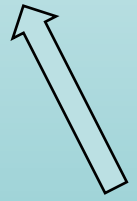
A Ditch In Time

Gravel Roads Maintenance Workshop

Before we start…

- Grade Gauge
- Screen
- Fines test bottle

Gonna take a sedimental journey




JCI
JCI 6203


Russ Lanoie

Raindrop erosion/sheet erosion

Unchecked Raindrop Erosion can soon results in Rill Erosion

Rills becoming gullys

Ultimately Gully Erosion!

Allard Hill road culvert inlet Aug 4 2018

- Big Pea Porridge Pond after big rain event

- **Water becomes unpleasant to swim in or drink**
- **Recreational potential and property value are adversely affected**

The book has the how to, Here we'll talk about the why

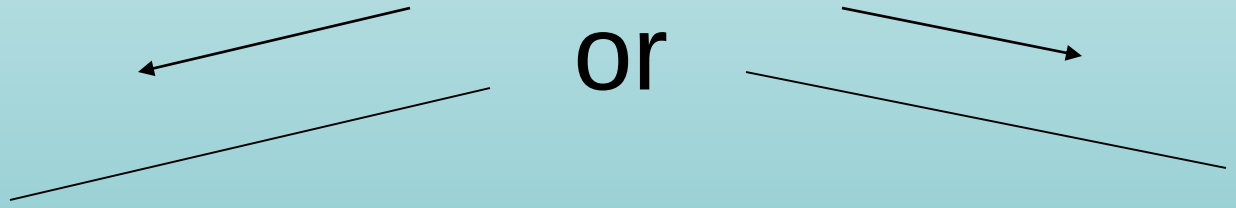
Water is the enemy of the road!

The three most important rules to remember when designing, building and maintaining a road:

#1. **Drainag**e: get the water off the surface of the road

The technique we use to get water off the surface of the road:

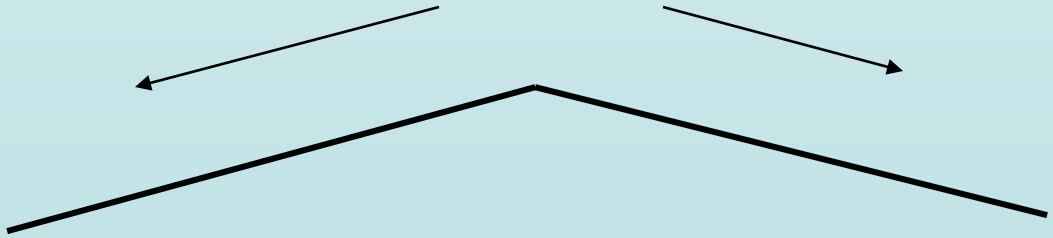
Slope the surface of the road to one side or the other so that water cannot ***sit*** on it and soak ***into*** it



or

or slope to *both* sides…

Forming a shape known as a..

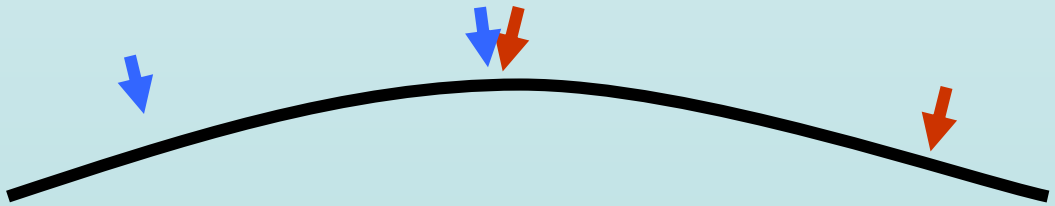


“crown”

Where water flows from the surface of the road to the ditch line (if there is one) on each side of the road

But doesn’t a crown usually look like:

Yup! But that doesn't make it right!



A rounded crown leads to a problem with the center of the road because it's the **only part of the road not pitched** to one side or the other. And it often gets more traffic than either side! (2x as much)

Here's what happens to a road with a rounded crown:

How much slope should there be for a proper crown?

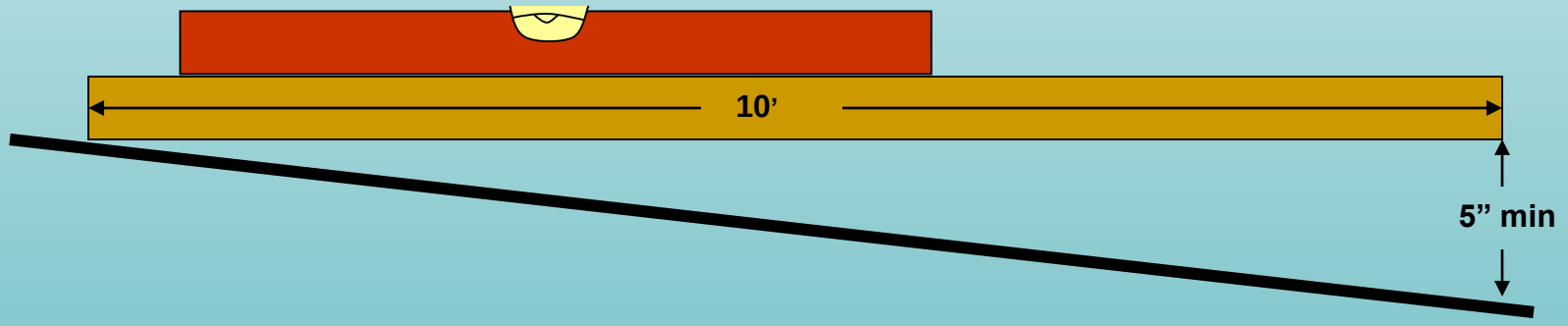
½” to ¾” per foot

Put another way, this is 5” to 7½”

per 10’ of lane width

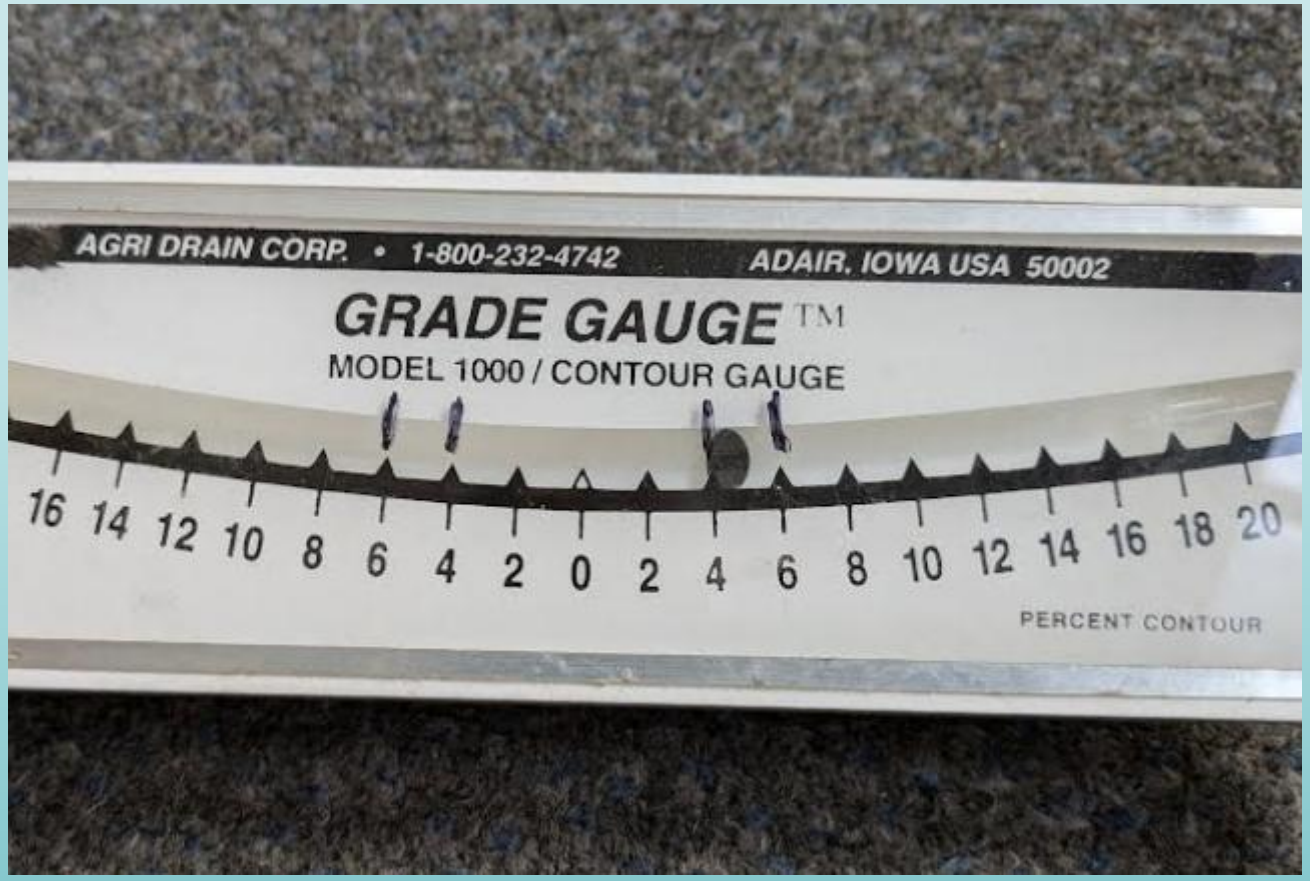
To measure this:

carpenter’s level and 10’ straight stick




GRADE GAUGE™
20 18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18 20

Minimum 4% or ½”/ft



Example of proper crown slope at left only and flat at right; same road, different slope on each side

