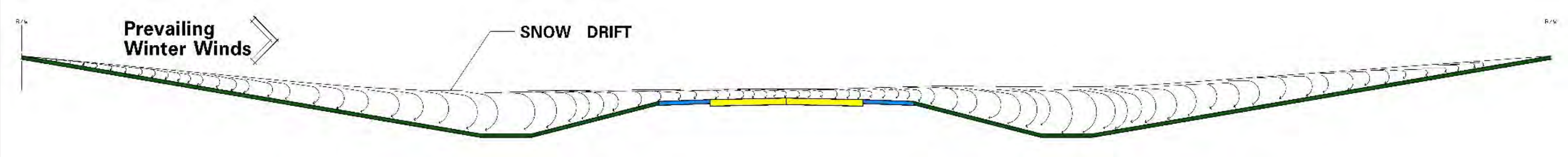
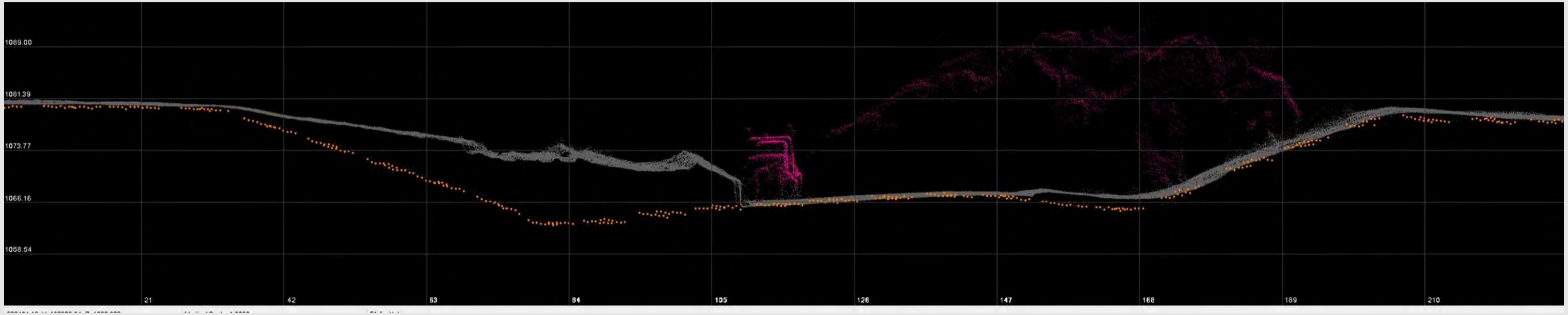
Why Grading for Snow Control Matters

Cut Sections Discussion





Point Cloud by Drone

Why Snow Drifts form in Cut Sections When:

Backslope not at 1 to 3

Inslope not at

1 to 4

Ditch Depth is less then 4ft

Ditch bottom width is less then 8ft

Why Grading for Snow Control Matters

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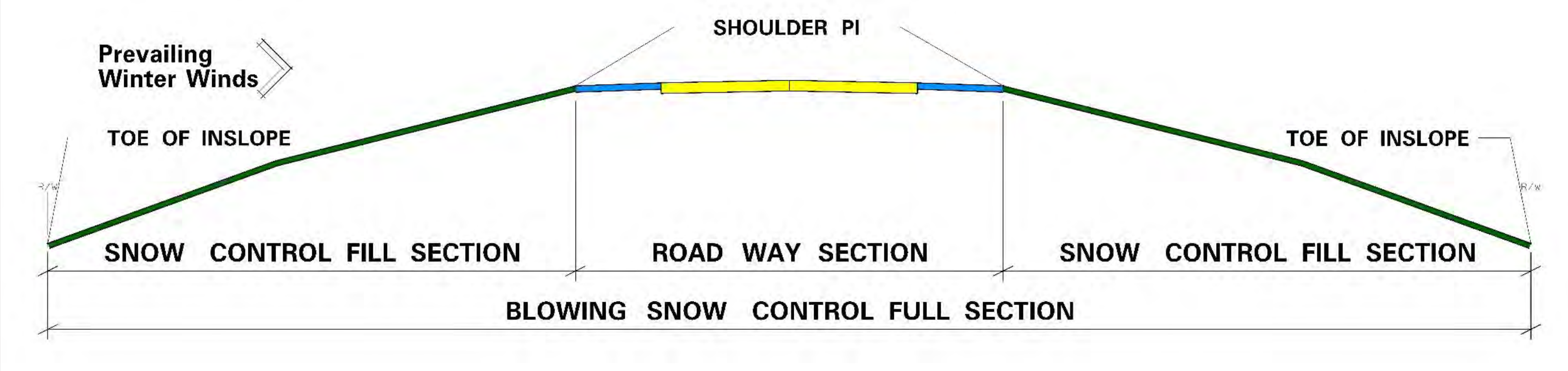
Snow Design Solutions



