Alaska February 2024 Roadway Maintenance Concerns and Issues

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Agenda

- Logistics
- Safety/Facility/First Aid
- Material presentation
- Breaks

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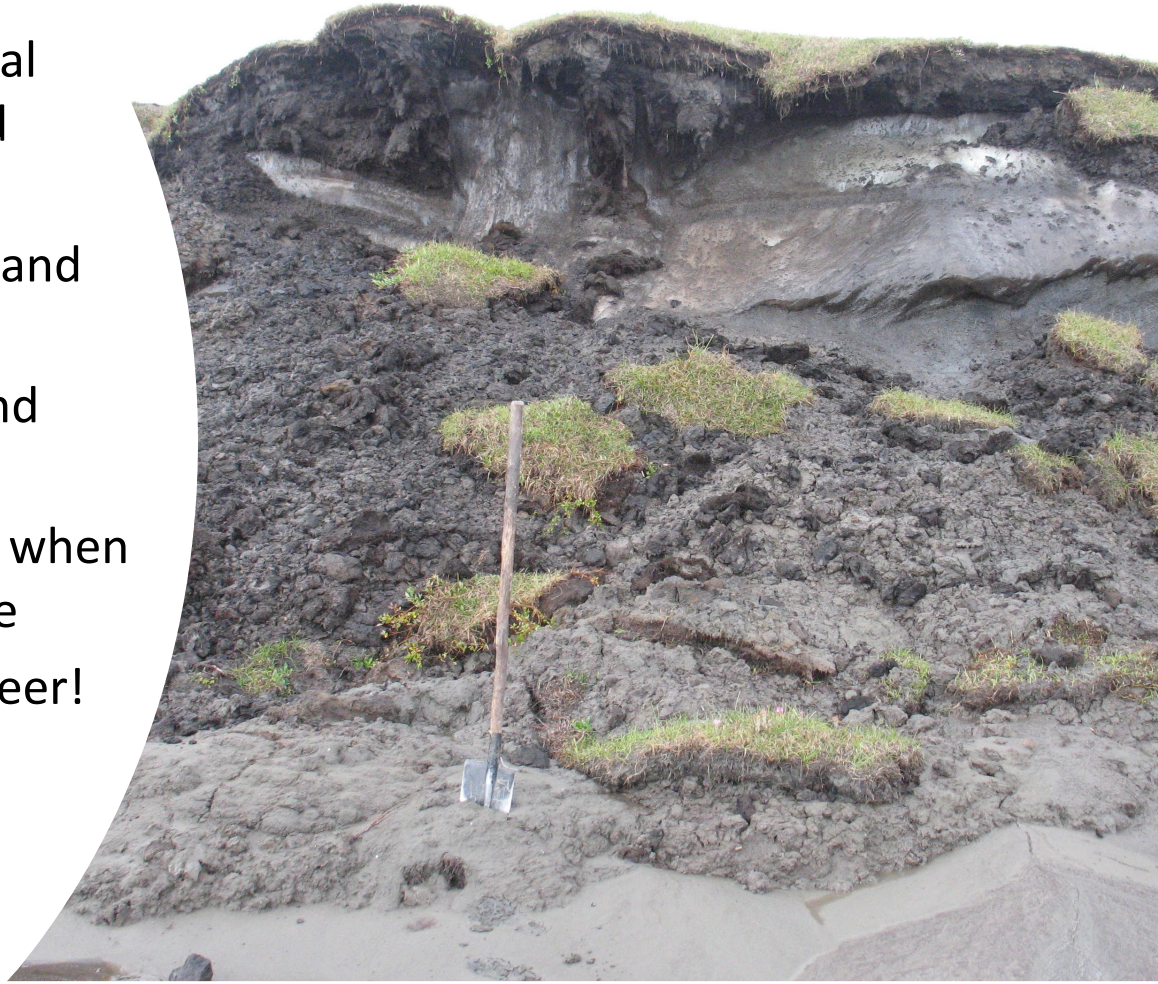
Life is good….

MONTANA STATE UNIVERSITY

Mountains & Minds

Purpose

- Provide you with a fundamental understanding of some limited gravel roads issues
- Allow you to discuss practices and ask questions
- Share successes, limitations and pitfalls of those practices
- Provide information of where, when and who to go to for assistance
- Enjoy playing stump the engineer!



What it is not….

- It is not presentation from an approved or details policy manual
- It is not a set of guidelines
- It is not a comprehensive body of knowledge

PRIMARY Issues contributing to historically poor performance of roads in the network

- Using unsuitable materials
- Lack of on-site investigation prior to construction
- Full scope of the project were not well defined
- Limiting scope to addressing only the most serious drainage deficiencies
- Improper shaping of the roadbed and inadequate compaction
- Poor contract administration: Limited leadership and governance
- Few aggregate sources were legally compliant
- Diversion of road maintenance funding for other administrative priorities

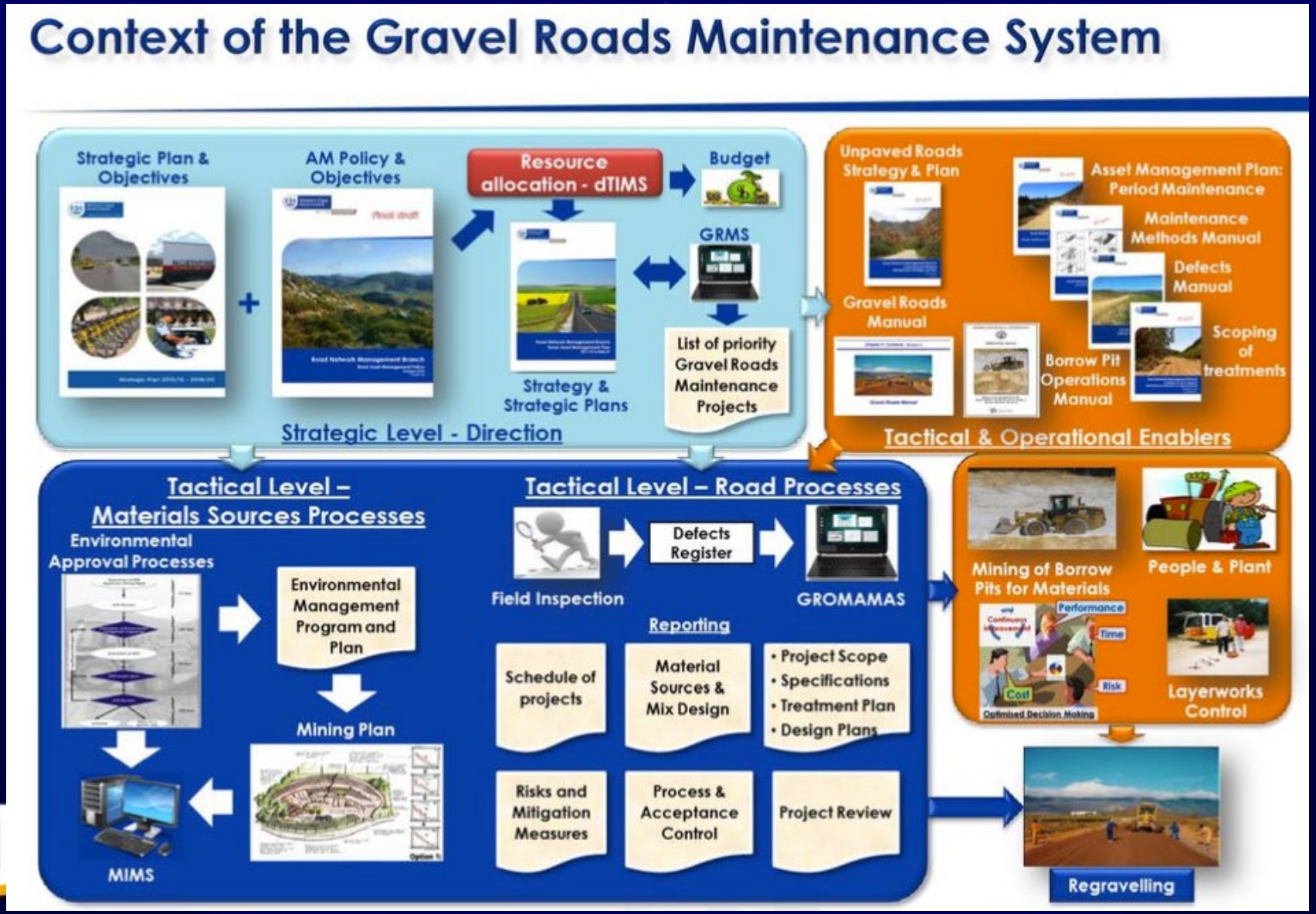
Gravel Road Maintenance

Gravel Road Maintenance

Classification of Maintenance

1. Routine Maintenance
   - Moderate depth and light blading
   - Gravelling, shaping and **compaction**
   - Culvert cleaning and repair
   - Ditch cleaning
2. Periodic Renewal
   - Heavy blading and re-shaping
   - Ditch reconstruction
   - Culvert replacement
3. Emergency Maintenance Work
   - Seasonal damage repairs
   - BAER, FEMA, ERFO, etc.