#1. **Drainag**e: get the water off the surface of the road

#2. **Drainage**: keep the water out of the base of the road

- Subsurface drains

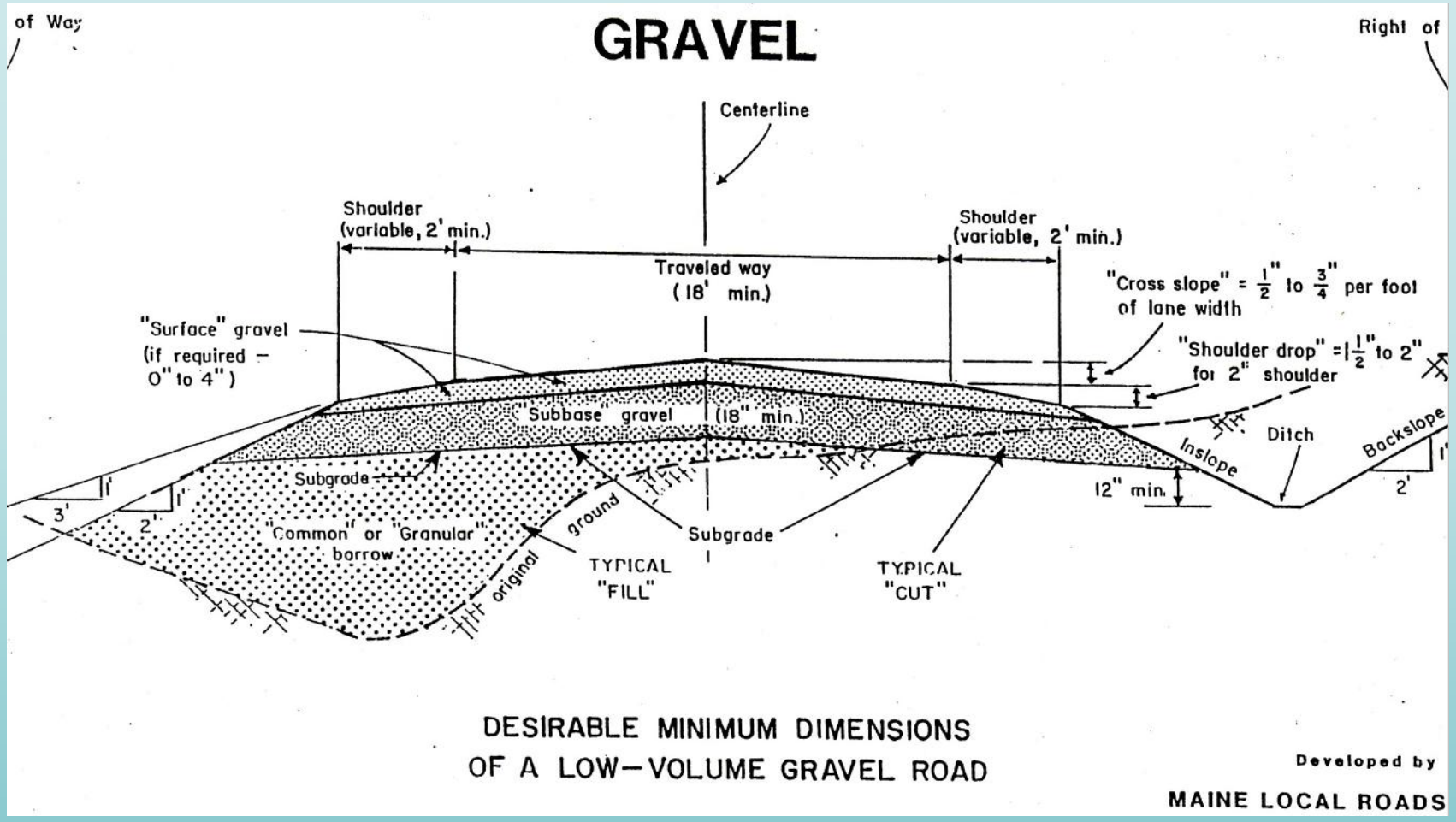

KUBOTA
Russ Lunsie

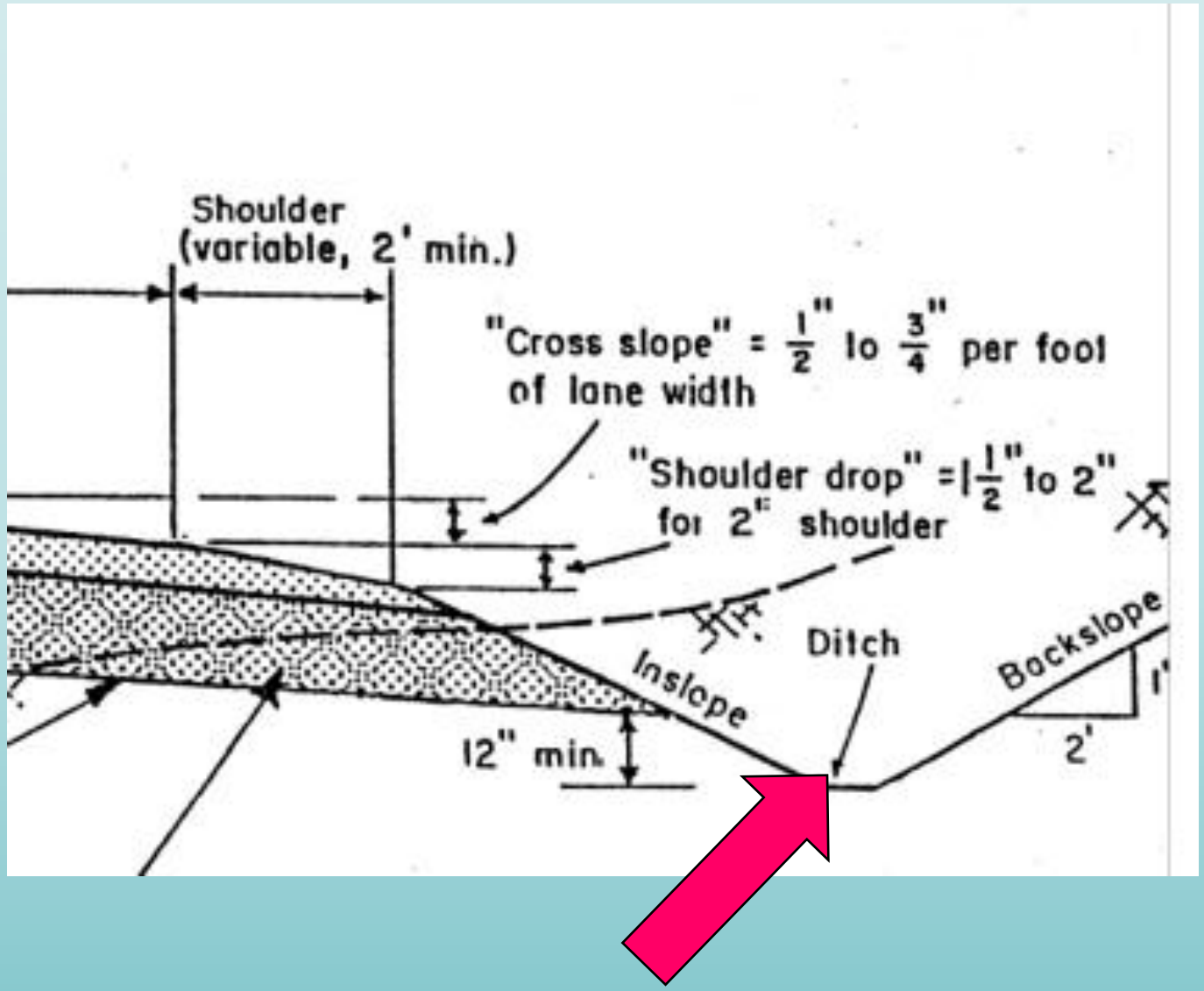

Front Runner
MESSER
MESSER

#1. **Drainag**e: get the water off the surface of the road

#2. **Drainage**: keep the water out of the base of the road

#3. **Drainage**: get the water safely away from the road


of Way
GRAVEL
Right of
Centerline
Shoulder
(variable, 2' min.)
Traveled way
(18' min.)
Shoulder
(variable, 2' min.)
"Cross slope" = 1/2" to 3/4" per foot
of lane width
"Surface" gravel
(if required –
0" to 4")
"Shoulder drop" = 1/2" to 2"
for 2" shoulder
Subbase gravel (18" min.)
Ditch
Backslope
Inslope
Subgrade
12" min.
3'
1'
2'
1'
2'
"Common" or "Granular"
borrow
original ground
Subgrade
TYPICAL
"FILL"
TYPICAL
"CUT"
DESIRABLE MINIMUM DIMENSIONS
OF A LOW–VOLUME GRAVEL ROAD
Developed by
MAINE LOCAL ROADS


Shoulder
(variable, 2' min.)
"Cross slope" = 1/2" to 3/4" per foot
of lane width
"Shoulder drop" = 1 1/2" to 2"
for 2" shoulder
Inslope
Ditch
Backslope
1'
2'
12" min.

Water turnouts:

- holes through whatever is obstructing flow at the side of the road
- get water away from the road.
- grader berm or a stone wall (be careful of these.)

- **Because they carry water away from the road, the more turnouts, the better.**

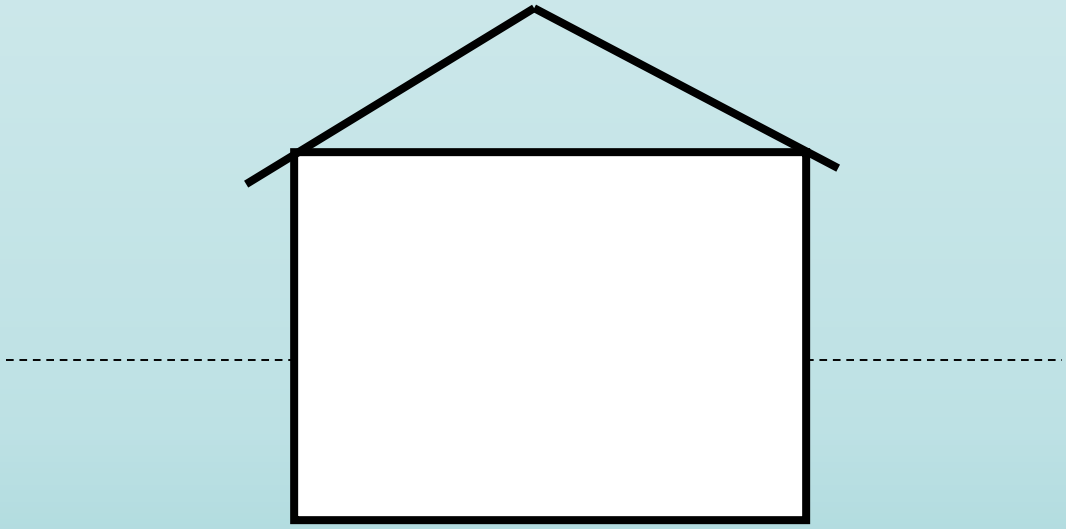
- **Make turnouts as far as possible from water bodies so that silt can be deposited before it reaches the water**

(see Camp Roads Manual)

So what makes a good road…

Let’s start at the beginning

A road should be like a house:



- A strong foundation to provide support
- A roof to shed water to keep the inside dry

The road foundation

- Mix of sand and rock for strength
- Minimum of “fines” for drainage

How strong should it be?

One big truck = 10,000 cars!

Lots of stone, sand filler, minimum fines for good drainage

Road building materials

Road surface materials

The road surface…

- **Lots of small aggregate** (stones) to provide strength with a **shape** that will lock stones together to support wheels
- **Sufficient "fines**," the binder that will lock the stones together, to keep the stones from moving around

Bank run gravel

At first this was simply screened to get out the big rocks

Later on it was crushed to make the rocks smaller

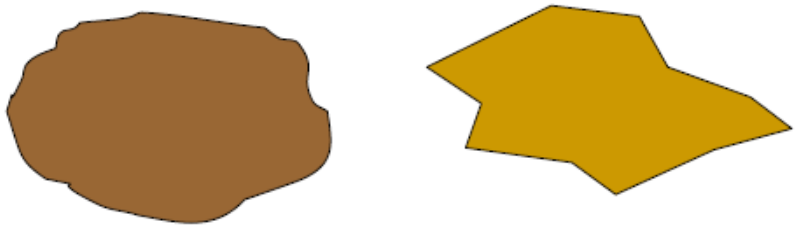
This is called “Crushed Bank Run Gravel”

But now…

The best material starts as solid rock that is drilled & blasted…

Then crushed into smaller pieces and screened to produce specific size aggregate

- Besides producing “aggregate” that is uniform in size and, occasionally, in content of fines versus stone, this process makes stone that is much more angular than that made just from screening bank run gravel




UNITED STATES OF AMERICA
LIBERTY
QUARTER DOLLAR

Sample of local ¾ ledge pack

Note how strong it is

Call it Ledge Pack, Hard Pack or whatever the local name it is

- Just remember that it began life as ledge and got broken down to the best road surface gravel ever available

A proper combination of correctly sized broken rock, sand and silt/clay soil materials will produce a road surface that hardens into a strong and stable crust that forms a reasonably impervious “roof” to our road

The optimum gravel road surface for most situations:

3/4” or 1” MINUS which means the largest aggregate is ¾” or 1” and the mix contains every size below that including sand, silt and clay

- **“Dirty” gravel *packs* but does not *drain***
- **“Clean” gravel *drains* but does not *pack***

RAP (recycled aspalt pavement)

- Pavement is made of clean ¾” and smaller material with no fines
- Hot asphalt provides the “glue” that holds it together instead of fines
- Asphalt starts at the plant at 360 degrees, is laid down at 275 degrees
- Works well for low volume, flat areas

  or as base material

  DOES NOT USUALLY PACK

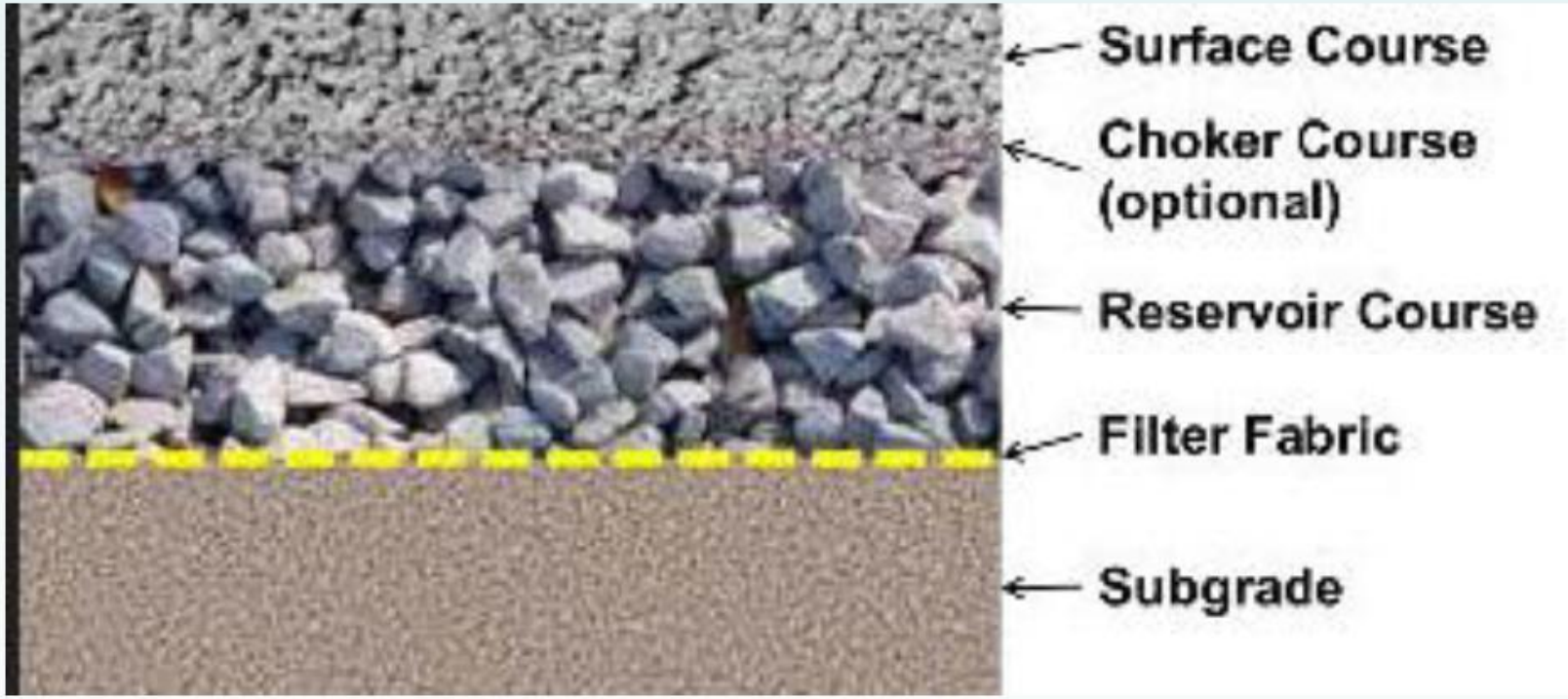
How much more stormwater does an unpaved road return to the ground than a paved road?

If a road surface is good gravel, properly graded and compacted

NO MORE!


us
quarter

Porous Pavement


Surface Course
Choker Course
(optional)
Reservoir Course
Filter Fabric
Subgrade

What is “Gravel”

- Architects and engineers call it one thing
- Folks in dump trucks usually call it another
- For our purposes,

  * GRAVEL is a mix of stones, sand, and “fines”

  * CRUSHED STONE is washed & graded *stone only (no sand & fines)*

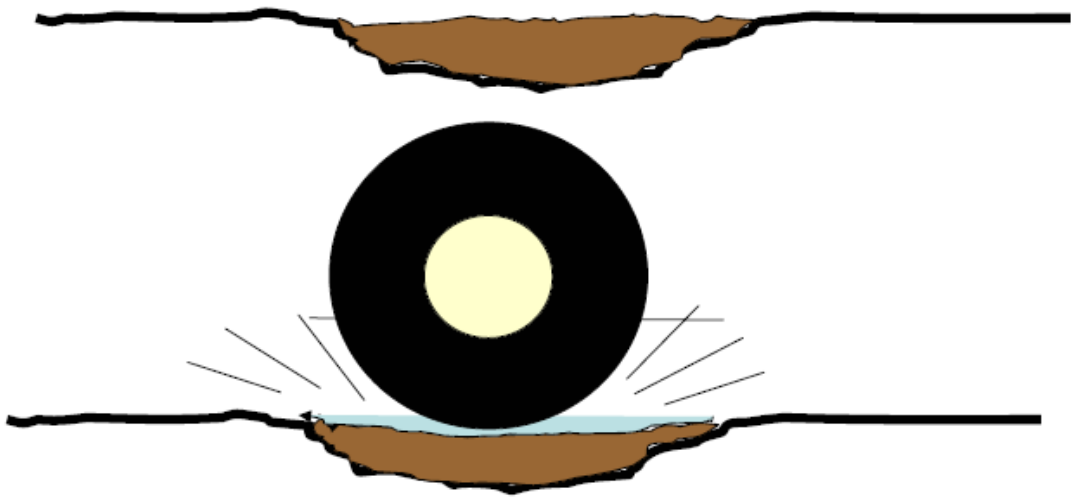
Be careful what you order!

Road surface problems, the causes and how to fix ‘em

Potholes:

The result of water and traffic on a *flat* road surface

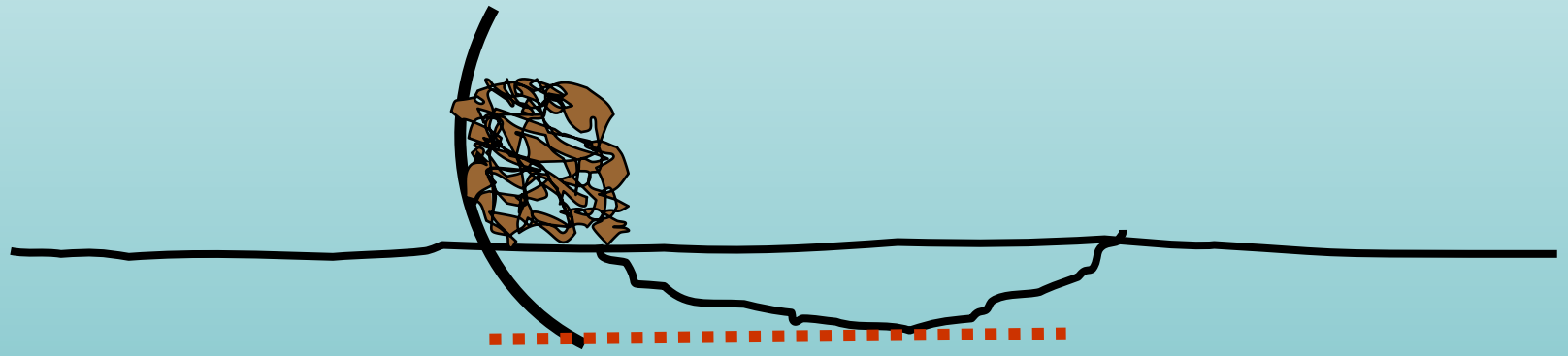
When a rut or pothole is filled in with loose material, the new material soon compacts down and fills with water in the next rain



Passing traffic splashes water and soil out to reopen the pothole

76

To get the best results, it is necessary to cut into the surface, ideally to the **bottom of the deepest ruts or potholes**



Just a few potholes here and there, not enough to tear up the whole road to fix?