Fill Sections

1 to 4 Inslopes

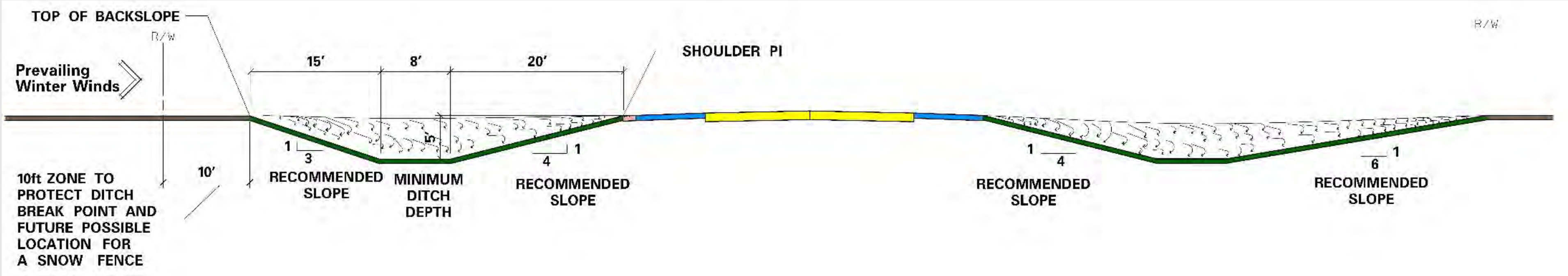
Strive for a Road Design Profile

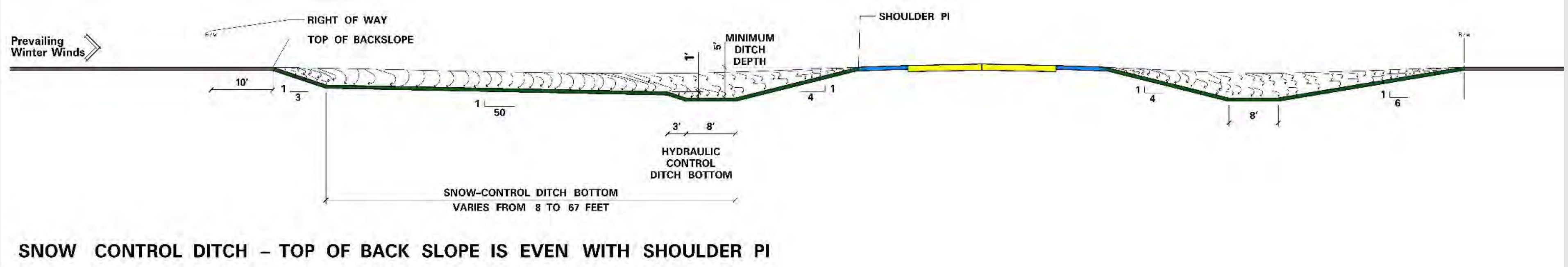
3ft above terrain

Outside of Clear Zone

1 to 3 Inslopes

Fill Sections Discussion





Enhanced Ditch Bottom

Upwind

- 1 to 4 Inslope
- 1 to 3 Backslope
- 5ft Ditch Depth
- Min 8ft Bottom
- Max 67ft Bottom Hydraulic Control
- 1 to 50 bottom
- 10ft to protect Backslope