Normal Gravel Road Maintenance Processes



Gravel Road Maintenance

Activities and treatments

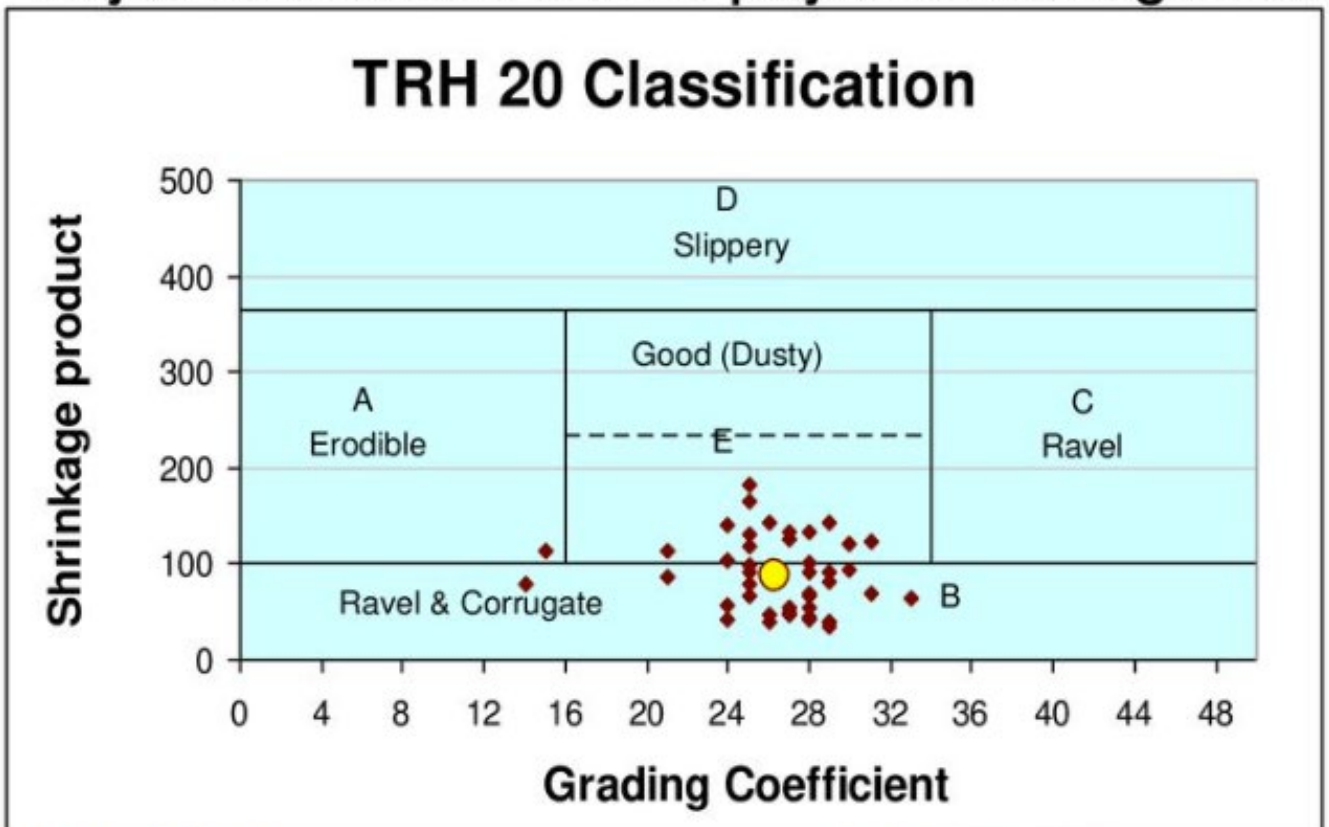
The LOS is associated with appropriate work activities and treatments that are constrained by the limited budget

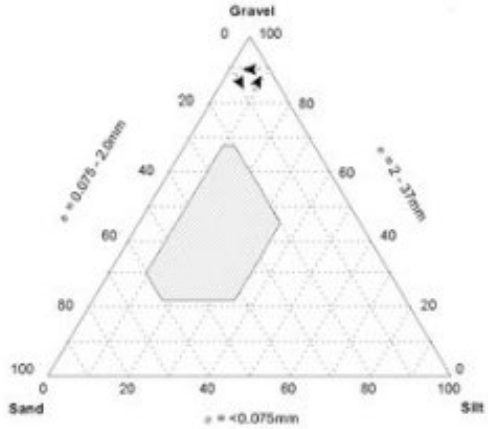
Level of service	Activities and Treatments
High and Medium	Blading maintenance Reshape Rework Drainage work Spot regravel Regravel based on priority (economics, social factors and risk)
Low and Very Low	Blading maintenance Reshape only where essential to maintain LOS requirements Drainage work only where essential to maintain LOS requirements Spot regravel only where essential to maintain LOS requirements

Gravel Road Maintenance Management System

The registration of projects is controlled by the Branch's Project Management System

Projects are scheduled in the project scheduling module





Gravel Road Maintenance

Trade-off between cost, performance and risk

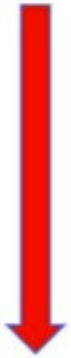
- A new risk based assessment sheet was developed to assess the trade-offs for the gravels not meeting the specification

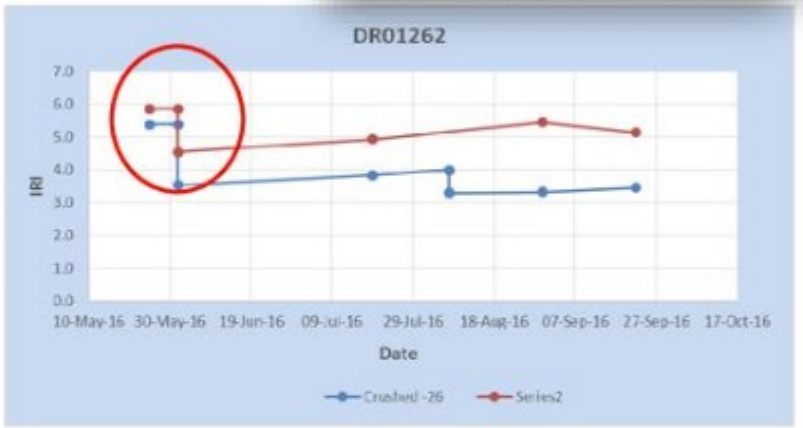
Factor	Categories
Climate	Wet, temperate, dry
Climate risk	**High, medium, low**
Average cost of material delivered to the road per m^3	**By comparison**
Shrinkage Product, Sp	0-100, 100-360, 360-500
Grading coefficient, Gc	0-16, 16-34, 34-48
Performance Classification	A- Erodible, B- ravels & Corrugates, C-ravels, D- slippery, E- good
Performance Risk (compare deviation of Sp and Gc from category E)	**High, medium, low**
CBR of Gravel Wearing Course, %	<9, 9-15, >15
Traffic, AADT	<150, 150-300, >300
% Heavy vehicles	≤5, 5-10, >10
Subgrade CBR, %	≤3, 3-5, >5
Load spreading risk	**High, medium, low**
Hardness, Treton IV	≤20, 20-65, >65
Hardness risk	**High, medium, low**
Oversize %	<5, 5 - 10, >10
Oversize risk	**Low, medium, high**
Cumulative risk	**L <10, 10≤M≤14, H>14**
Comments and Recommendations	