It can be OK to fill potholes in this case, follow these rules:

- OVERFILL the potholes just like an auto body repairman overfills a dent in the car
- Compact the gravel with the truck that's hauling the gravel or
- Let traffic compact it

A bump (the overfilled pothole) will not get larger as will a pothole filled with water

Washouts: usually on hills and slopes:

- caused by poor surface material and/or
- inadequate pitch to get water off to the side and, too often,
- Plugged culverts

Cut to the bottom of minor washouts, just like for potholes
BUT SOMETIMES:

Tin Mountain field station driveway, Christmas 2023

Double ruts

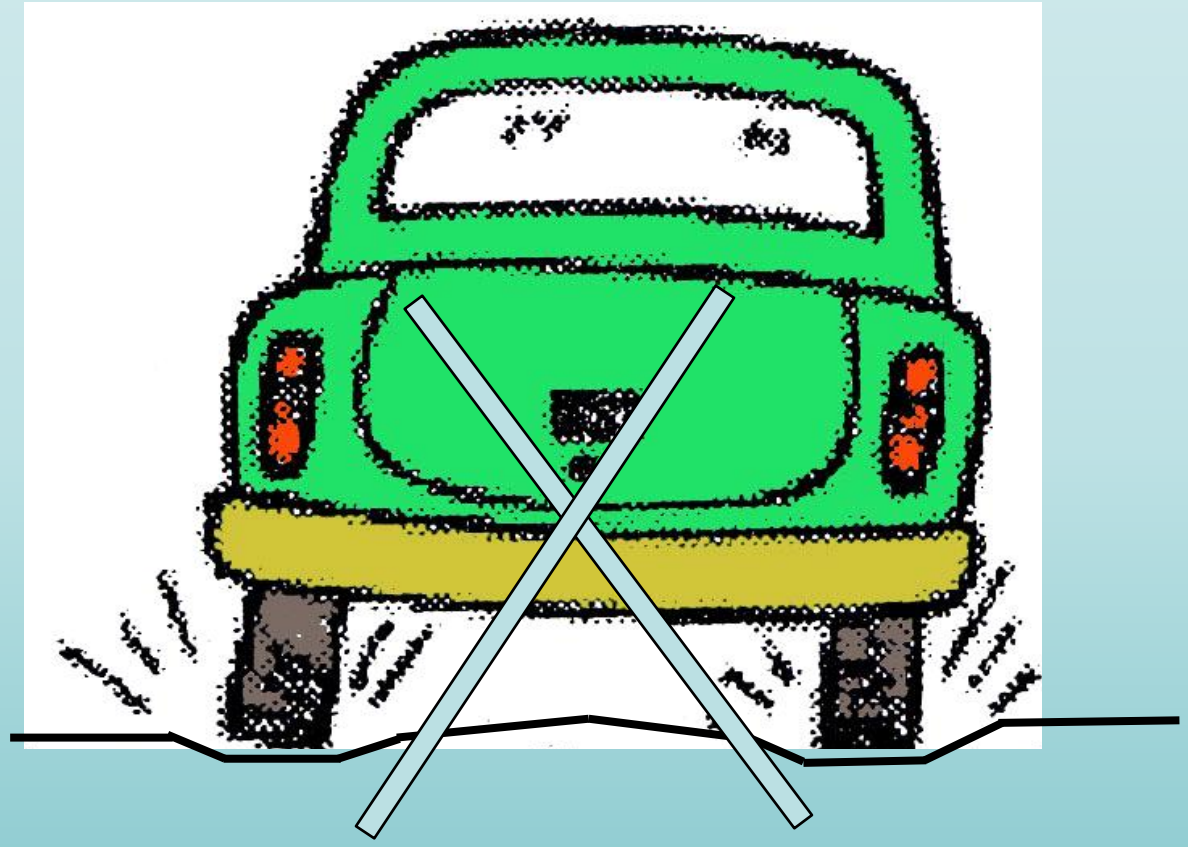
Wheel tracks allowed to become washouts

Simple fix:

Regular maintenance at first sight of wheel tracks starting to turn to ruts, especially on hills.

Also try to get everyone to drive all over the road instead of in the same ruts all the time

Don’t drive in the ruts!



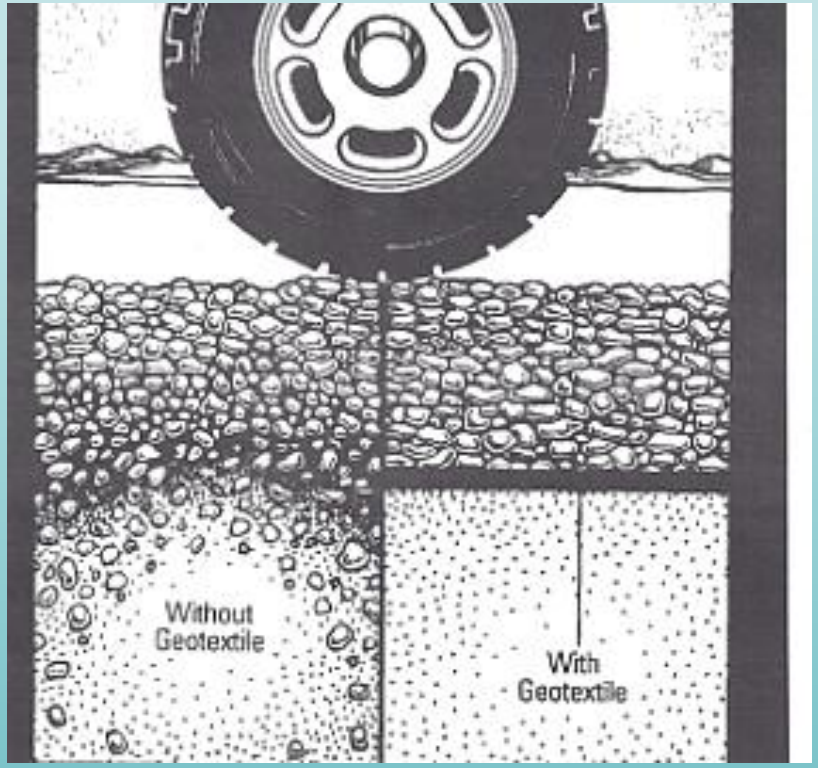
Drying up a muddy road

Deep mud (early Spring)

Use larger (1 ½” stone) until road firms up; cheaper than ¾ stone and stronger

Add geotextile (road fabric)

Geotextiles keep the gravel on top from being pushed down into the soil underneath, compensating for a poor road base



Geotextiles cost less than

- The price of the equivalent amount of gravel to get the same effect (much less)
- The cost of hauling the gravel

OR

- The cost of spreading the gravel

According to one report, a layer of geotextile costs about the same as one inch of gravel

The equipment:


CASE
Front Runner


JOHN DEERE
8875
Front Runner

Front Runner®

the versatile grading and cleanup tool

- **Heavy duty grader/rake system mounts easily in place of snowplow**
- **Uses existing snowplow hoist and angling controls**
- **Natural forward facing operation enhances the digging action to *cut out potholes, ruts, & bumps and clear debris ahead of vehicle***
- **Simple wheel adjustments provide true *crowning action***
- **Truck remains fully serviceable for other applications while ready to go to work maintaining roads**
- **Takes advantage of the truck's suspension system for *faster and smoother operation* than any other construction vehicle**

Summer road maintenance from the seat of your plow truck!

Set to crown!

How often should a road be graded?

- It depends totally on conditions, usually dictated by rainfall, or sometimes lack of it.

- There is no set rule for how often

Ideal conditions for grading

- Springtime after most frost has left-

  Road may still be soft but FrontRunner can help dry it out if not too wet

Maintenance tips

Trees help keep a road from drying out and create a nice canopy, but leaf build-up on the road can make it harder to maintain and lead to washouts in the traveled way as water flows around them.

Get rid of leaves soon after they have just fallen


Clearing accumulated leaves

Grader berms & ice dams

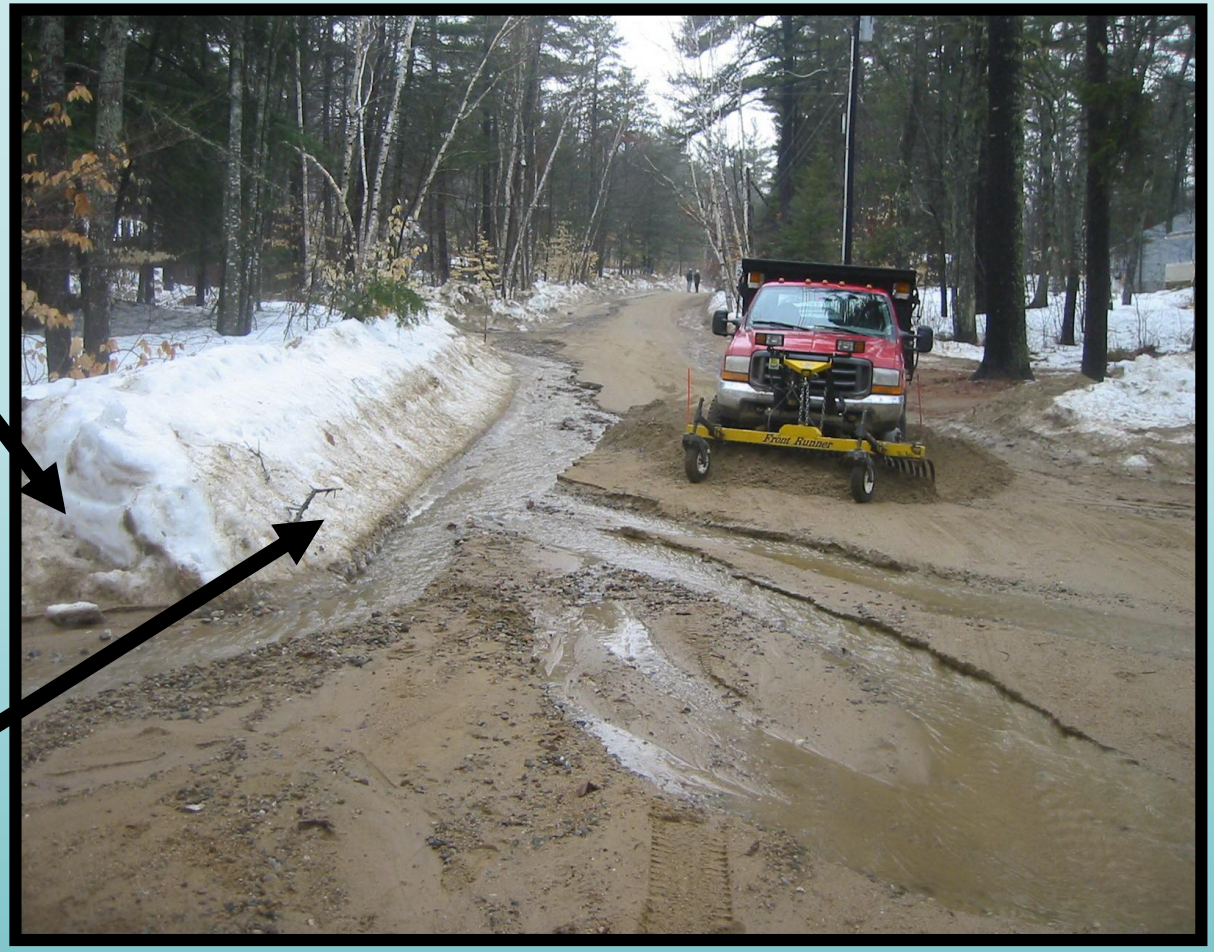
Note ditch at left, water traveling in road

ice dams form at the sides of the roads during icy winters.

And even worse when Spring rains are more intense than usual (4/05)

Road ditch under snow

Ice dam

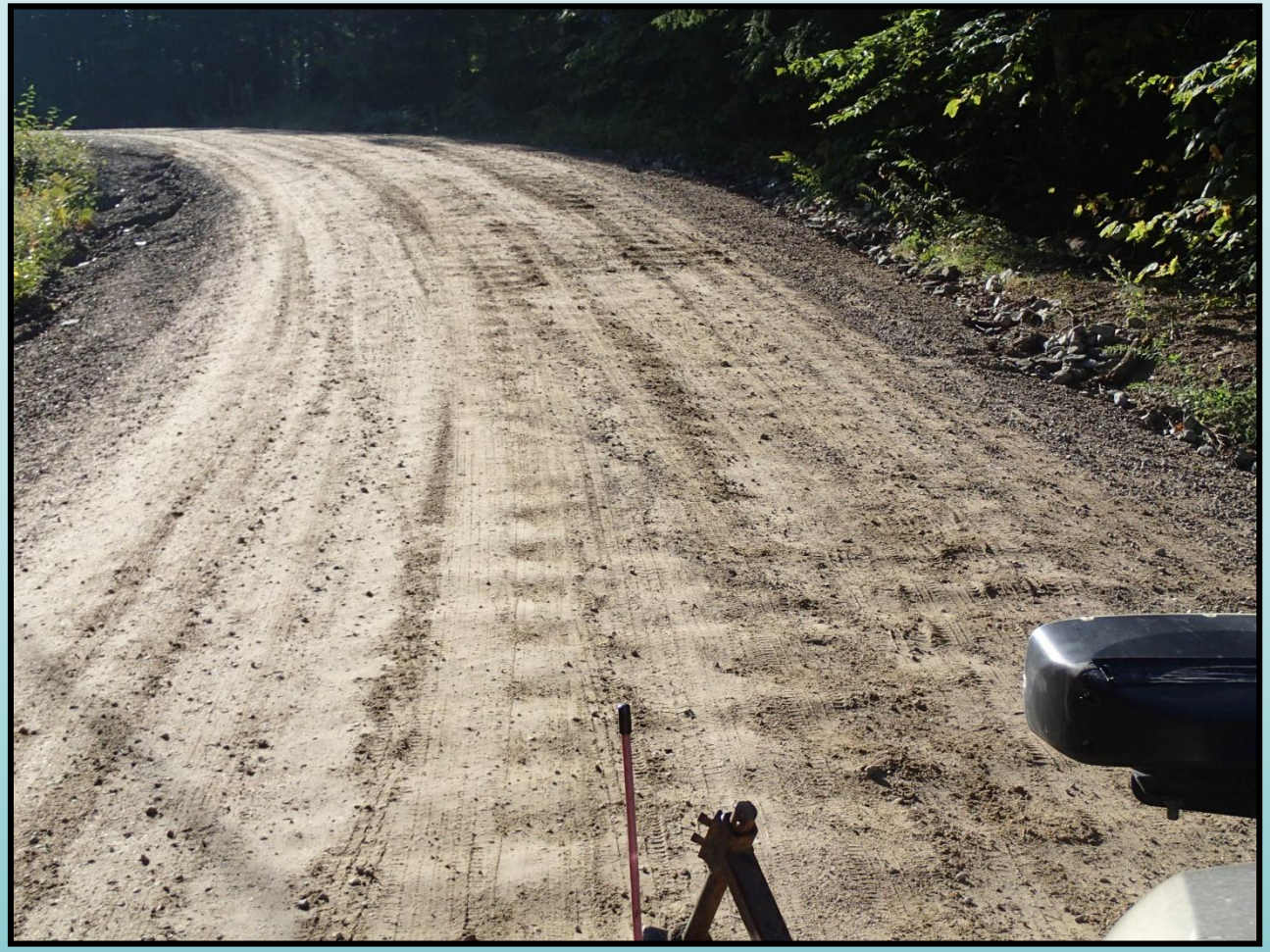


Snowplow damage!