Downwind

- 1 to 4 Inslope
- 1 to 6 Backslope
- 5ft Ditch Depth
- Min 8ft Bottom

Snow Design Solutions

Cut Sections Discussion

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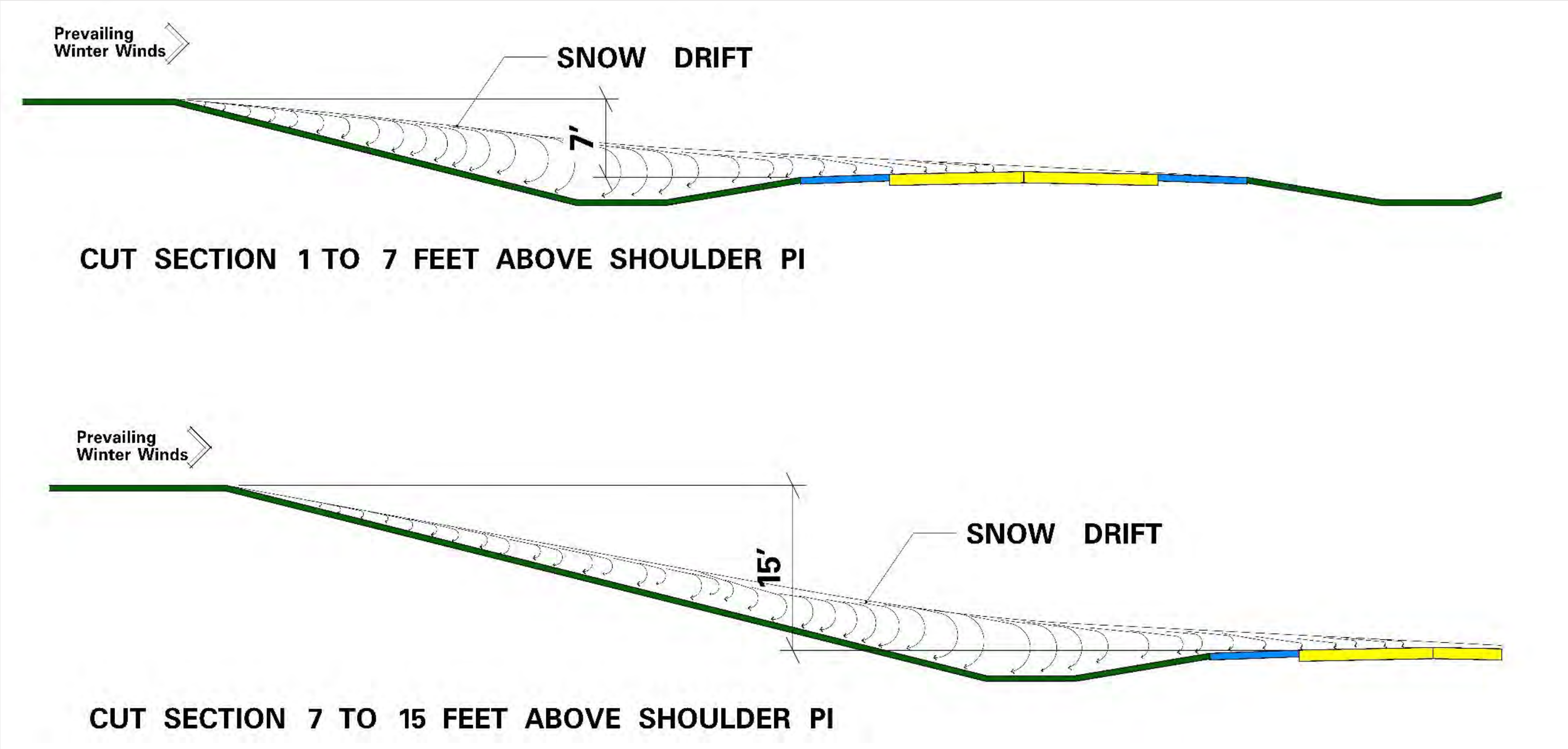

To control drifting When

Cuts are 1 to 7 foot

- Main cause of drifting
- Lengthen ditch bottom and depth
- Maintain 1 to 3 Backslope

Cuts are 7 to 15 foot

- Less drifting
- More vertical snow storage
- Lengthen ditch bottom and depth
- Maintain 1 to 3 Backslope