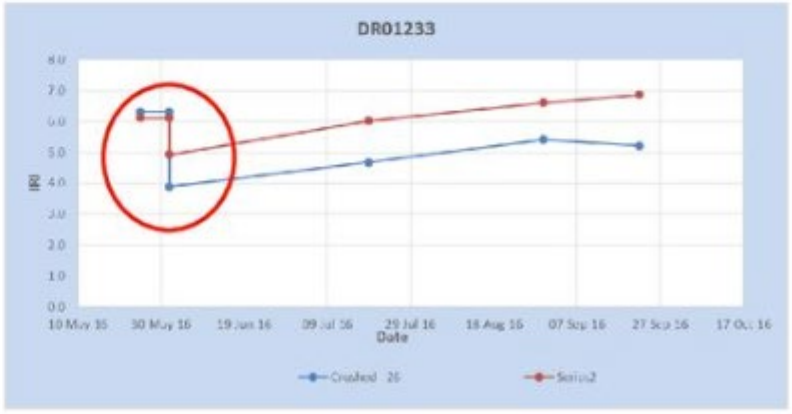
Gravel Road Maintenance

Effect of crushed material

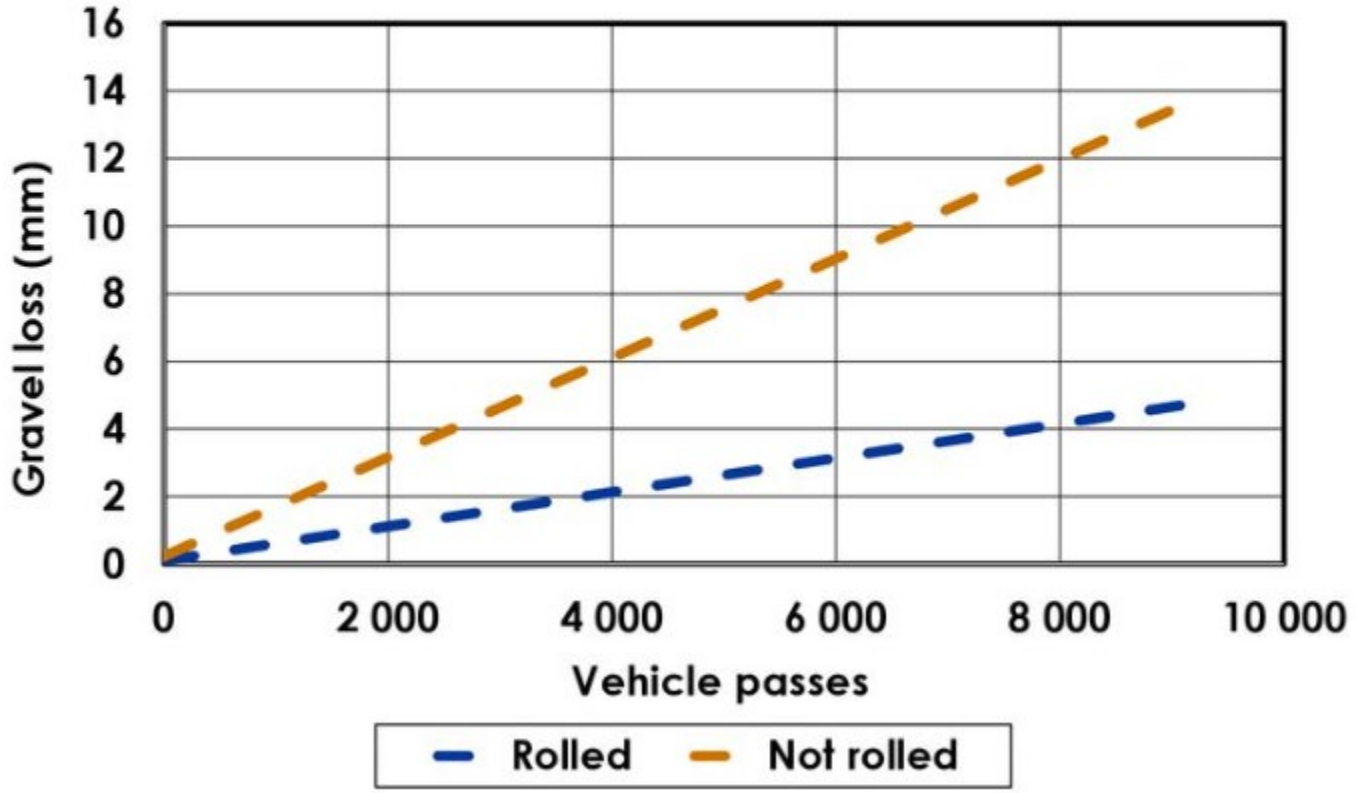
- 1 IRI extra improvement after blading
- Cost difference
  - 5 blades vs 10 blades