Snowplow digs in soft road

Regrade,
avoid by plowing carefully !

Or, stay off the road until snow melts



Washboard:

Lack of fines, good locking stone, and/or moisture

- Regrade,
- Top with good gravel,
- Add CaCl

Dust, road surface fines blowin’ in the wind

- Apply Calcium or Magnesium Chloride in moderate amounts to settle dust
- In heavier amounts to also harden the road surface to save on maintenance

CaCl can be applied as as 77% flake by hand or by push spreader

Or as 35% liquid mixed with water

- .3 gal/sq yd first year application
- .2 gal/sq yd follow up

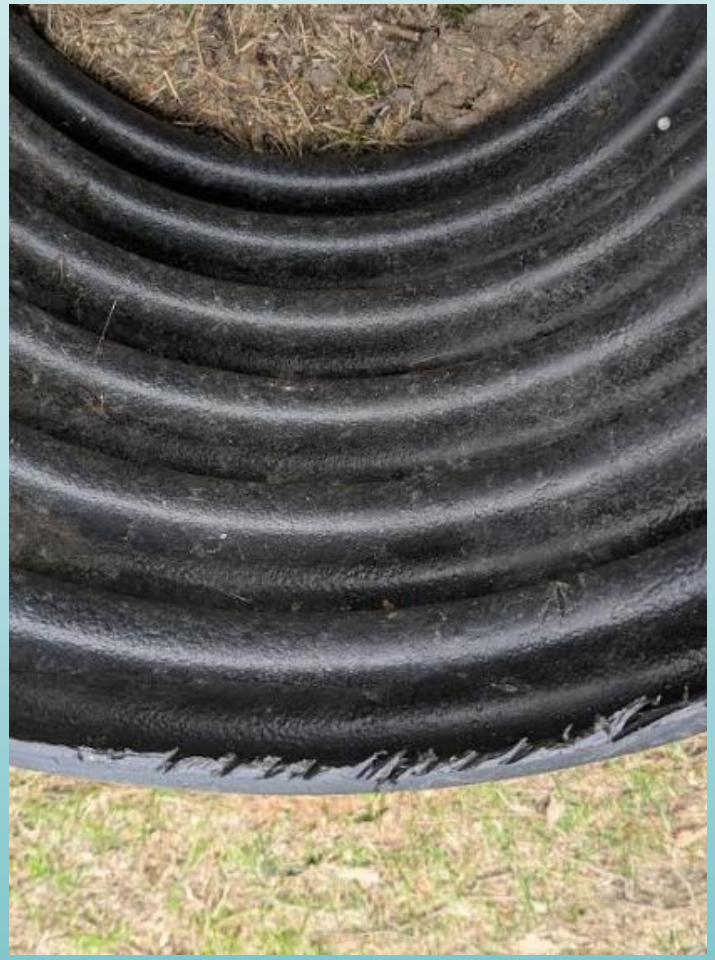
Paving as an alternative:

- On steepest hills
- Road must be ready:
- Strong, well drained base
- Adequate drainage away

Spring of 2019

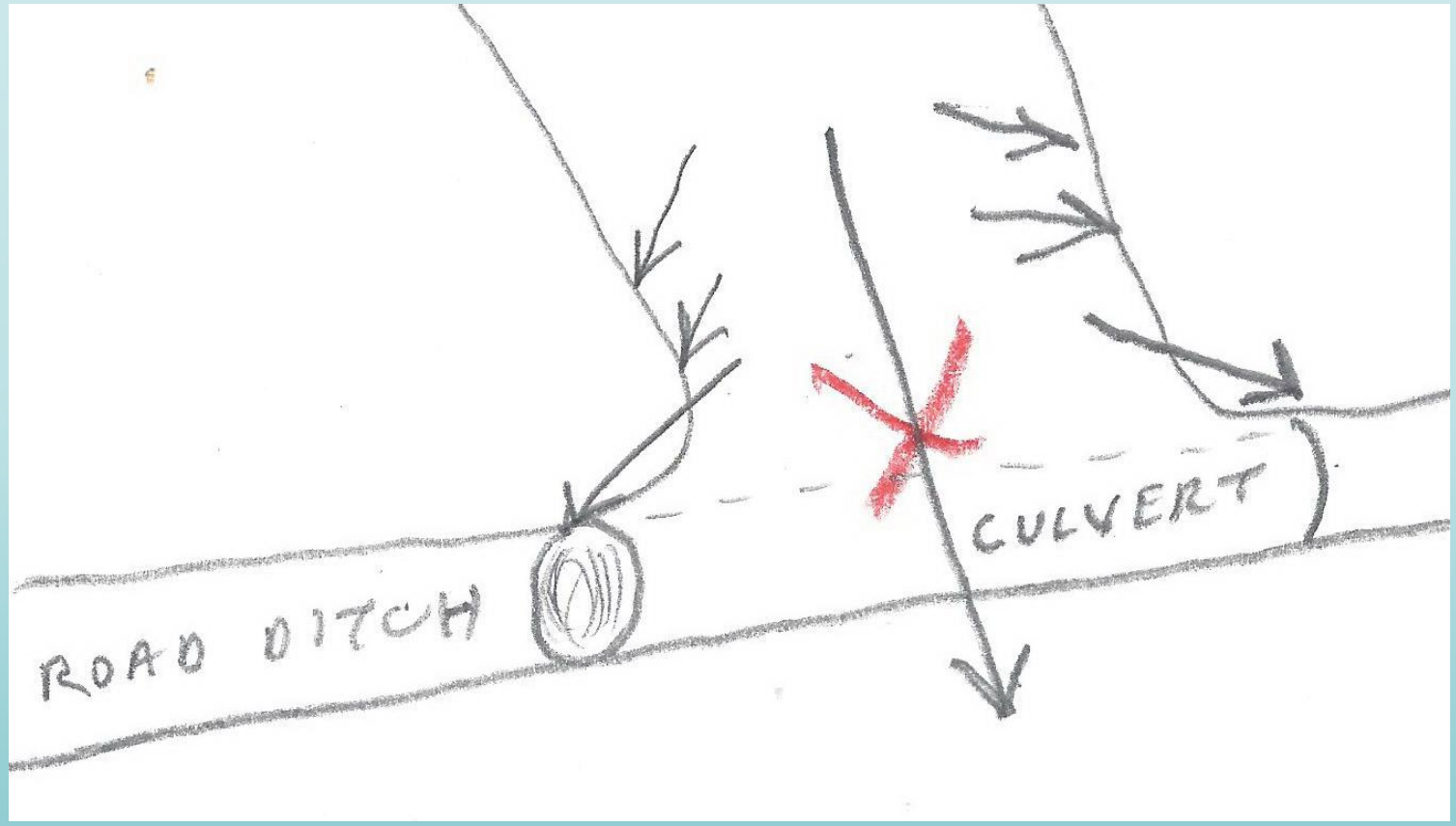
Culverts, necessary evils

- This driveway had a plugged culvert over ten years ago that I washed a hole through and video’d the process.
- thousands of hits on YouTube
- I keep both the inlet and outlet clear so it has never plugged since.



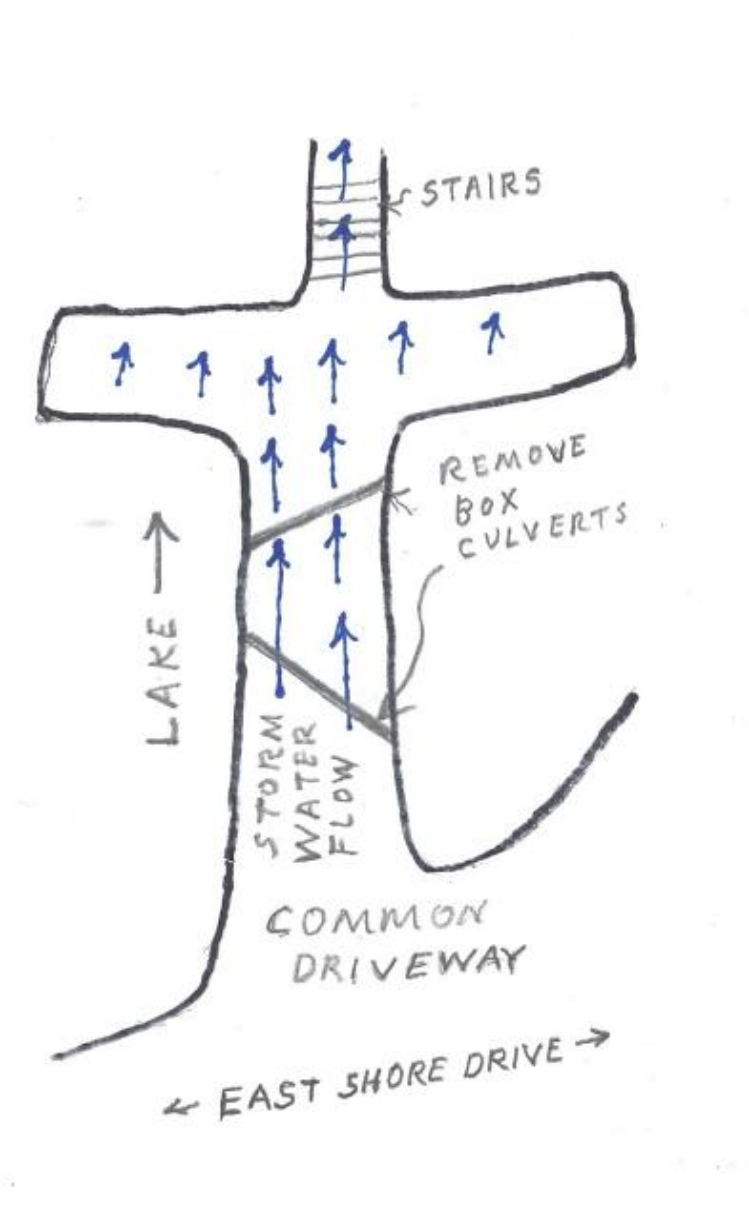
An alternative to culverts, the “rolling dip”

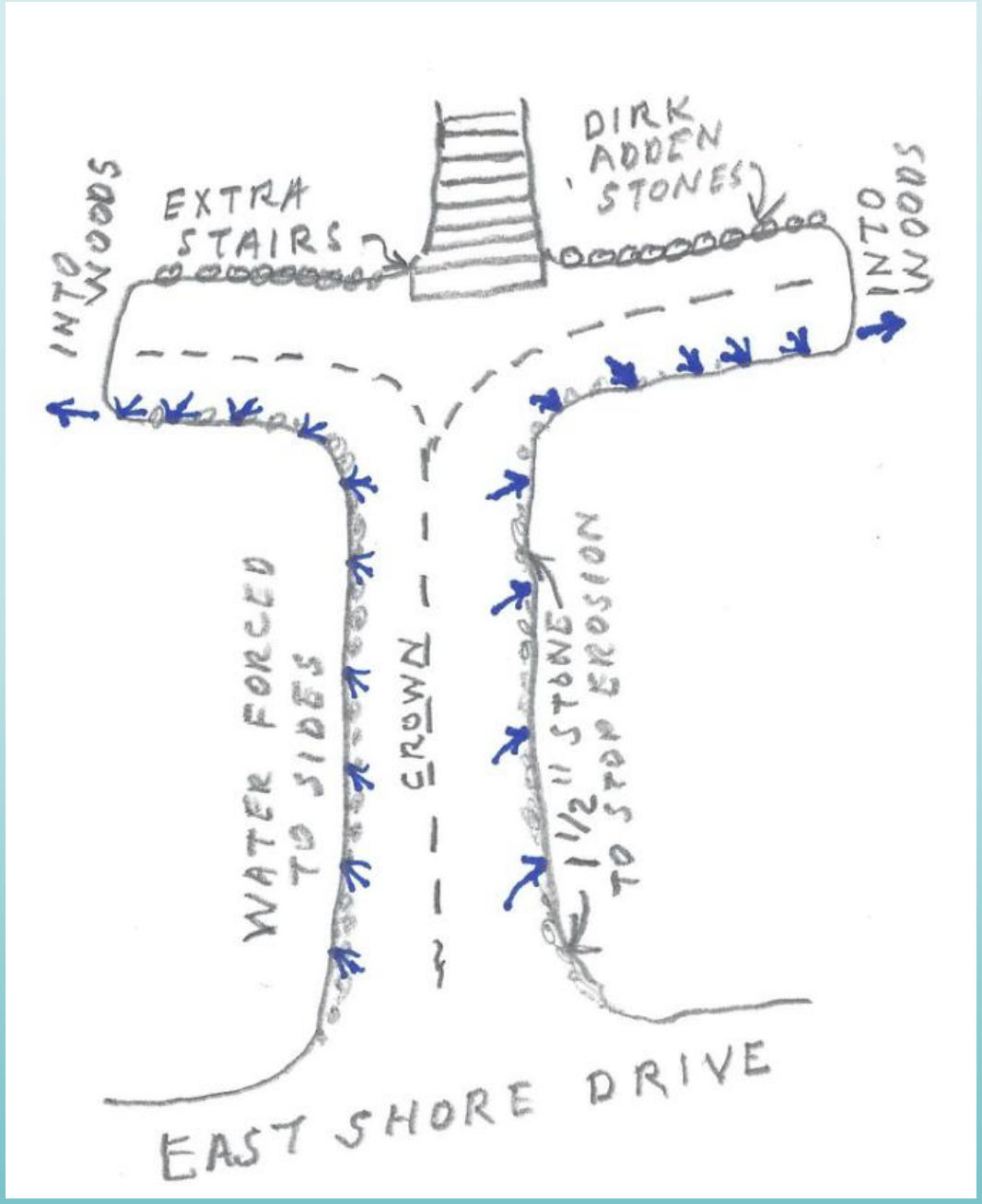

Driveways dumping
onto roads


ROAD DITCH
CULVERT

"Silver Lake is a part of our family's history. We want our grandchildren, and those after us, to enjoy it as we have."