Snow Design Solutions

Cut Sections Discussion

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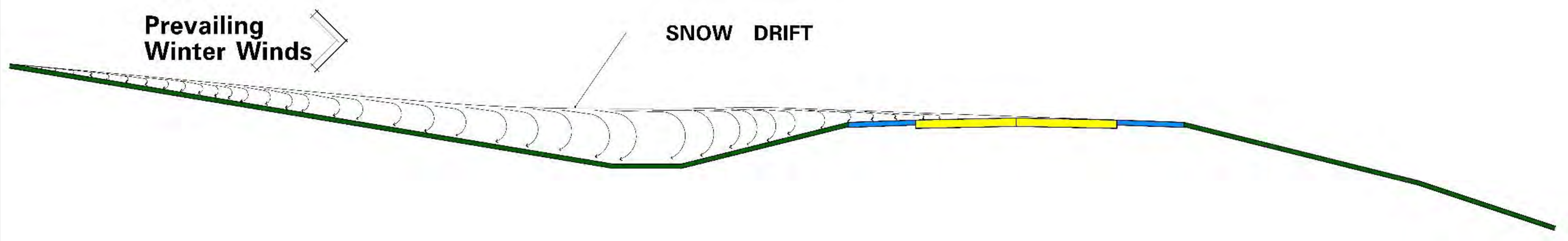

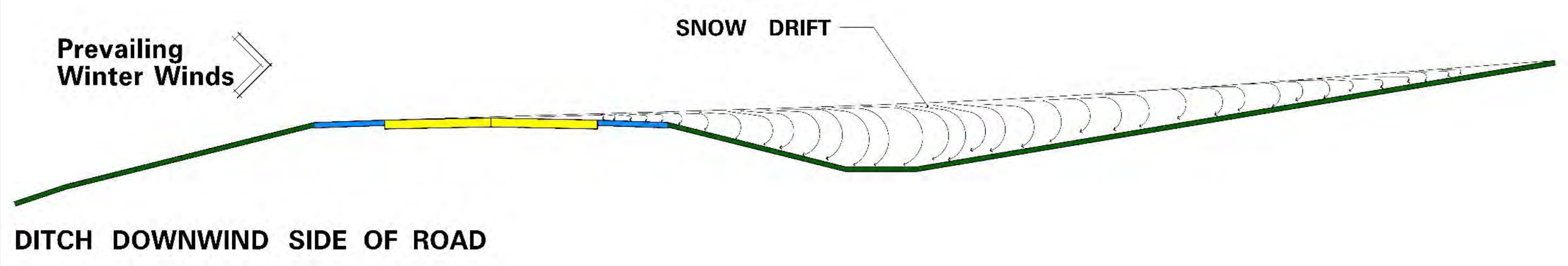

Ditch Upwind

- 1 to 3 Backslope
- 1 to 4 Inslope
- 5ft Ditch Depth
- 8 to 67 Ditch Bottom

Ditch Downwind

- 1 to 4 Inslope
- 1 to 6 Backslope
- 5ft Ditch Depth
- 8 to 67 Ditch Bottom

Snow Design Solutions

Combination Cut and Fill Sections Discussion

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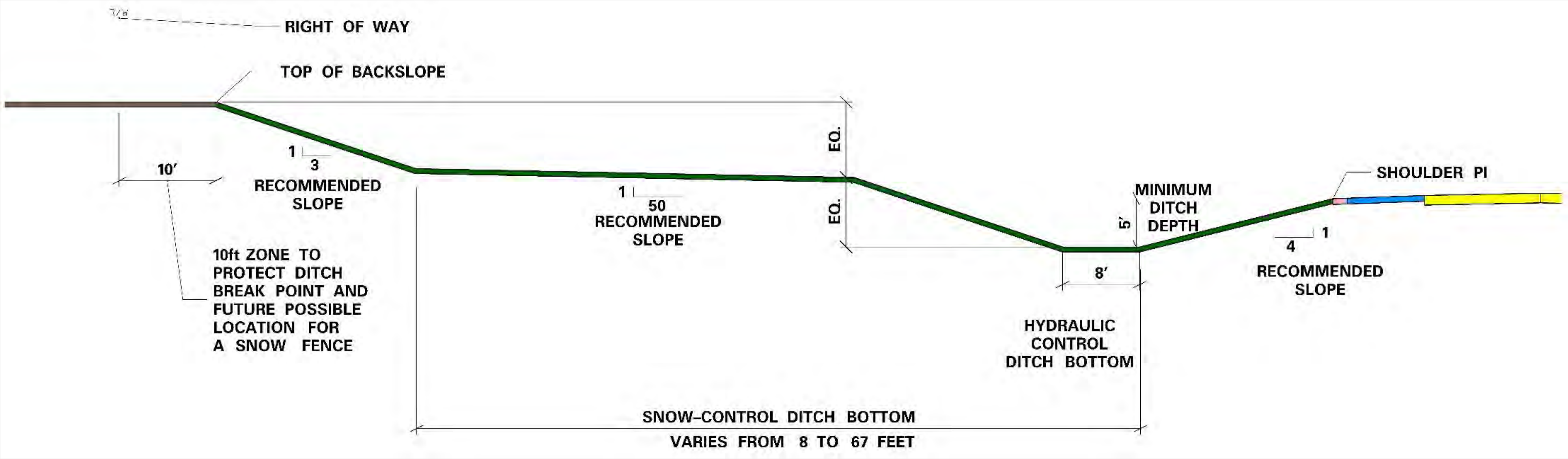