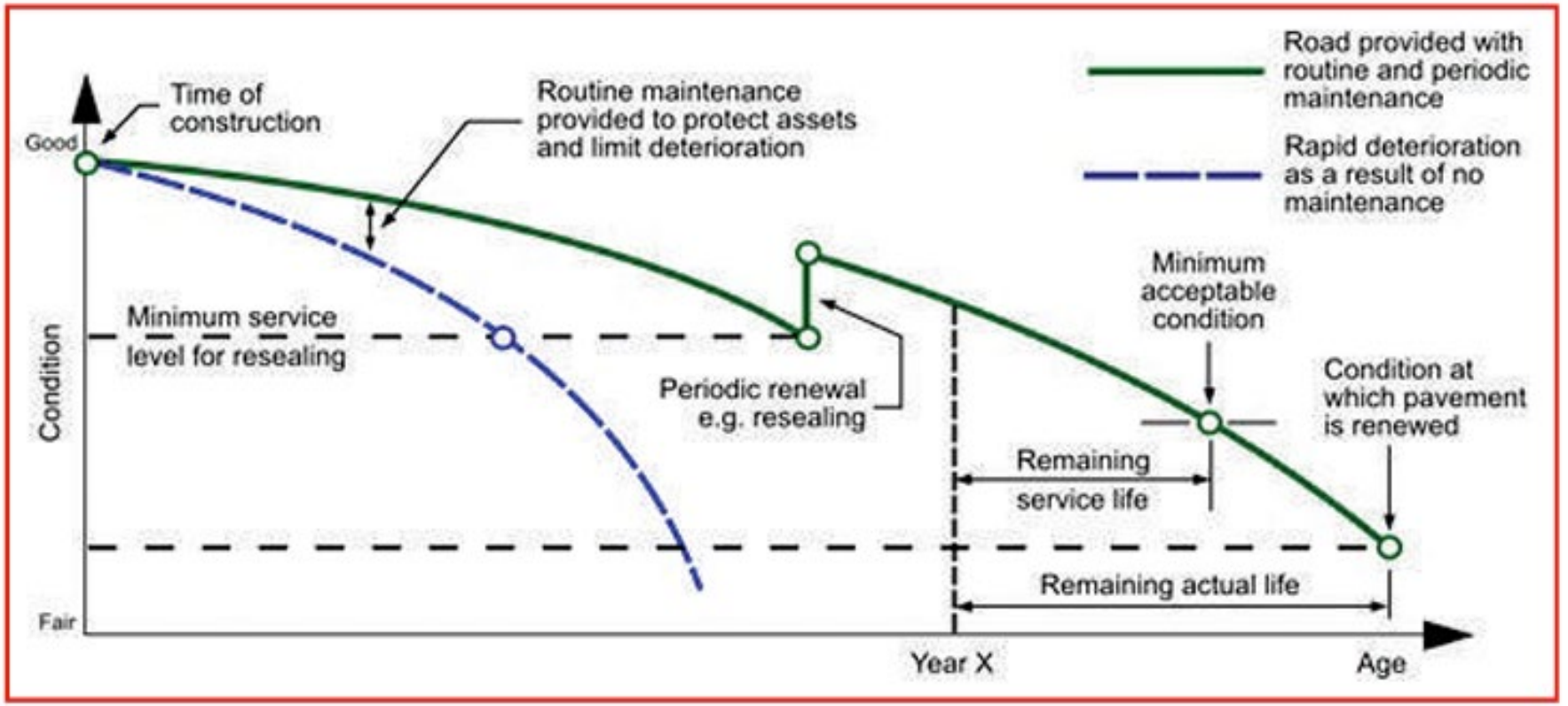




Effect of rolling on gravel loss

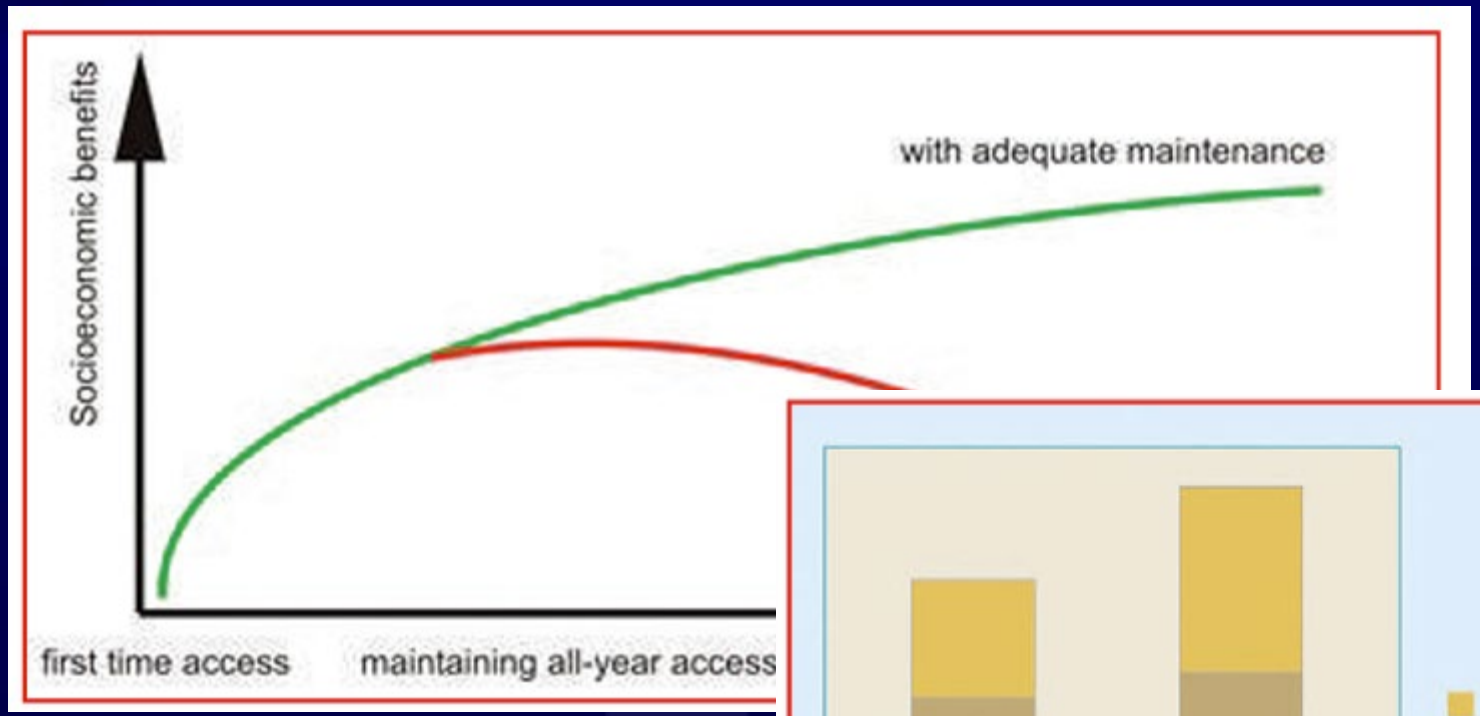


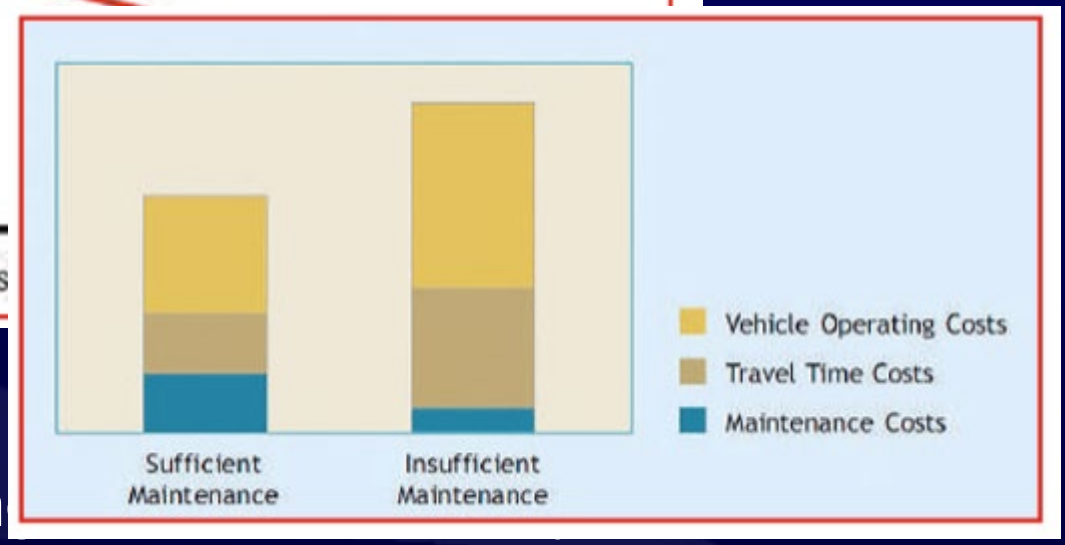
Gravel Road Maintenance



Carrying out regular and routine maintenance, the deterioration of the roadway is slowed, and the recurring costs for repair are manageable.

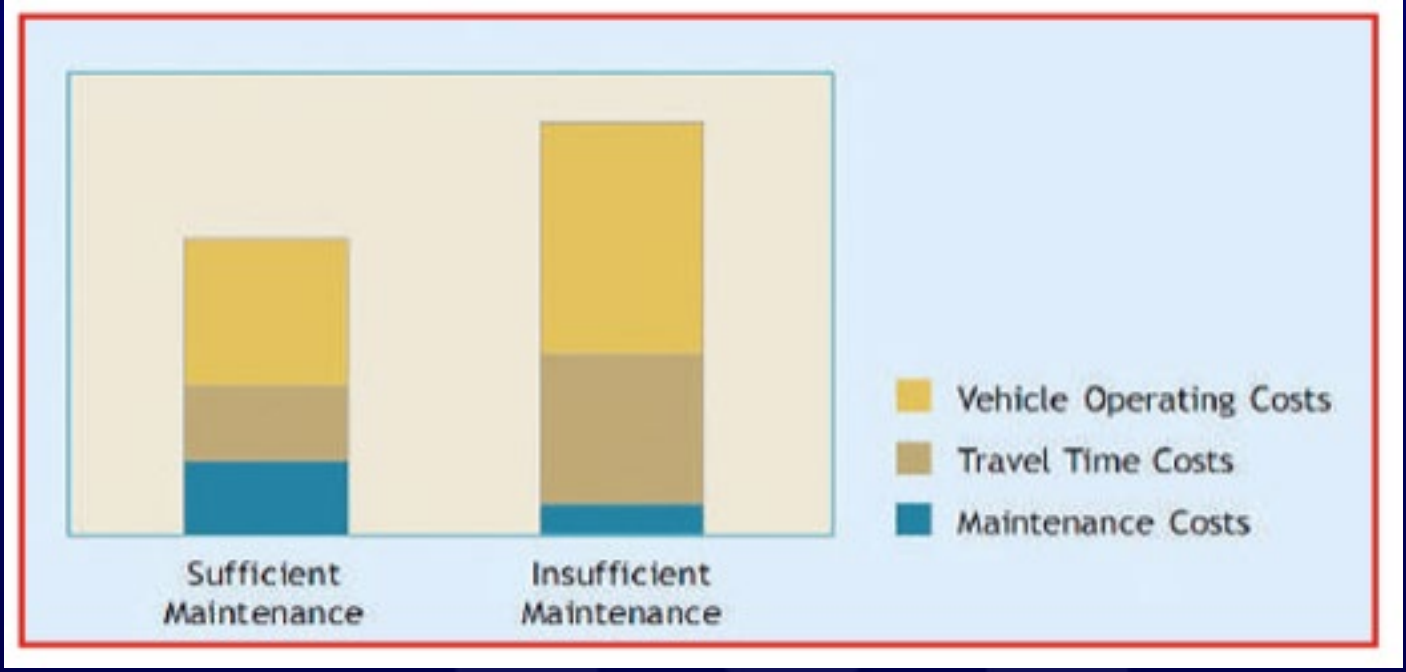
Gravel Road Maintenance





If we are not goin
be built to begin with?