—Dirk and Mary Landis


STAIRS
REMOVE
BOX
CULVERTS
LAKE
STORM
WATER
FLOW
COMMON
DRIVEWAY
EAST SHORE DRIVE


INTO WOODS
EXTRA STAIRS
DIRK ADDEN STONES
INTO WOODS
WATER FORCED TO SIDES
CROWN
1 1/2" STONE TO STOP EROSION
EAST SHORE DRIVE


POLY CASTER
DEL


FISHER

Winter sand!!!


Front Runner

Alternatives to sand

Rip rap for stabilizing ditches if vegetation is inadequate

How NOT to do it.

Much better

Check dam plugged with winter sand

Be vigilant!

Getting Rid of Stormwater

Year round storm water collection and disposal

Russ Lanoie 3/2010

Catch basin / drywell at house entrance. Cast iron grate is flush to ground surface

Catchbasins are structures that collect surface water and either allow it to soak away into the ground below or be conducted away via a below ground culvert pipe. This article deals strictly with catchbasins as they provide a solution to the problem without limiting the use of the surface above them as do open ended culverts.

1. Intercepting water: requires finding the preferred location for a collection structure. This should be at the lowest point, or a point that can be made lower than its surroundings to draw water to the catchbasin. This can be in a driveway or walkway or just beside it where access to it can be maintained during winter months. The surface does not have to be sloped very much to direct water to the structure, particularly if the surface is paved with asphalt or paving stones.

2. Getting rid of the water: depends on soil and topography. It is usually preferable to pipe water away to a "daylight" outlet because this allows any volume of water to be disposed of. If not possible, the catchbasin will have to be part of a drywell that allows water to soak directly into the ground or at another location away from the catchbasin. This requires some planning to be sure the structure can handle excessive storm water without filling up faster than water can soak into the ground.

Light duty catch basin with 6" outflow pipe to daylight

Industrial strength for under commercial parking lot across from Daily Sun. Porous concrete structure surrounded by stone

Interceptor basins collect water and pipe it away to daylight

Combination catch-basin drywell / soakaway

Custom poured concrete structure with outlet pipe cast near bottom. Pipe extend to daylight outlet. Structure carries away storm water from middle of paved driveway where ice dams had caused it to collect

18" plastic pipe provides a base for cast iron grate and a reservoir and distribution area for water to soak away through holes in the pipe. Filter fabric covers several yards of 1 1/2" drainage stone surrounding catch basin. Installed at edge of development road.

Most DIY projects that fail are due to water control devices such as culverts and drains are too small. They'll handle most rainstorms but not the BIG ones.

barguard

- One inch of rain on one acre = over 27,000 gallons of water
- Roofs and blacktop driveways heat up in sun, transfer heat to rainwater
- Fish don’t like hot water

Impact of increased development on existing road systems:

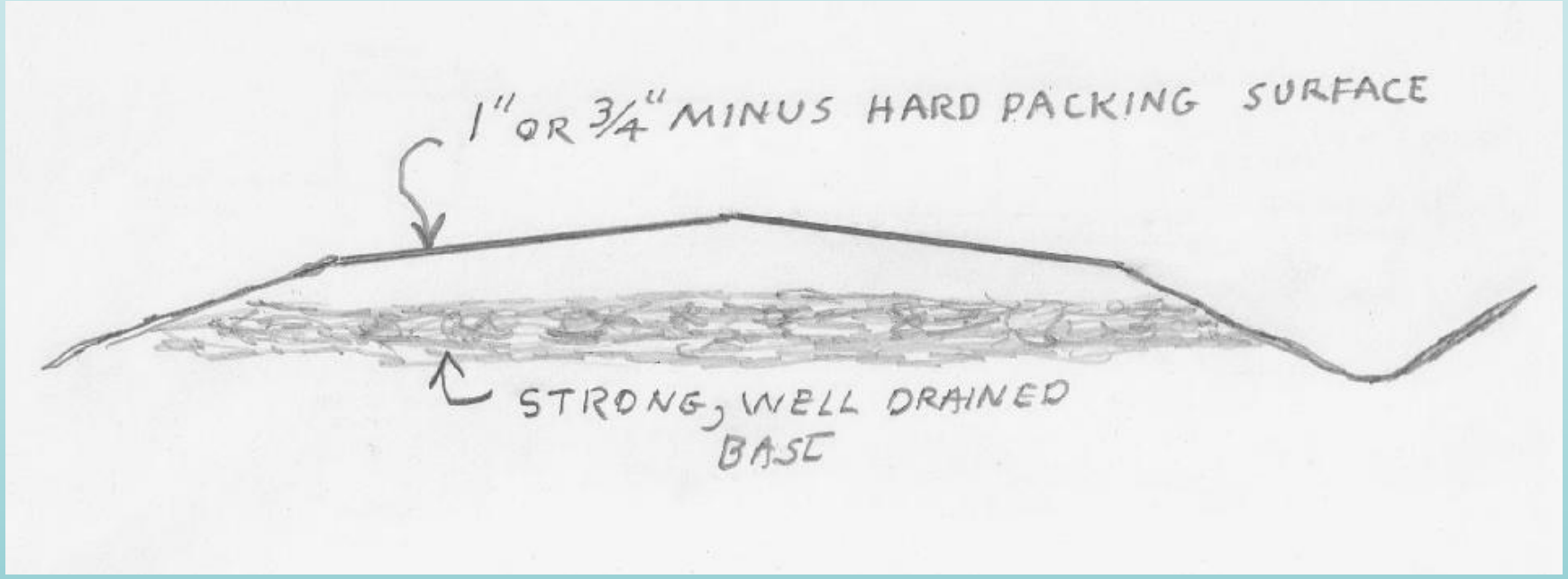
- Fewer places to safely dispose of water
- More water to dispose of
- More traffic

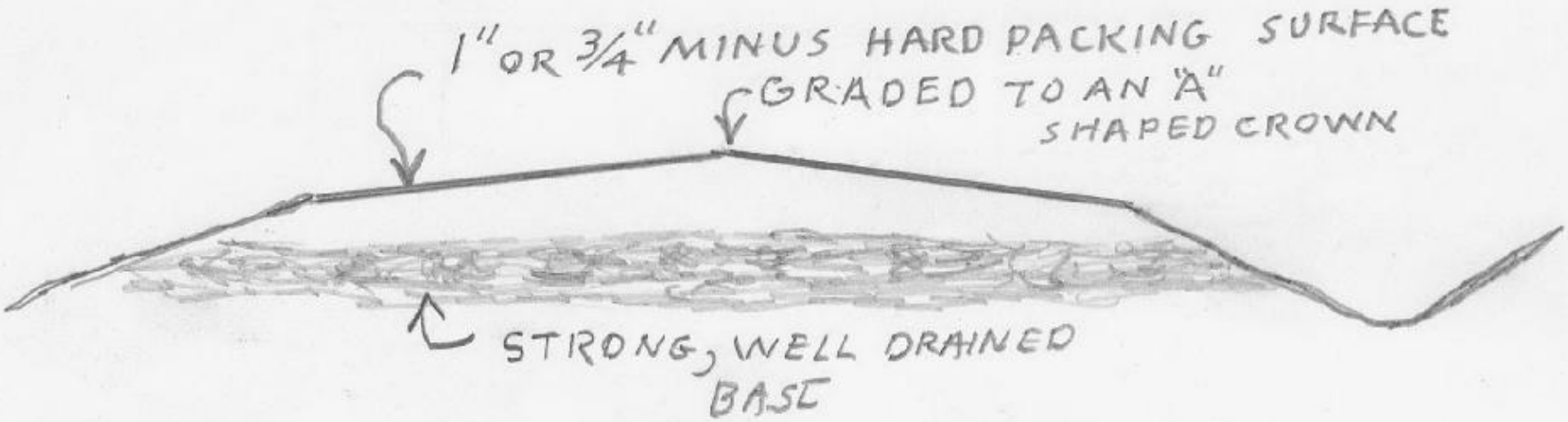
The Road Steward…

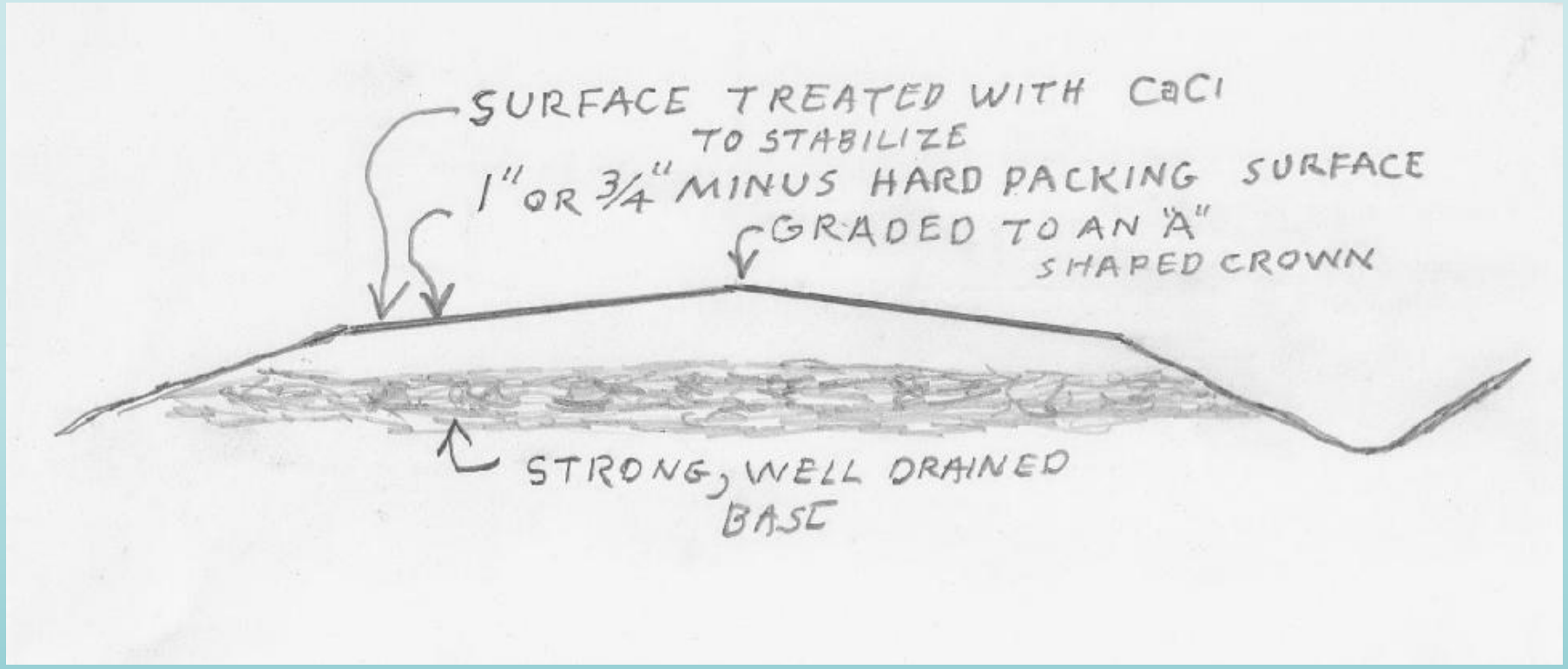
Every private road should have a steward, someone to watch out for the things that can cause greater problems if not taken care of NOW! If it's your own driveway, YOU are the steward. Knowing when to take action yourself or to notify whoever can take action might save a road or driveway from disappearing needlessly.