Terraced Ditches

- When its not Practical to fully excavate an Enhanced ditch
- Backslope is 3 feet or greater above Shoulder PI
- Equal Heights
- 1 to 50 Bench Slope
- Both Backslopes 1 to 3
- 8ft Ditch Bottom

Snow Design Solutions

Cut – Terraced Sections Discussion

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NW Quadrant TH 10 and TH 32

Interchange During Construction

In March 2013 the drift did not reach the ramp.

Snow Design Solutions

Enhanced Ditch Bottom Example

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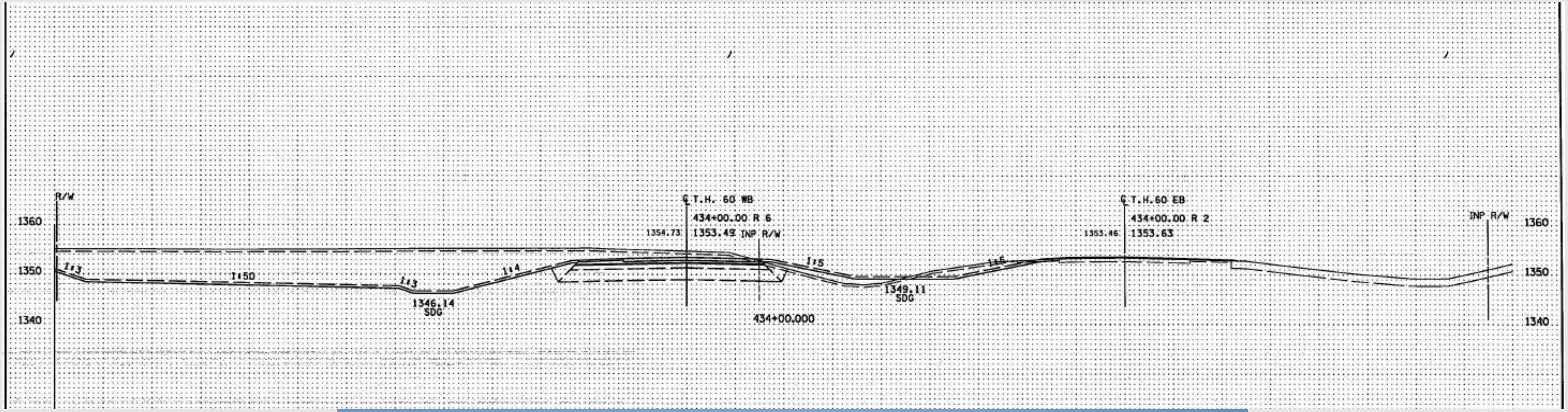