Gravel Road Maintenance



If we are not going to maintain it, the societal and financial costs will increase.

If we can't afford to do it right, we certainly can't afford to do it over!

Discussion

Seven Major Topics:

1. **Weak subgrades**
2. Chemical dust control
3. Pit-run to crushed aggregate
4. Geogrid costs, use and potential benefits
5. Linear road crock crushers
6. Winter Road Building
7. Road Destabilization/ Geotechnical strain

Climate Resiliency

1. **Weak subgrades**
2. Chemical dust control
3. Pit-run to crushed aggregate
4. Geogrid costs, use and potential benefits
5. Linear road crock crushers
6. Winter Road Building
7. Road Destabilization/ Geotechnical strain

All have something in common:

Managing roads for Climate Resiliency

Weak Subgrades/ Natural materials below our road base

Weak subgrades:

- What is evidence of weak subgrade?
  - Potholes
  - Rutting
  - Shoving

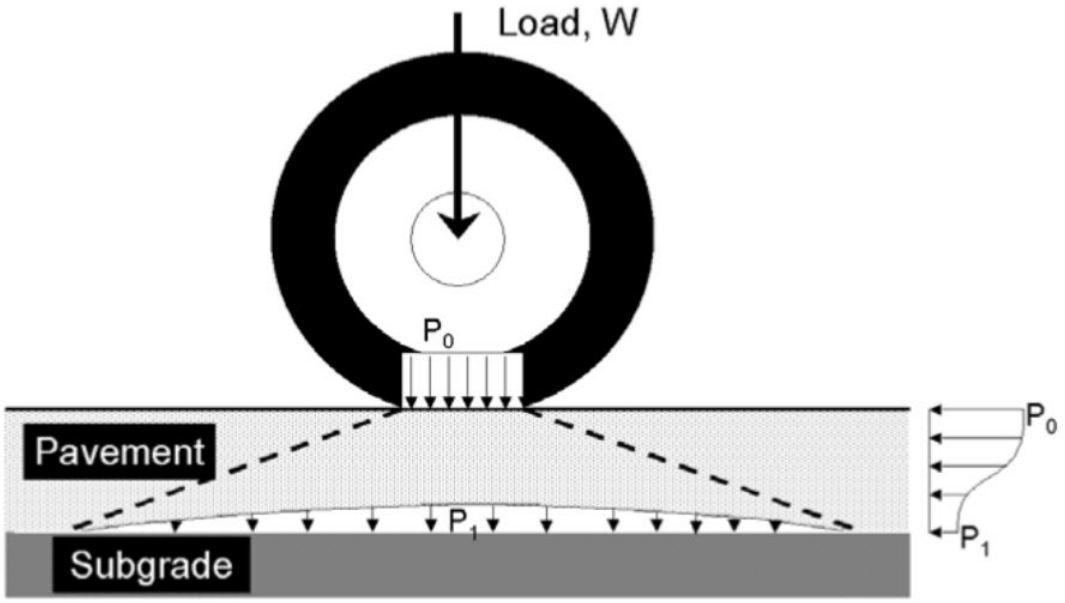


Figure 2 - Spread of wheel load pressure through the pavement

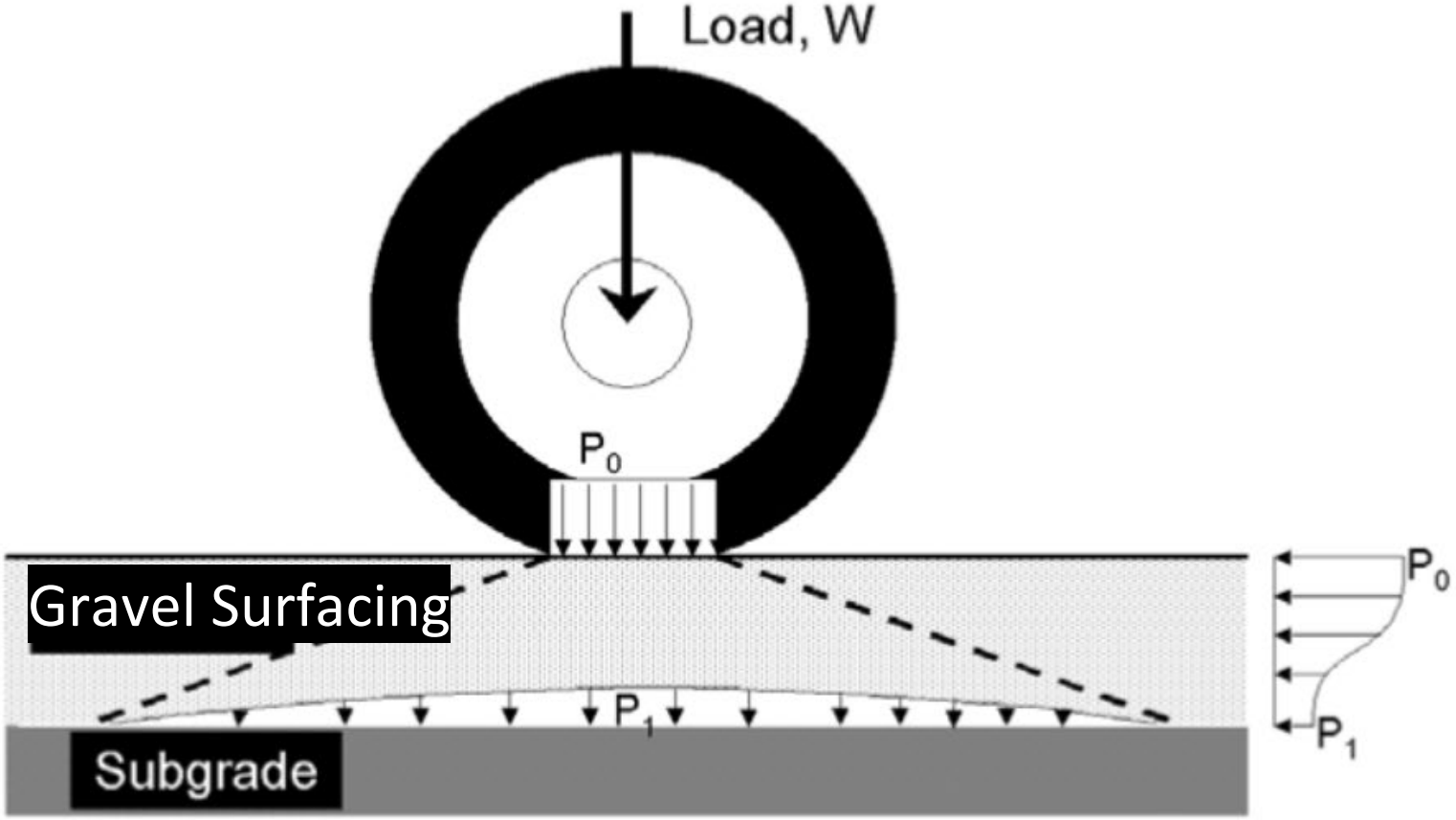


Figure 2 - Spread of wheel load pressure through the pavement

Weak Subgrades/ Natural materials below our road base

What are causes/considerations?