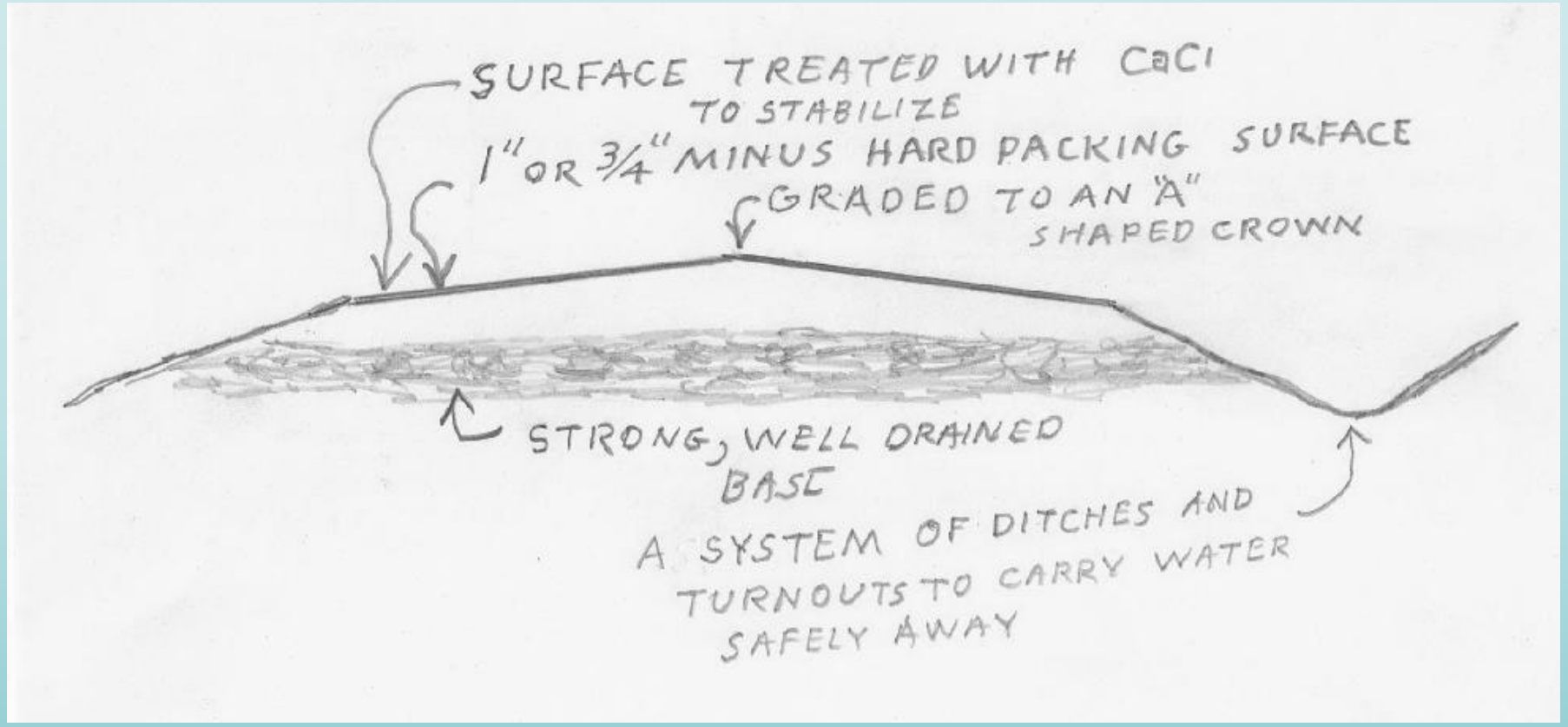
Final goal…


STRONG, WELL DRAINED
BASE


1" OR 3/4" MINUS HARD PACKING SURFACE
STRONG, WELL DRAINED BASE


1" OR 3/4" MINUS HARD PACKING SURFACE
GRADED TO AN "A"
SHAPED CROWN
STRONG, WELL DRAINED
BASE


SURFACE TREATED WITH CaCl
TO STABILIZE
1" OR 3/4" MINUS HARD PACKING SURFACE
GRADED TO AN "A"
SHAPED CROWN
STRONG, WELL DRAINED
BASE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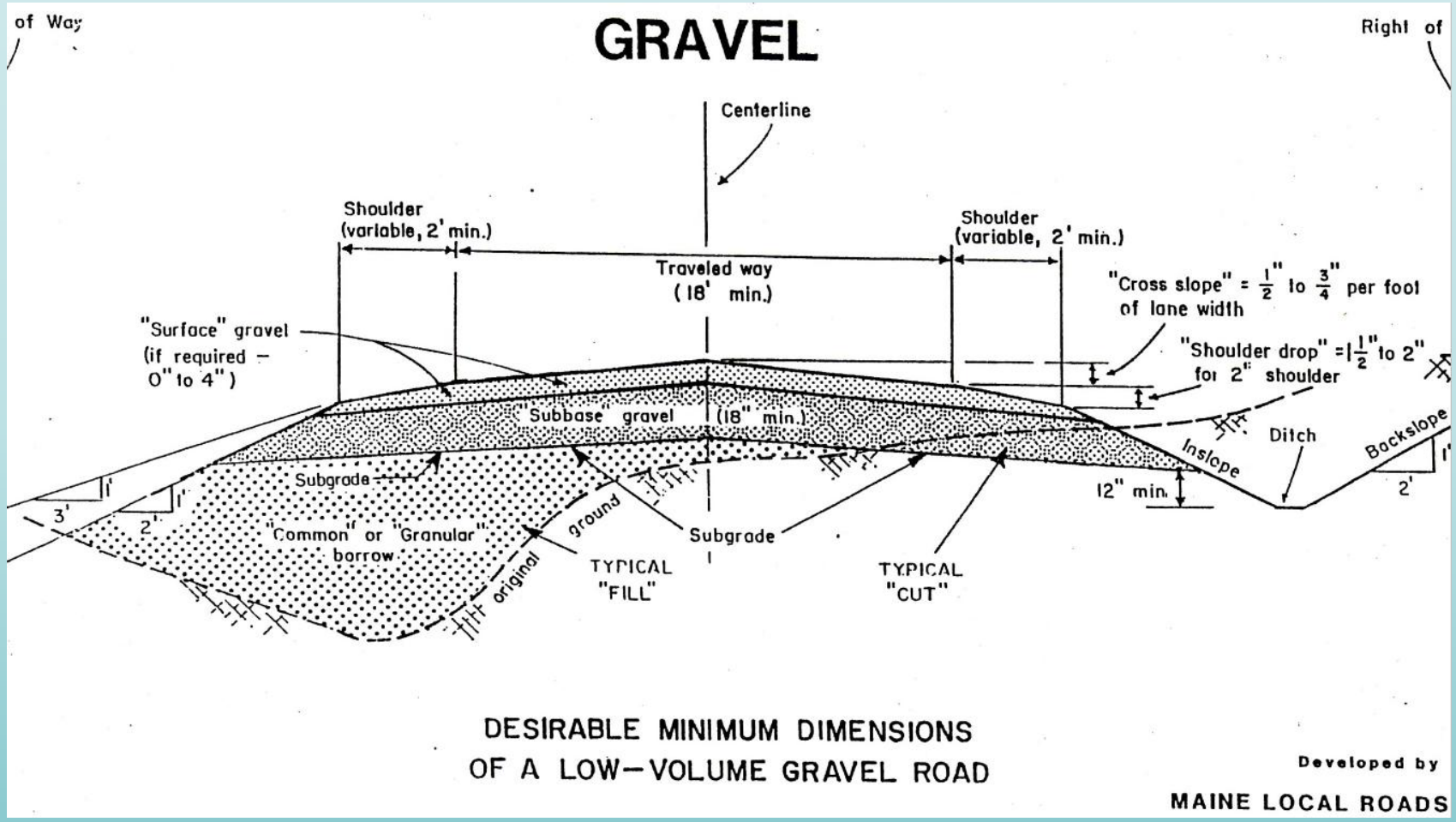
GRADED TO AN "A"
SHAPED CROWN
STRONG, WELL DRAINED
BASE
A SYSTEM OF DITCHES AND
TURNOUTS TO CARRY WATER
SAFELY AWAY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borrow
original ground
Subgrade
TYPICAL
"FILL"
TYPICAL
"CUT"
DESIRABLE MINIMUM DIMENSIONS
OF A LOW–VOLUME GRAVEL ROAD
Developed by
MAINE LOCAL ROADS

Ultimate goal:
Keep road smooth and firm enough to shed water by sheeting, not allowing gullys to form

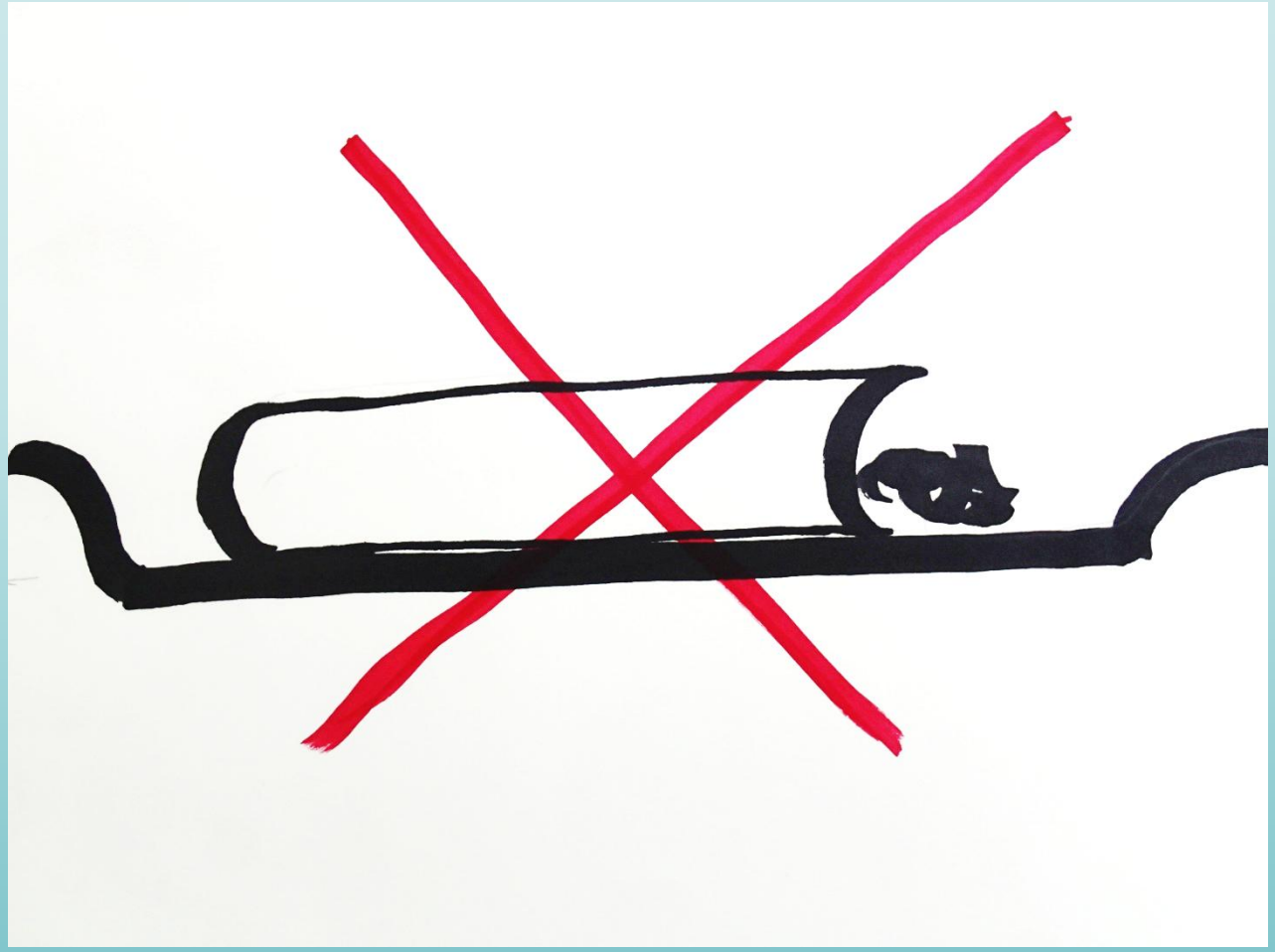
To our benefit…

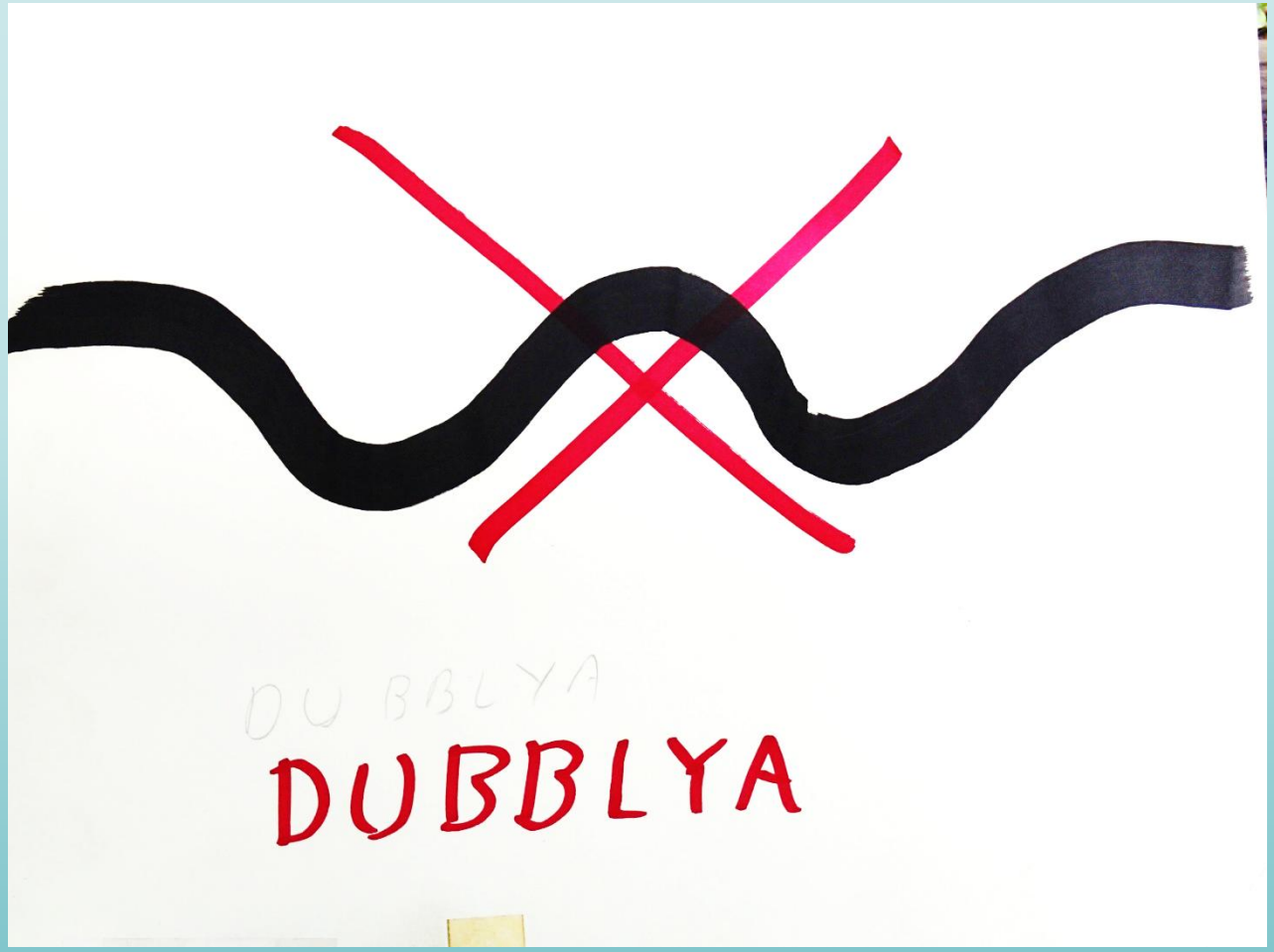
The same techniques used to improve the road surface to reduce erosion also makes the road **easier and smoother to travel on**.

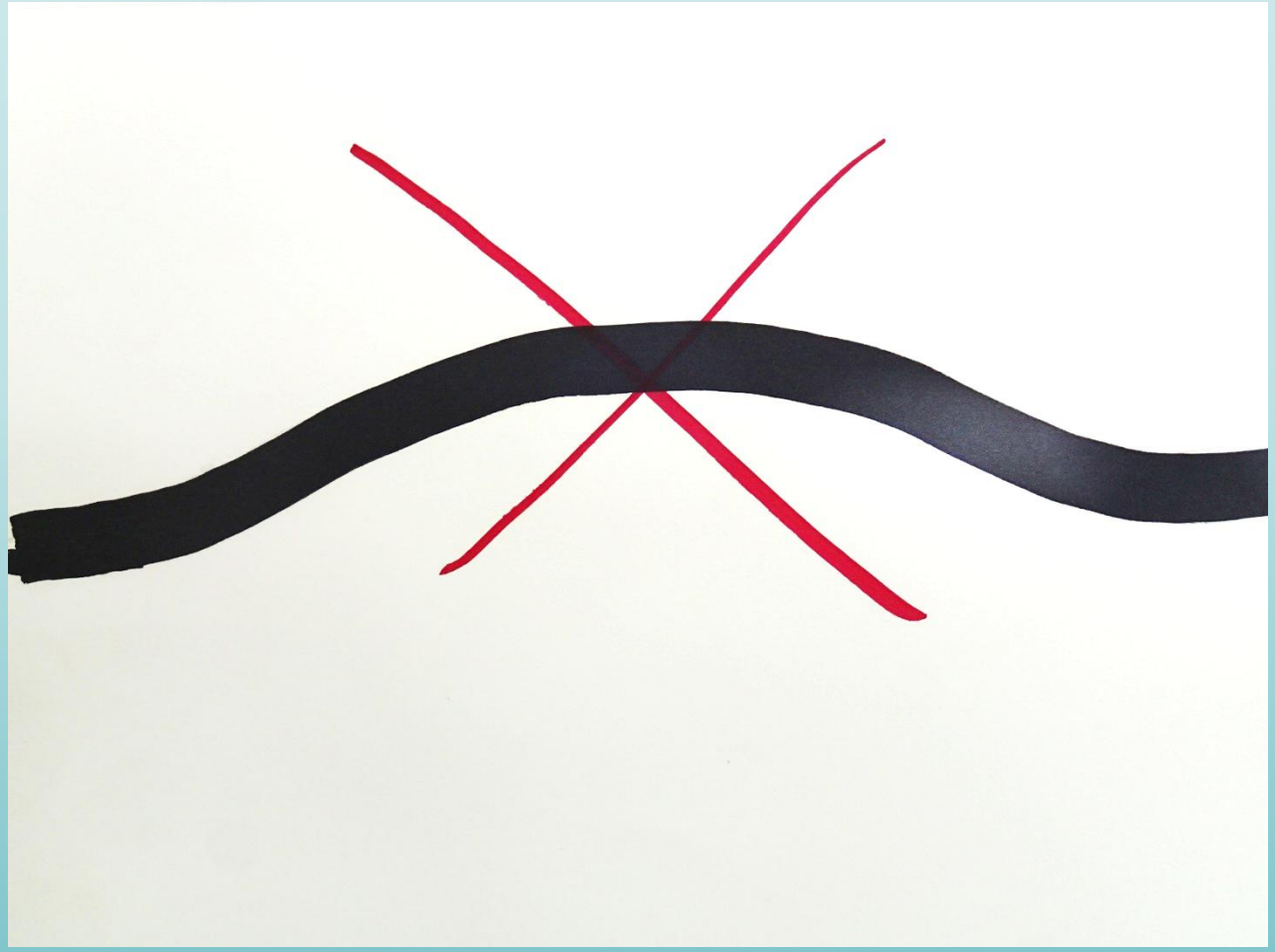
This helps to **make allies** of all road users, helping to win their confidence when we strive to perform other upgrades to reduce sedimentation.