SP 1703-69 TH 60 cross section

SP 1703-69 TH 60 Looking Westbound @ station 434+00

Snow Design Solutions

Enhanced Ditch Bottom Example

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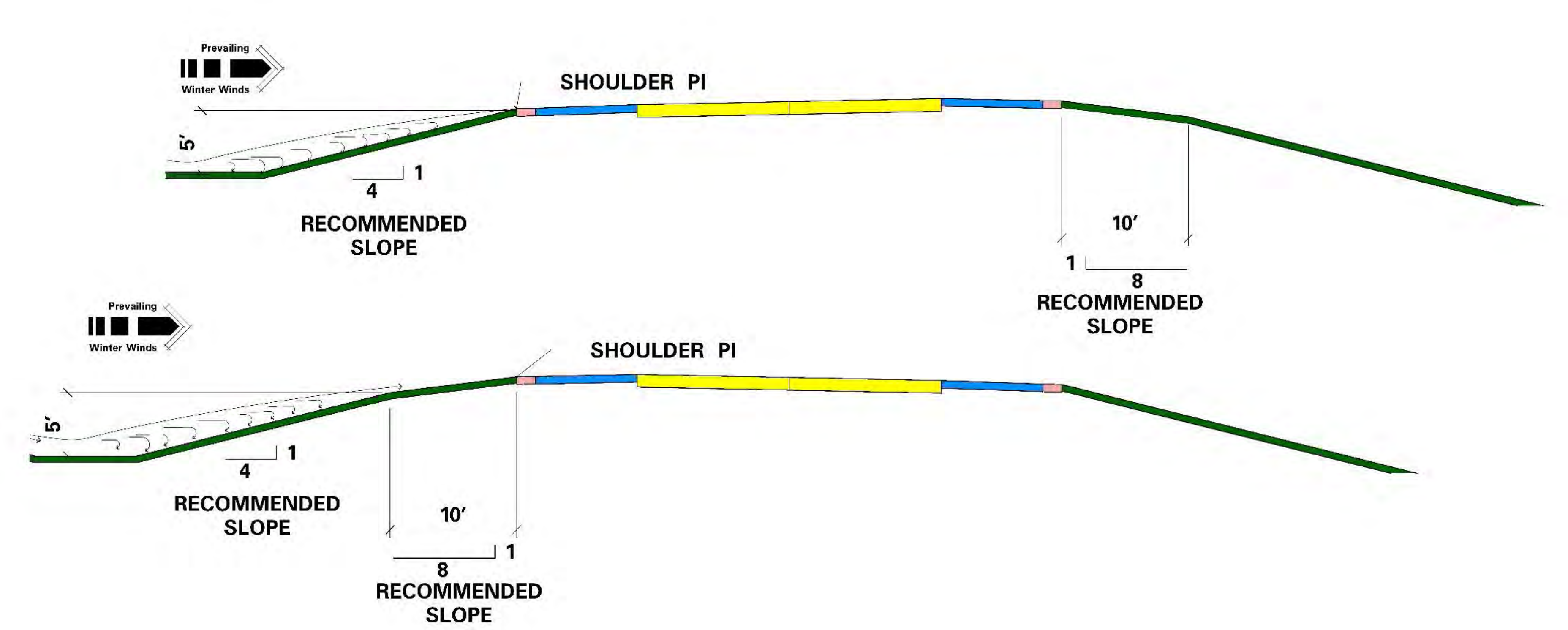