- Winter construction will mask areas of weak subgrade
- Construction in these areas needs to be done right the first time, or it will need to be re-done.
- Many options are available…. Each one has their proper application and cost.
- Mechanical Stabilization is becoming more common

Weak Subgrade

Repair or reinforcement of weak subgrades:

- Use of Geotextile fabrics (Separation/ Stabilization) alone is NOT ENOUGH. These are not STRENGTH increasers…
- Multiple types of technologies available.
- GEOGRIDs can and do make up for strength needed in many cases.
- Excavation/repair of failed areas is difficult and costly

Weak Subgrade

Repair process should include:

- Removal and salvage of suitable materials
- Cutting/Excavating unsuitable materials to measured depth
- Compaction of subgrade and placement of proper Geotextiles as appropriate
- Backfill/QA
- Capping and final cleanup/QA

Use of Portland Cement

Cement-Stabilized Flowable Fill

- Low compressive strength
- Can be cut with an excavator after cured
- Proven technology to provide a stable backfill
- Used for utility trench backfill
- Cost is high

Use of Portland Cement

Cement-Stabilized Backfill

- Use locally available soils mixed with cement at a 10% Type 1 cement mixture
- Proven technology to provide a stable backfill
- Cost is high

Reinforcing Base and Subgrade Courses

Use of Geogrids in placed materials as a strength enhancement

Mechanical Stabilization Concepts

Performance Benefits

- Increase life of roadway
- Reduce roadway Distresses
- Reduce Maintenance

Construction Expedient

- Lack of High-Quality aggregates
- Excessive Haul Distances
- Soft Unstable Subgrades

Construction Benefits

- Easy to use
- Reduce Aggregate Thickness necessary
- Reduce Construction Time
- Reduce Construction Costs

Mechanical Stabilization

Using Geosynthetics

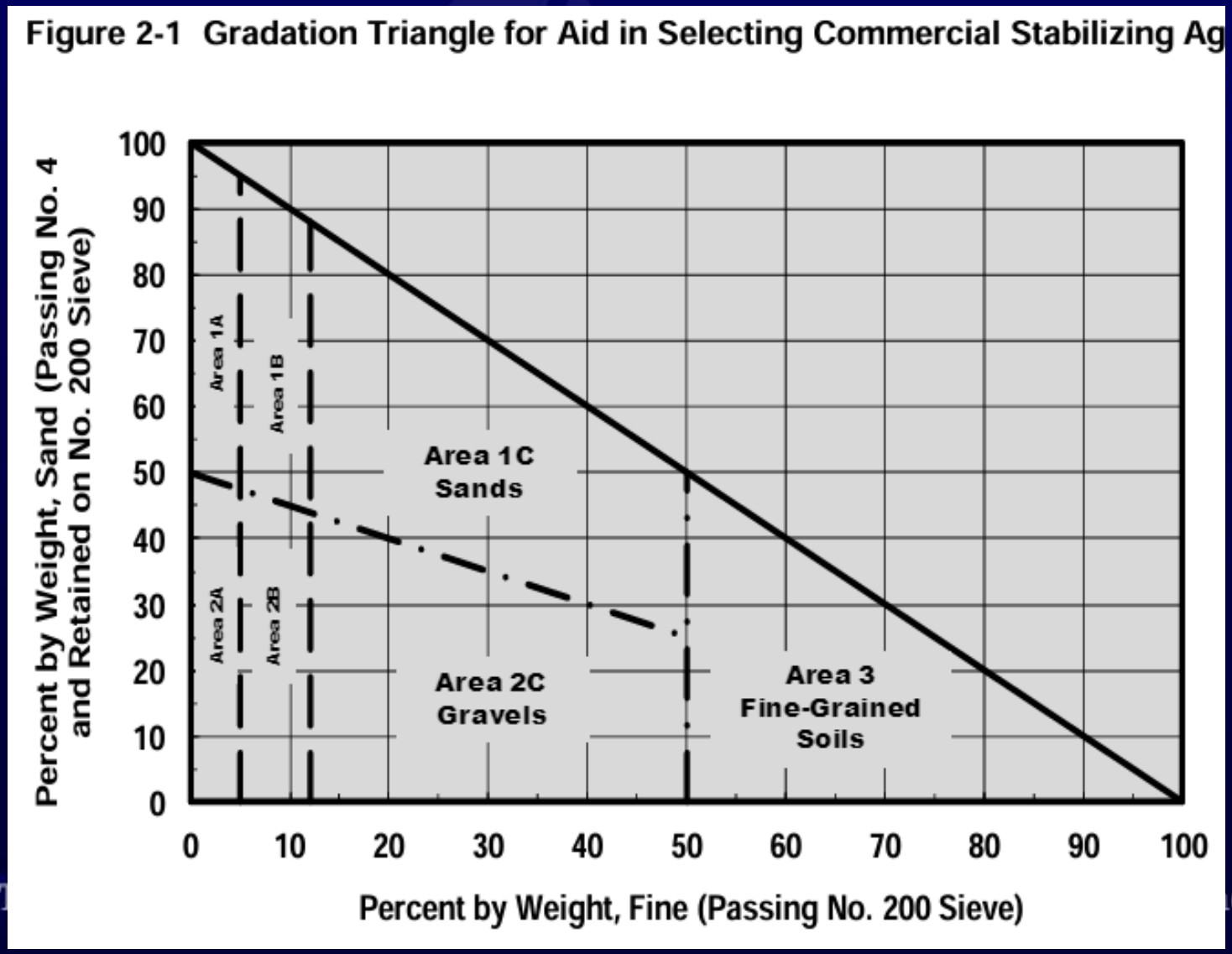
- Separation
- Reinforcement
- Drainage
- Filtration
- **Containment**

Categories of Geosynthetics

- **Geotextiles**
- **Geogrids**
- Geomembranes
- Geosynthetic Clay Liners
- Geonets,
- Geopipe
- Geocomposites
- Geofibers
- **Geocells**

How to select what to do?

Based on Soil type/Soil Group, See USACE UFC 3-250-11



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How to select what to do?

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Table 2-3 Guide for Selecting a Stabilizing Additive

Area	Class (b)	Type of Stabilizer	Restriction (LL and PI)	RESTRICTION (% PASS NO. 200) (c)	REMARK
1A	SW or SP	1. Polymer/bituminous emulsion and cement 2. Portland cement 3. Lime-cement-fly ash 4. 2 and 3 with fiber (a)	PI not to exceed 25	3 & 4. Lime requires at least 25% passing the No. 200 (0.075 mm) sieve	Soils near or above their optimum moisture content may require drying prior to emulsion stabilization.
1B	SW-SM or SP-SW or SW-SC or SP-SC	1. Polymer/bituminous emulsion and cement 2. Portland cement and fiber (a) 3. Lime and fiber (a) 4. Lime-cement-fly ash and fiber (a) 5. 2, 3, and 4 with fiber (a)	1. PI not to exceed 10 2. PI not to exceed 30 3. PI not less than 12 4. PI not to exceed 25	3, 4, 5. Lime requires at least 25% passing the No. 200 (0.075 mm) sieve	Soils near or above their optimum moisture content may require drying prior to emulsion stabilization.
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2A	GW or GP	1. Polymer/bituminous emulsion and cement 2. Portland cement and fiber (a) 3. Lime-cement-fly ash and fiber (a) 4. 2 and 3 with fiber (a)	PI not to exceed 25	3 & 4. Lime requires at least 25% passing the No. 200 (0.075 mm) sieve	Well-graded material only. Material to contain at least 45% by weight of material passing No. 4 (4.75 mm) sieve. Soils near or above their optimum moisture content may require drying prior to emulsion stabilization.
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(a) Monofilament polypropylene fiber – Length and denier will vary depending on soil type
(b) Soil classification corresponds to ASTM D2487-17. Restriction on liquid limit (LL) and plasticity index (PI) is in accordance with ASTM D4318-17e1.
(c) PI ≤ 20 + 50 – percent passing No. 200 (0.075 mm) sieve

GeoCell

- Cellular Confinement systems used to reinforce low quality backfill materials
- Requires 8-inch thick layers of geocell reinforced soils (total of 16 inches of reinforcement
- Geotextile can be placed below each geocell layer when needed

Weak Subgrade

Geogrid

- Subgrade stabilization
- Diagonal ribs that increase the in-plane stiffness
- Triangular pattern forms a hexagon to improve how the product absorbs the forces from traffic loading
- High aspect ratio provides high level of interlock with the surrounding aggregate
- Results in a more resilient solution that will withstand severe weather events, the increasing impact of climate change, and other challenging environmental conditions

Geogrid

Seven Major Topics:

1. Weak subgrades
2. **Chemical dust control/STABILIZATION**
3. Pit-run to crushed aggregate
4. Geogrid costs, use and potential benefits
5. Linear road crock crushers
6. Winter Road Building
7. Road Destabilization/ Geotechnical strain

Road Stabilizers

Chemical dust control?

OR

Roadway stabilization?

Questions:

- Why and for what purpose?
- What to use?
- How to use it?
- How long will it last?
- Ideas on cost-share?

Road Stabilizers

The why:

- Material quality improvement
- Reduced moisture susceptibility/drainage
- Roadway layer thickness reduction
- Durable temporary operating surface

Techniques:

- Chemical Stabilization
- Mechanical Stabilization

Road Stabilizers

What to use?