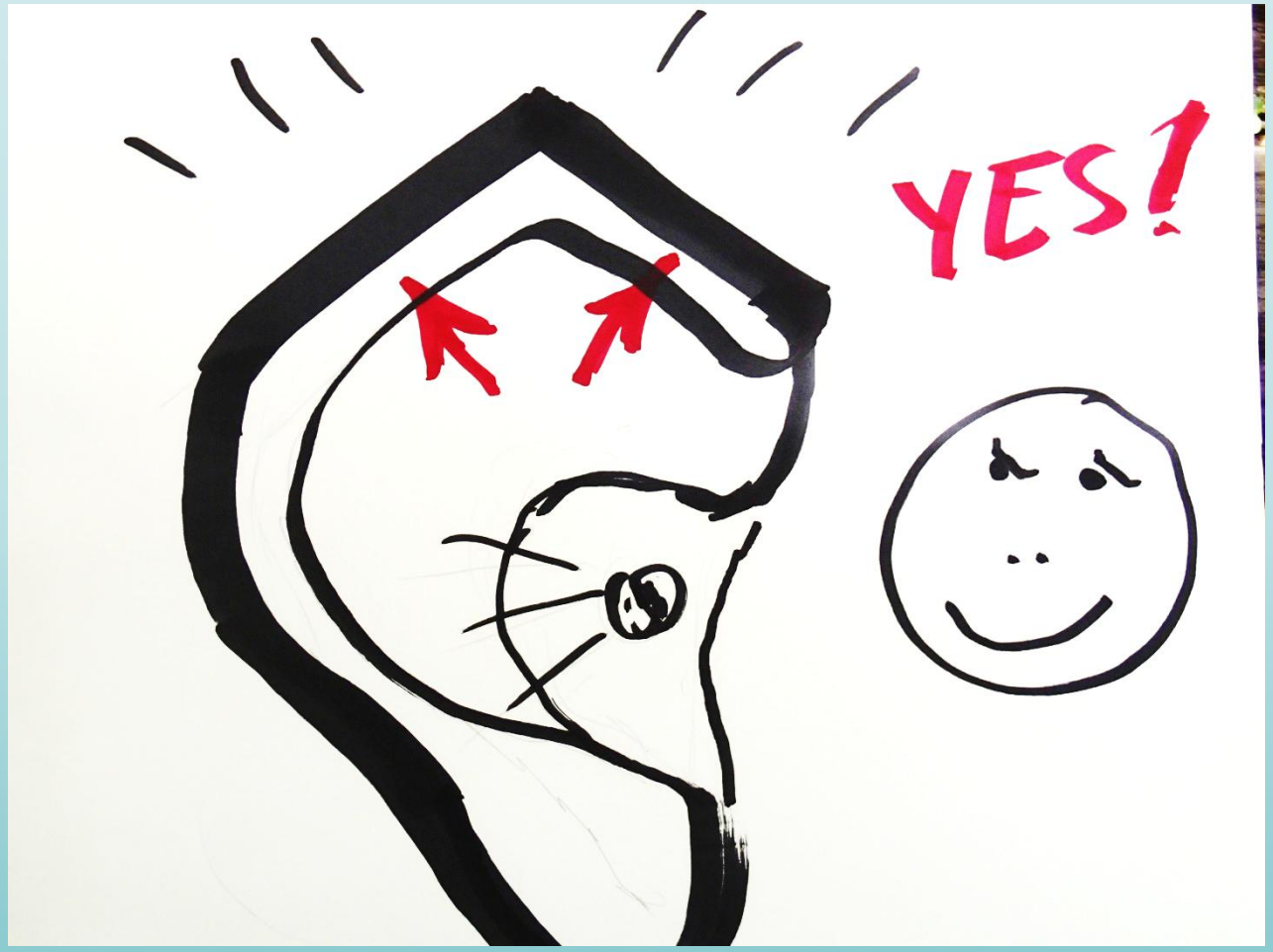
The Perfect Crown

I think that I will never see…

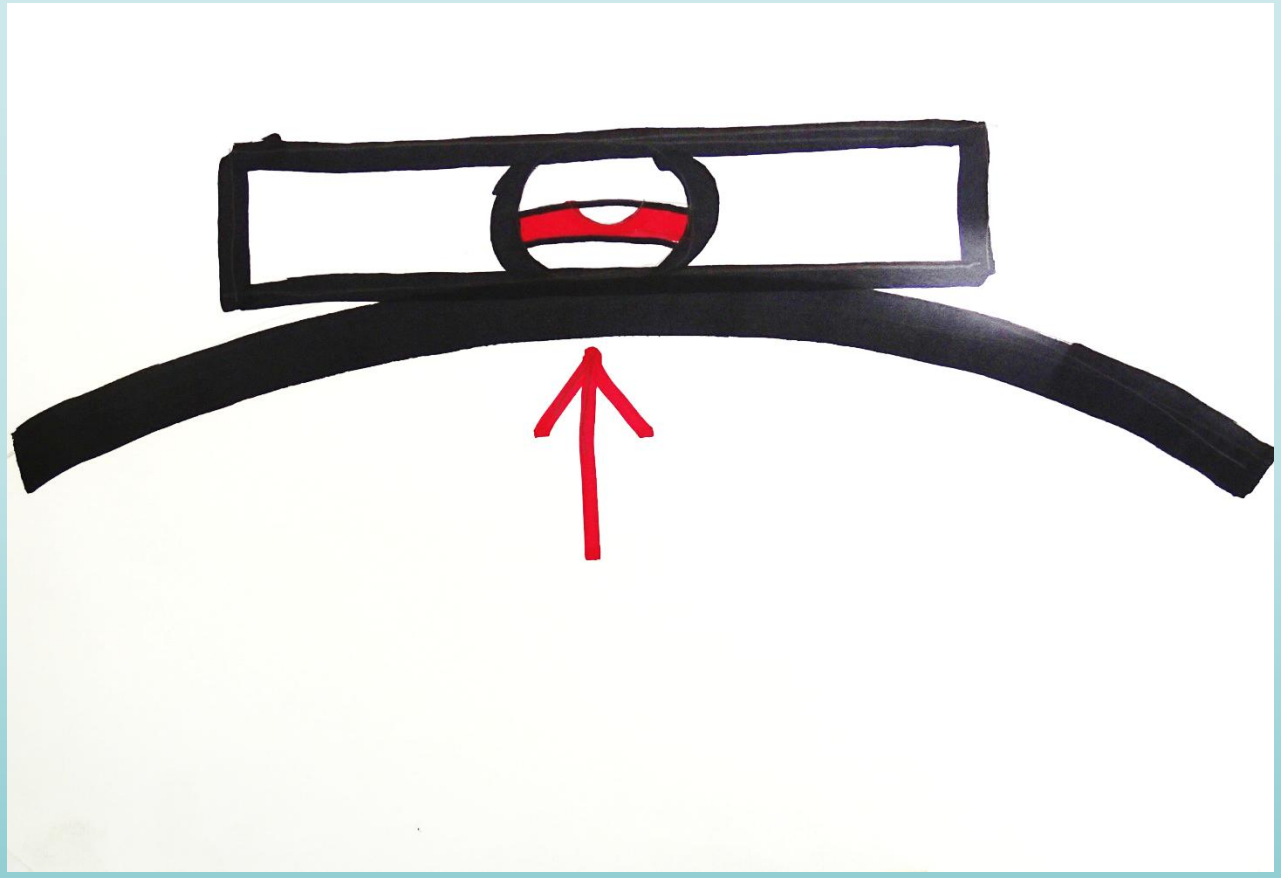


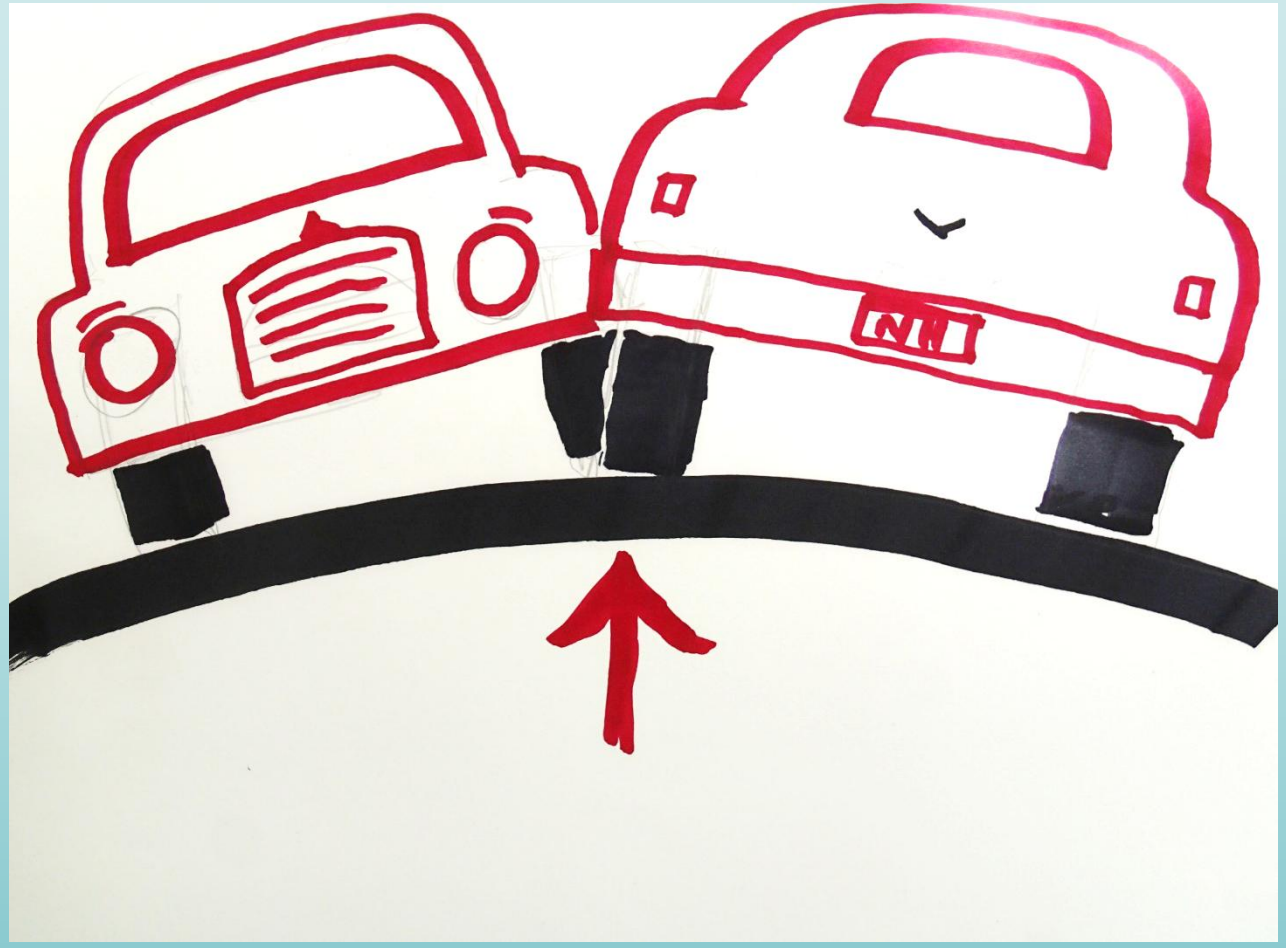

DUBBLYA

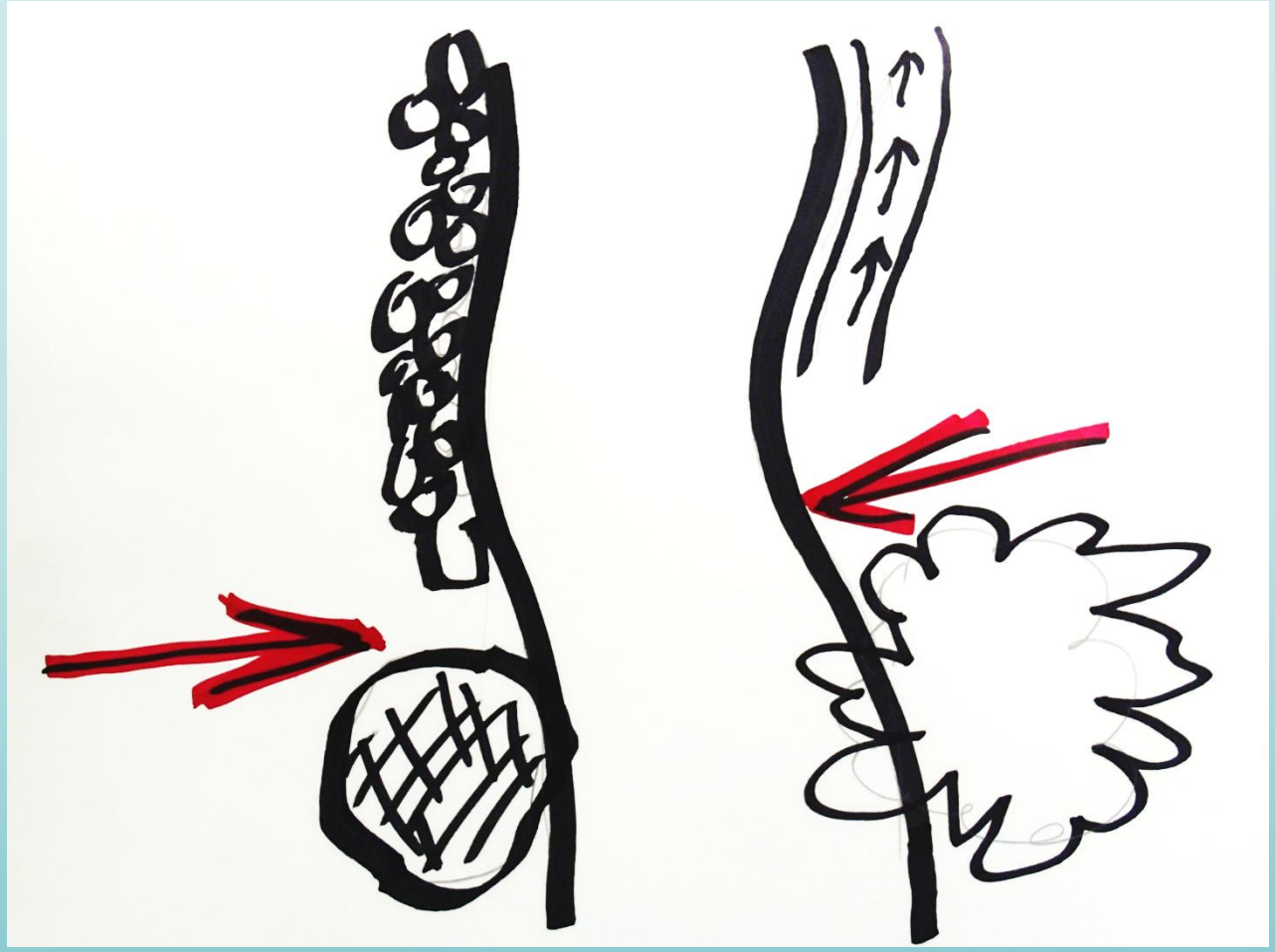



YES!