Particularly Problematic

Curve bends into Prevailing winds

- 1 to 4 Inslope upwind side
- 1 to 8 Inslope Downwind side for 10ft then 1 to 4

Curve bends away Prevailing winds

- 1 to 8 Inslope Upwind side for 10ft Then 1 to 4
- 1 to 4 Inslope Downwind side

Snow Design Solutions

Horizontal Curves and Superelevation Sections Discussion

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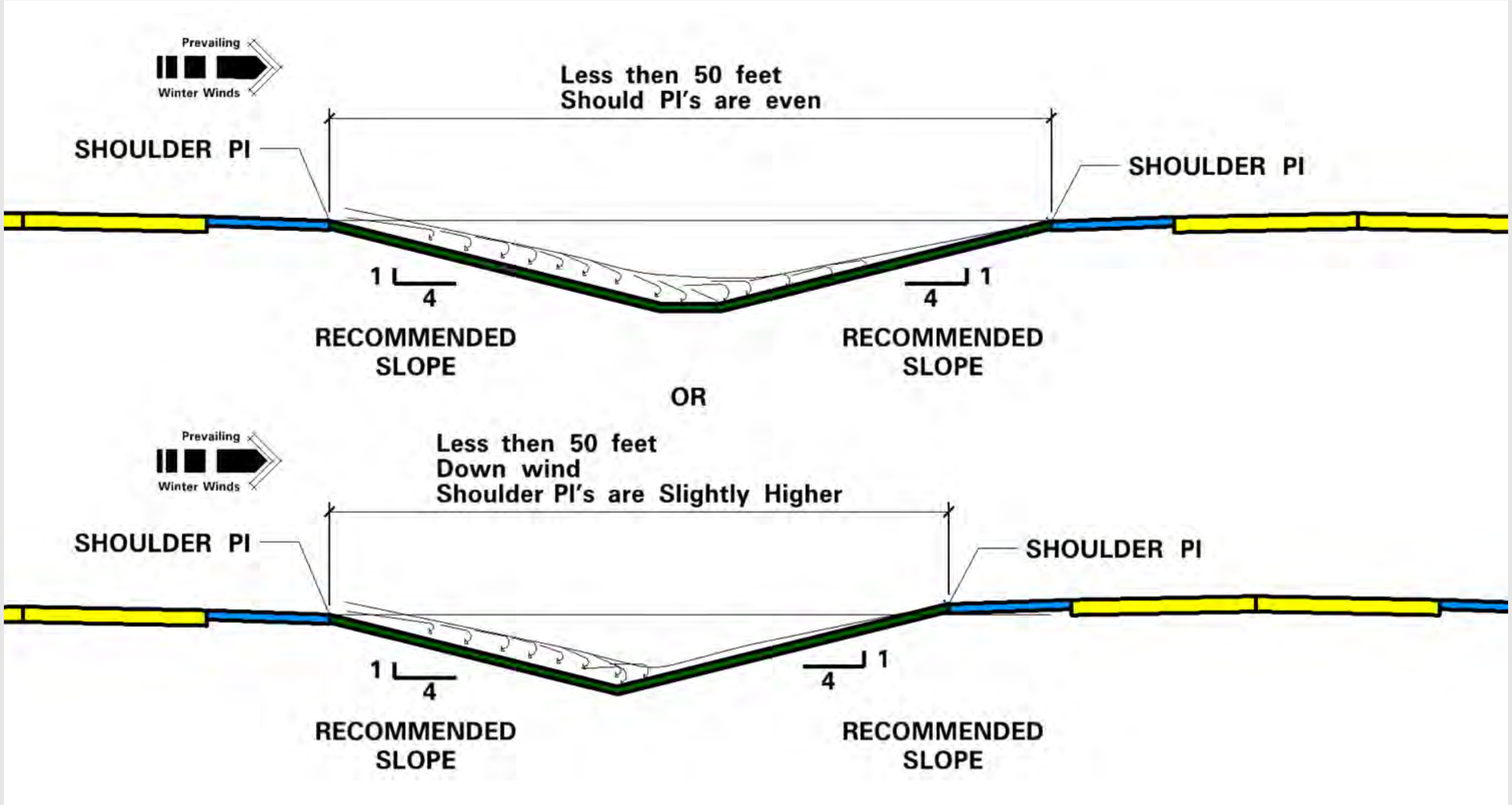