- Chlorides (Mg, Ca)
- Bituminous Emulsions
- Portland Cement
- Lime
- Fly Ash
- Polymer Emulsions
- Lignosulphates
- Organic Resins
- Petroleum Resins
- Ionic
- Enzymes
- Bacteria/Microbially induced Calcium Carbonate precipitation

Road Stabilizers

Magnesium Chloride

- Comes pre-mixed or as a concentrate
- Can rely on experience of local agencies for process, ordering, etc.
- Simple to apply and use with a water truck and spray bars
- Need to calibrate application rate of “X” gallons per SQYD

Road Stabilizers

Costs: $MgCl_2$

- 2022-2023 From contractors: Lyman/We Dust Control, etc.
- $1.25-1.50/ln ft at 18 feet wide
- Maintenance Application at 0.25 gal/SQYD

How to select what to do?

Based on Soil type/Soil Group

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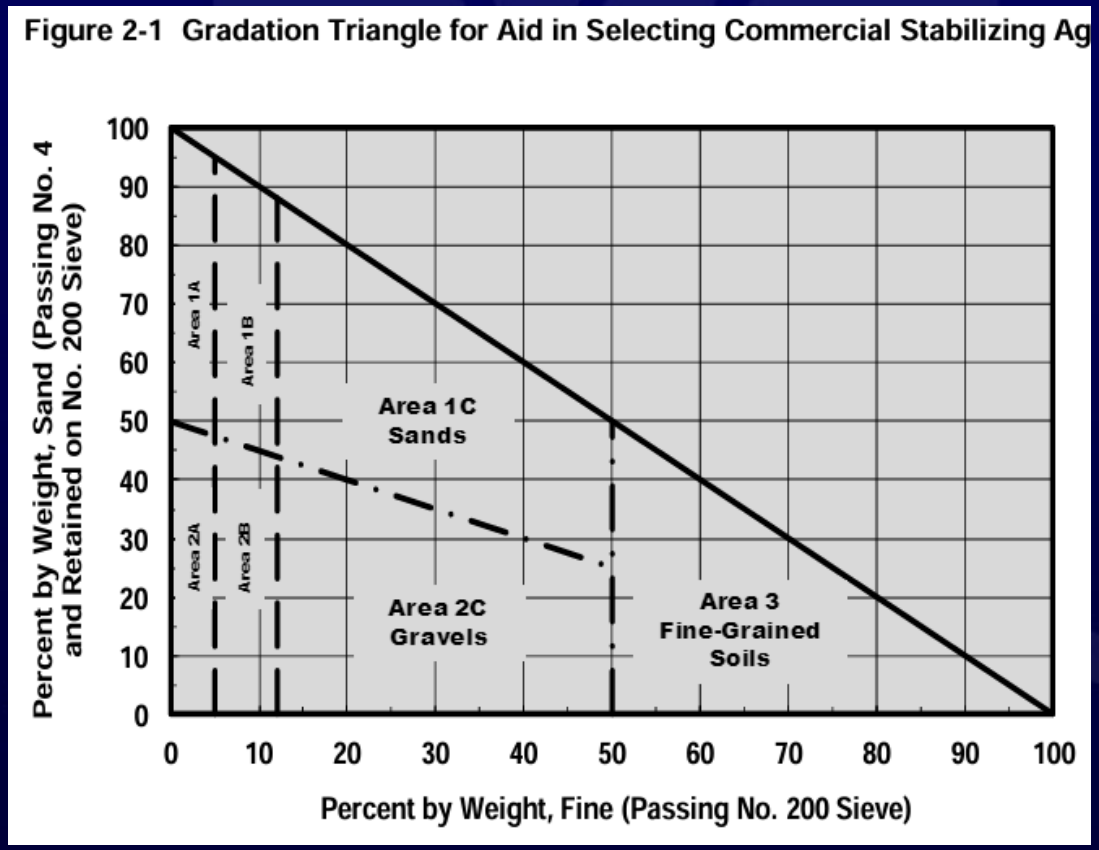

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Calcium Chloride on Rural Roads

icing chemical as well as a dust palliative

How does it work as a palliative?

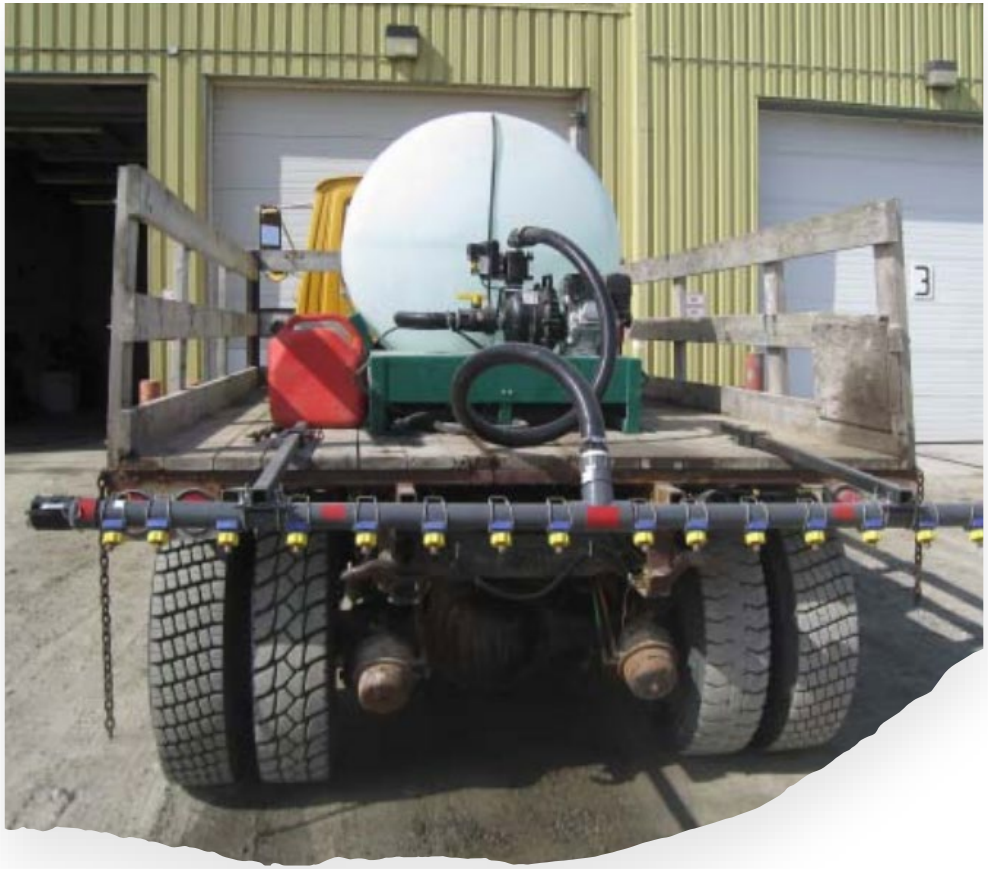
- Calcium chloride has a strong affinity for water. It will attach to moisture in the air or soil and hold it.

Why use Calcium Chloride?