UGH!








Rule
#1


THE
END

- Big Pea Porridge Pond after big rain event

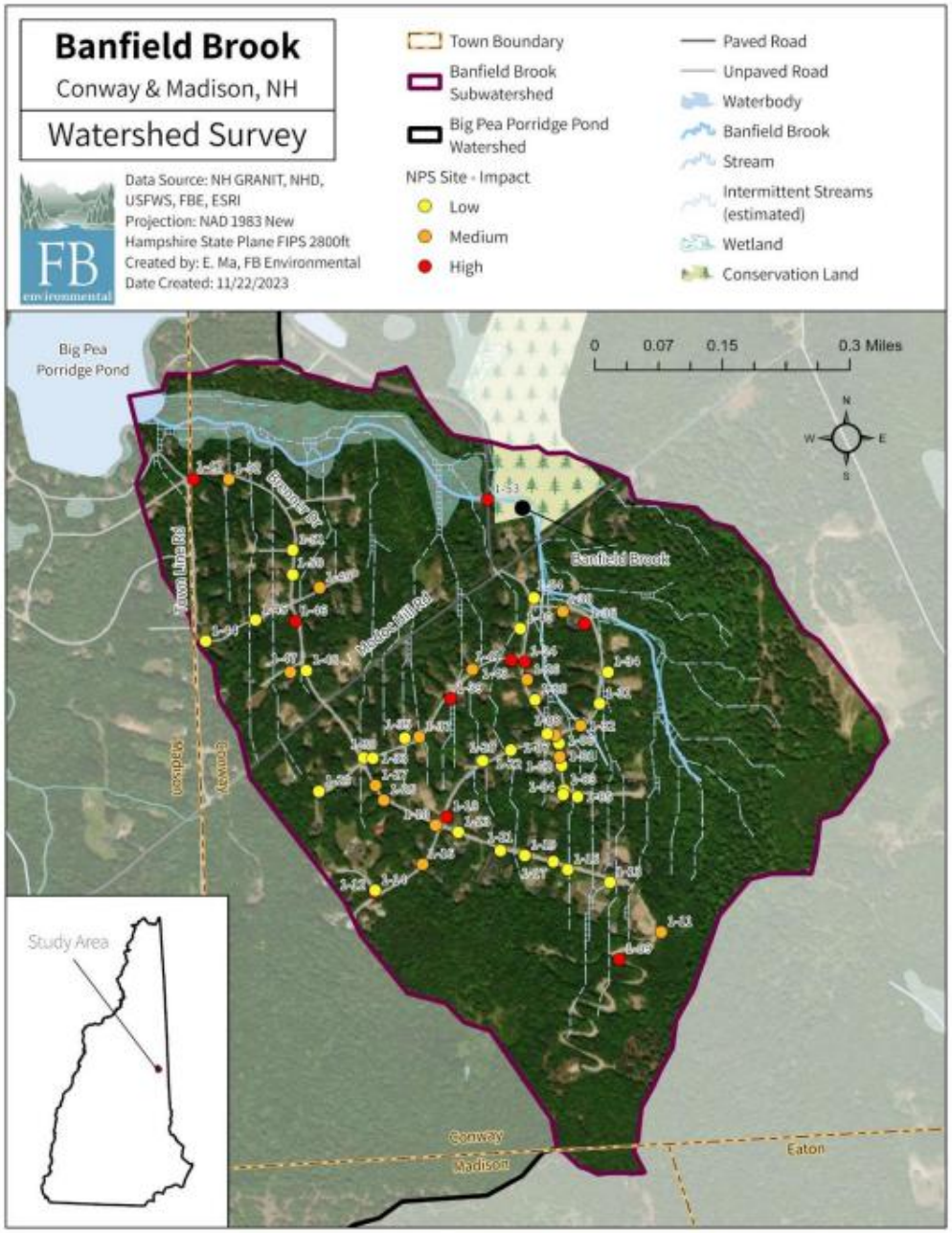


Figure 1. All identified Banfield Brook watershed survey sites.

The Rockhouse development has been a major contributing factor to the siltation of Big Pea Porridge along with the town of Conway roads.

Rockhouse development in the town of Conway consists of 140 lots, slightly over ½ acre each on steep slopes with poor soils.

Development has over 100 homes and more to be built soon.

It was developed in 1971 before the Conway Planning Board would have stopped it from happening.

All roads are gravel, though some were original paved but most pavement has broken up and surfaces returned to gravel.

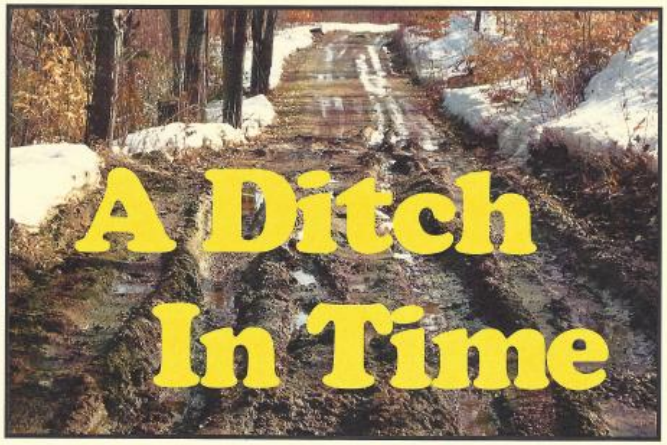
While the development is entirely in the Town of Conway, all runoff ends up in Big Pea Porridge which is entirely in the Town of Madison.


BIG PEA PORRIDGE POND
PRESERVATION ASSOCIATION

Big Pea Watershed Preservation Association: address siltation and other issues threatening the health of the pond in conjunction with the Village District of Eidelweiss and the Rockhouse Mountain Homeowners Association.

https://www.peaporridgepond.org/

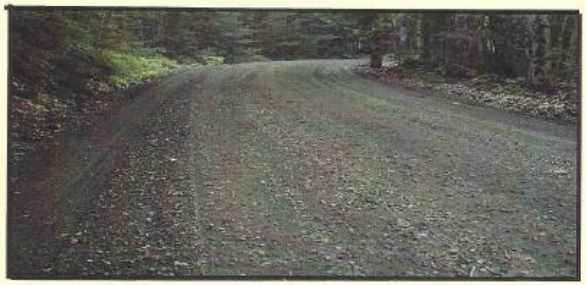
Modoc Hill Rd, Town of Conway



A Ditch In Time

An owner's manual for those who live and travel on dirt and gravel roads

by Russ Lanoie, Conway, NH



Includes a complete Troubleshooting Guide and Quick Tips for low cost/no cost things you can do right away to improve your unpaved road or driveway

Rural Home Technology

Presented By Russ Lanoie

Home | About Us | Road and Driveway Maintenance | Wet Basements | Septic Systems | Alternative Energy | Water Well Construction

Sharing over a half century of experience and innovation at solving soil and water related issues for rural homes and businesses...

LP

★★★★★

I've just been visiting your wonderful website! What generous sharing of helpful and thorough information!

J.S., FRYEBURG, MAINE,

★★★★★

I went to your website and spent an educational hour or more surfing! You have certainly taken a great deal of care in putting useful information out to educate your consumers.

Welcome to this site where Russ Lanoie shares much of what he's learned during his fifty plus years of innovative problem solving in New Hampshire's White Mountains. Russ has done extensive writing and produced several videos on soil and water related issues and, as his career slowly winds down, offers this information to anyone whom it may help solve their own problems. Russ welcomes questions and feedback and will respond as time permits.

How to dry out existing basements and keep new basements from ever getting wet

An owner's manual for those who live and travel on dirt and gravel roads

QUICK TIPS: THINGS THAT CAN BE DONE NOW TO IMPROVE YOUR GRAVEL ROAD OR DRIVEWAY

Every private road should have a steward, someone to watch out for the things that can cause greater problems if not taken care of NOW! If it's your own driveway, YOU are the steward. Knowing when to take action yourself or to notify whoever can take action might save a road or driveway from disappearing needlessly.

As a steward you should watch:

Water drainage patterns on the surface of the road. If water is beginning to flow where it should not, even a hasty scratch mark with a hoe, shovel, stick or heel of a boot to redirect water to where it *should* go might divert disaster. Catching this in time is the key. Hence the title of A Ditch In Time.

Culvert inlets and outlets as well as ditches to be sure they are not blocked. A stick or two across a culvert or a ditch can dam water flow just like a beaver dam, especially if other debris snags on and builds up. The dammed water will find another path across or out into the road, most likely causing a washout. When you are out for a walk, throw those errant branches back into the woods.

Water bars (sometimes known as "rolling dips.") Be sure they are not losing their shape due to mechanical damage from snowplows or normal wear and tear and therefore allowing water to jump over and run down the wheel tracks in the road. A little handwork can often make them serviceable once again.

Water turnouts and grader berms. Keep turnouts open and look for areas where more turnouts might be added. Cut slots through grader or snowplow berms to let water off the roadbed, especially on hills. This is true even for paved roads with regards to snowplow berms.

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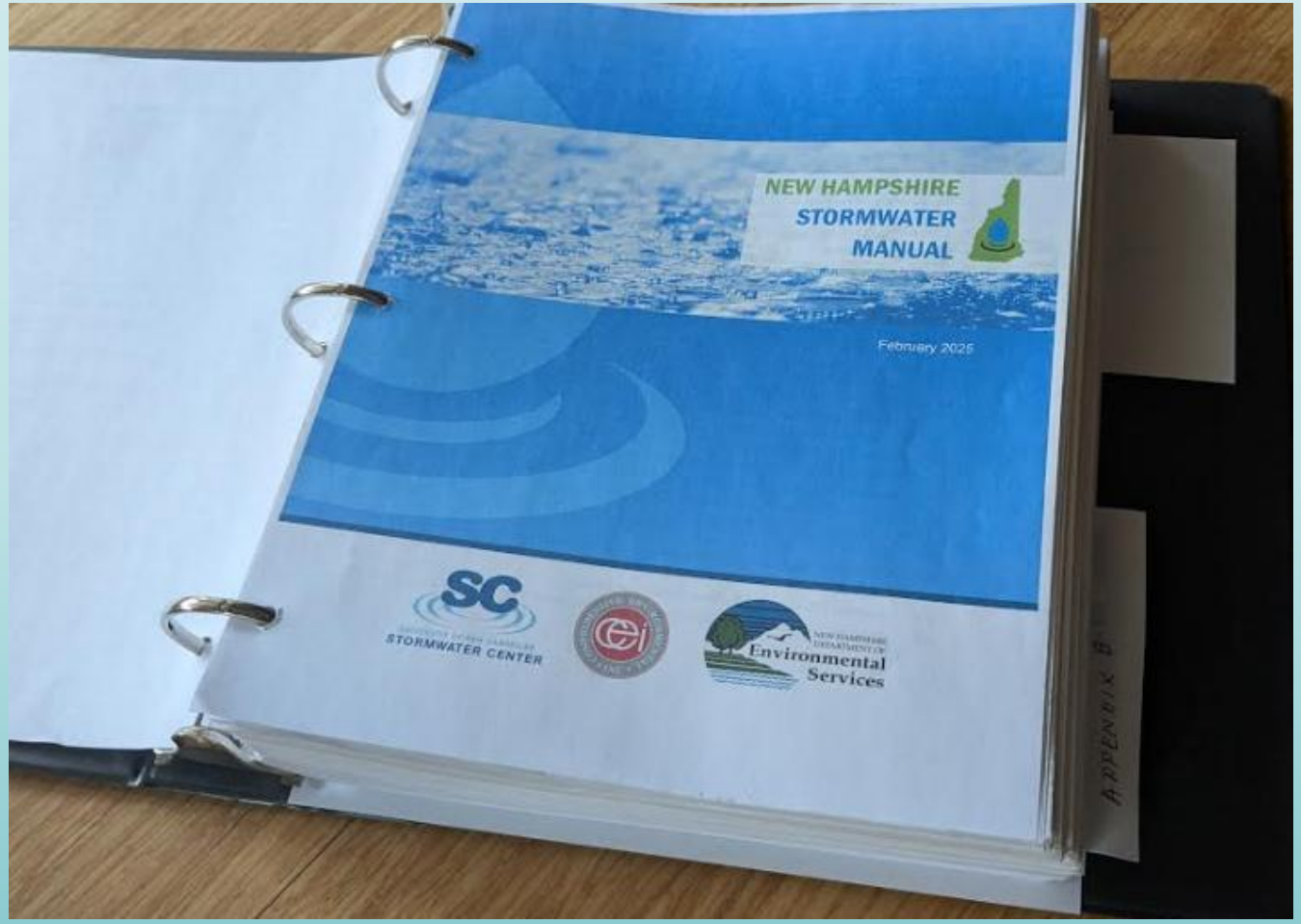
JUN 10 — Leadership Webinar Series Module 9: On the Balcony - Art of the Debrief
Credits: 1 Supervisory (12:00 PM - 1:00 PM EST) Location:
Register: Individual

JUN 10 — Lunch 'n Learn: Social Media & Public Works
Credits: 1 Supervisory (11:00 AM - 12:00 PM EST) Location:
Register: Individual

JUN 10 — Basic Pavement Management for Local Agencies - Part 2
Credits: 2 Technical (2:00 PM - 4:00 PM EST) Location:
Register: Individual

JUN 10 — Evaluation of Precast Concrete Pavement Systems Webinar
Credits: 1 Technical (12:00 PM - 1:15 PM EST) Location:
Register: Individual

VIEW ALL UPCOMING TRAINING


NEW HAMPSHIRE
STORMWATER
MANUAL
February 2026
STORMWATER CENTER
Environmental
Services
APPENDIX B

Links on NH Lakes website to:

- NH Stormwater Manual
- UNH Technology transfer Center
- Big Pea Porridge Watershed Preservation Association
- Maine Camp Road Manual
- Rural Home Technology, Russ Lanoie's website including

A Ditch in Time

Check fines test bottle