Over 50ft from each other

- Upwind lanes
- Elevation is higher

Equation

$$H=0.04W$$

Within 50ft or less from each other

- Downwind lanes
- Elevation even or slightly <u>higher</u>

Snow Design Solutions

Divided Highways Sections Discussion

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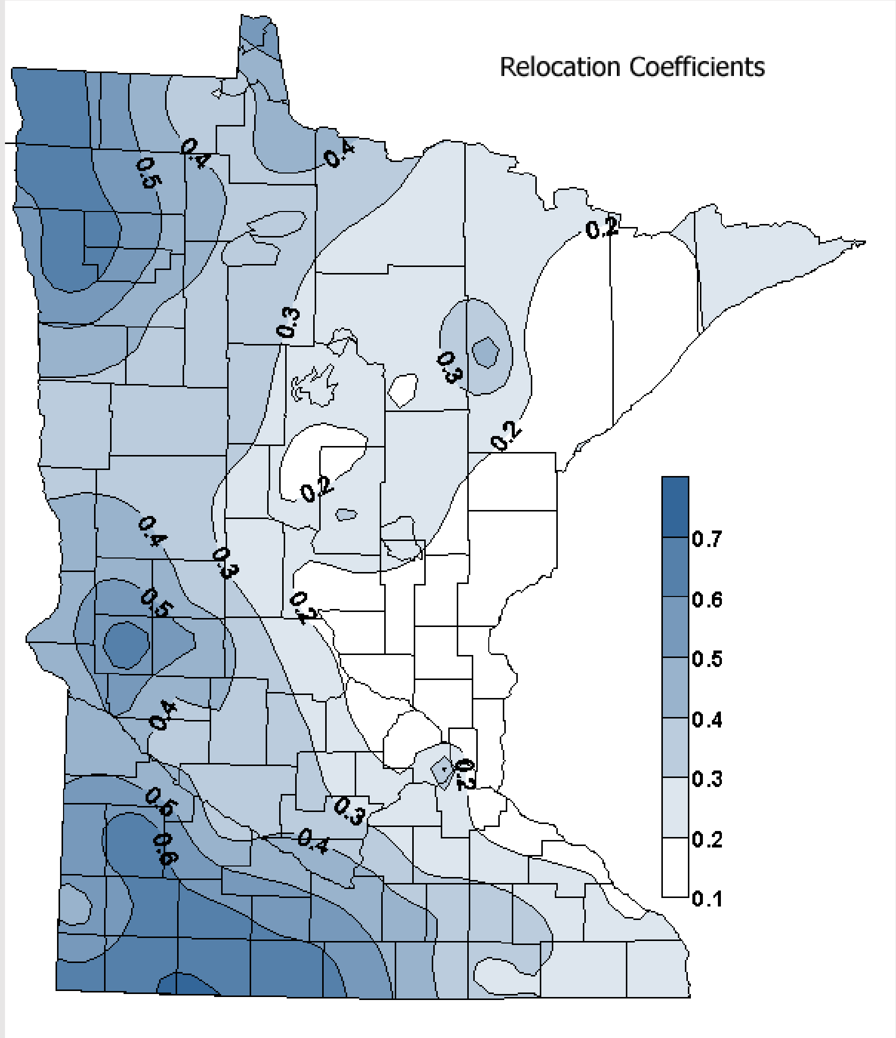

Ideally – Plan Lane Expansion without Concrete Barrier or Plate-Beam

Ideally – Drainage structures Located outside of clear zone

If possible, do not use Concrete Barrier or Plate-Beam for Bridge Barriers or Transitions

If used, include snow fences in Design

Concrete Barrier

- Impaired Visibility
- Snowdrift Formation
- Obstruction of plow-cast snow

Designing for

Traffic Barrier

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Longitudinal Traffic Barriers

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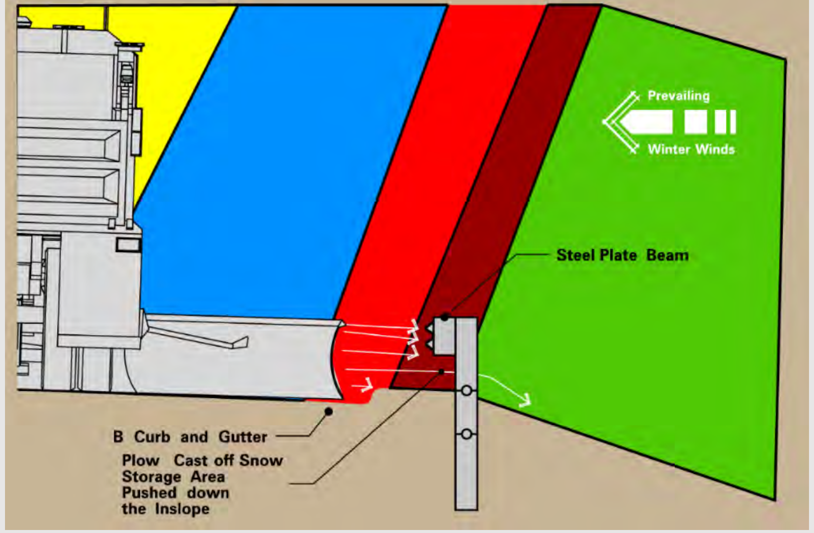

Plate-Beam

- Obstructs plow -cast
- Trips wind, creates snowdrifts
- Both upwind and downwind

Cable

- Is Preferred
- Less likely to trip the wind
- Minimum length of 300ft

Curbs

- Use D curbs

Snow Design Solutions

Abutments

Cause Snowdrifting

Both Upwind and Downwind

Snow Design Solutions

Bridges and Overhead Structures

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To Protect Bridge Abutments

Create trip points with

Living or Structural Snow Fences

Snow Fence Design Solutions

Bridges and Overhead Structures

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Earth Berm

https://snowcontroltools.umn.edu/design-tool

Fence Porosity of 0.10 for Berms

Snow Design Solutions

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Thank You again!

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