- It is the second most common palliative besides MgCl2 in Montana
- It can be a very cost-effective palliative
- It requires minimal equipment apply
- Workforce development is minimal
- It has proven to be safe when used as a palliative

Downsides

- Calcium Chloride is an irritant
- Strong bitter taste
- Corrosive
- Improperly manage can be detrimental to the environment



Ideal Road and Materials

- Define project limits
- Correct/establish proper drainage
- If necessary, refresh surface course
  - Ideally ¾ dense graded material with 8 to 15% passing 200 sieve
  - Ideally a minimum of 4” thick for grading
- Establish grade and proper shape
- If you have silt or clean sand, calcium chloride is not a good choice

Application of Calcium Chloride

- Topically Applied
  - Liquid
  - Solid
- Mixed into Soil
  - Liquid
  - Solid
- Application rate
  - 1 to 1.5% by weight

Required Equipment

- Applied as a solid
  - Grader
  - Spreader
  - Water truck
  - Compactor (optional)
- Applied as a Liquid
  - Grader
  - Water Truck
  - Compactor (optional)
  - Forklift (optional)

Steps to Apply Solid Topical Application

- Shape Road
- Compact
- Loosen upper 2+ inches
- Add chloride flake
- Water
- Compact

Steps to mix (2 to 4 inches)

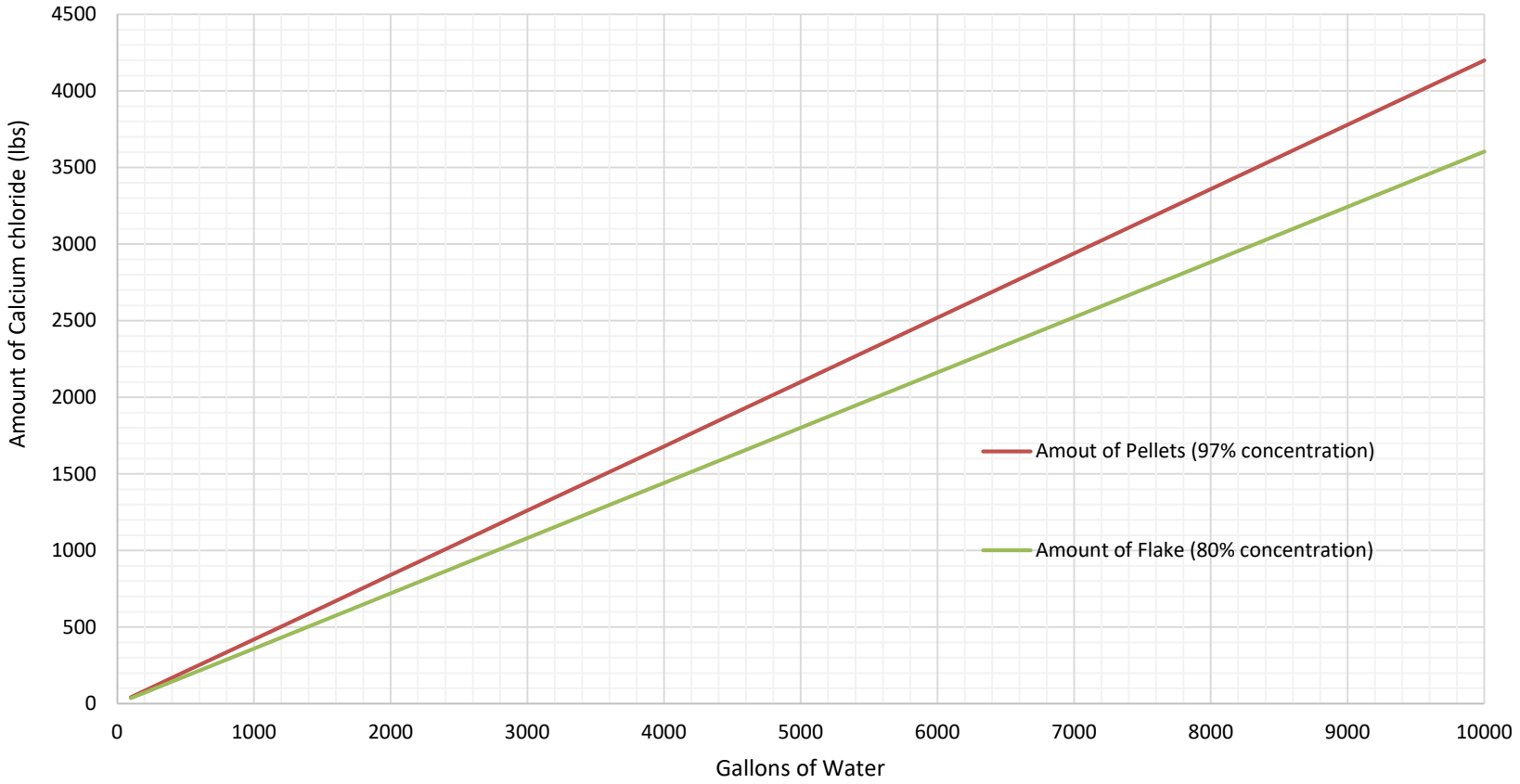
- Windrow to centerline
- Add salt to windrow
- Blend
- Shape
- Water
- Compact

Steps to Topically Applied Brine

- Shape Road
- Apply Brine
- Compact

Steps to Blending Brine (2 to 4 inches)

- Loosen roadway to desired depth
- Apply Brine
- Blend
- Shape
- Compact


Amount of Calcium Chloride (35% solution)
Amount of Calcium chloride (lbs)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Gallons of Water
Amout of Pellets (97% concentration)
Amount of Flake (80% concentration)

Flake Spreaders

Water Truck options

Chlorides

- There are several ways to apply chlorides. Choose the way that fits the equipment you have.
- Plan where you are going to apply chlorides carefully; Generally, focus on the higher trafficked areas.
- Plan early. Order early.

For Calcium:

- Order bags if you can't handle super sacks
- Keep the product dry
- Protect your people and your equipment

Seven Major Topics:

1. Weak subgrades
2. Chemical dust control/STABILIZATION
3. **Pit-run to crushed aggregate**
4. Geogrid costs, use and potential benefits
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6. Winter Road Building
7. Road Destabilization/ Geotechnical strain

Pit Run Rock/Aggregate Sources

- Rock sources can be very uniform or highly variable
  - Uniformity in geology and character is favorable
  - Fractured rock, angularity, durability
  - Underlying minerology

- For bank-run pits: Pit run gradation is very important
  - Screening of oversize materials is often necessary
  - Characterization of fines
  - #40 sieve/fine fraction is a key element for surfacing

Pit Run Rock/Aggregate Sources

- Strength and durability are key factors to know if they will be crushed via a contract

- Pit-run to crushed aggregate
  - Suggestions on what to look for and what to avoid

Pit Run Rock/Aggregate Sources

Pit-run to crushed aggregate : Suggestions on what to look for and what to avoid…

Pit Run:

- Fines content: Fines characterization and ratio
  - Silt, Clay, Plasticity: LL, PL, PI
- Roundness, fractured faces, durability
- Larger rock

Seven Major Topics:

1. Weak subgrades
2. Chemical dust control/STABILIZATION
3. Pit-run to crushed aggregate
4. **Geogrid costs, use and potential benefits**
5. Linear road crock crushers
6. Winter Road Building
7. Road Destabilization/ Geotechnical strain

Agenda

Geogrid

- Fix your water and drainage problems FIRST!
- Where to use: Clays, weak subgrades, poor soils
- Pros:
  - Great support from Tensar
  - High strength, excellent results when done properly
  - Saves money that should otherwise be spent on hauling and placing rock/gravel
- Cons: Must be installed at proper depth, and using properly graded and sized materials above and below

Seven Major Topics:

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BIG TRACTORS!

- What about linear road crock crushers?
  - Costs and outcomes?
  - https://www.youtube.com/watch?v=z07KPulgGW0 [youtube.com]
  - https://www.vanwaycrushers.com/
- Issues as I see them:
  - Large equipment HP output necessary
  - Possible USFS Partnership
  - Great contractors (see VanWay crushers, etc)
  - Slow progression, multiple passes
  - Large investment in prep of materials and roadway
  - Costly wear parts and down time
  - Contracting is expensive ($12-18K/mile on the low end)
  - Needs to be the right problem for this solution

Seven Major Topics:

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Winter Road Building?

- What are your concerns?
- Issues: Construction in Frozen Soils

Winter Road Building

- Pros:
  - Stable platform for excavation, travel, etc
  - Minimal erosion control needed during construction
- Cons:
  - Inadequate and unachievable compaction
  - Frozen Ground
  - Dystopic Geology (Stable when frozen)

Seven Major Topics:

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High Cost Solutions

Road reinforcement of unstable areas/local instability

- Over-steepened cut-slopes and unstable fill-slopes.
- Use of Gabion Baskets
- Soil nails
- MSE Walls
- Cable anchors
- Etc

Avoiding High-Cost Solutions

- Over-steepened cut-slopes: **Proper Cut Slope design and Staking**
- Unstable fill-slopes: **Proper Embankment Placement and repairs**

If ROW and significant environmental impacts are not an issue, we should AVOID: Soil nails/MSE Walls/Cable anchors/Etc.

IN LONDON THEY DRIVE
ON THE LEFT... IN MONTANA
WE DRIVE ON WHAT'S LEFT

Life is good….

MONTANA STATE UNIVERSITY

Mountains & Minds