Principles of Erosion and Sediment Control

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Transportation and Infrastructure Renewal
2016

NOVA SCOTIA

Why are you here?

➡ ***ESC Certification***

As of 2005, <u>all</u> government construction sites require on-site supervisory staff with a "Certificate of Training" (***ESC Green Card***).

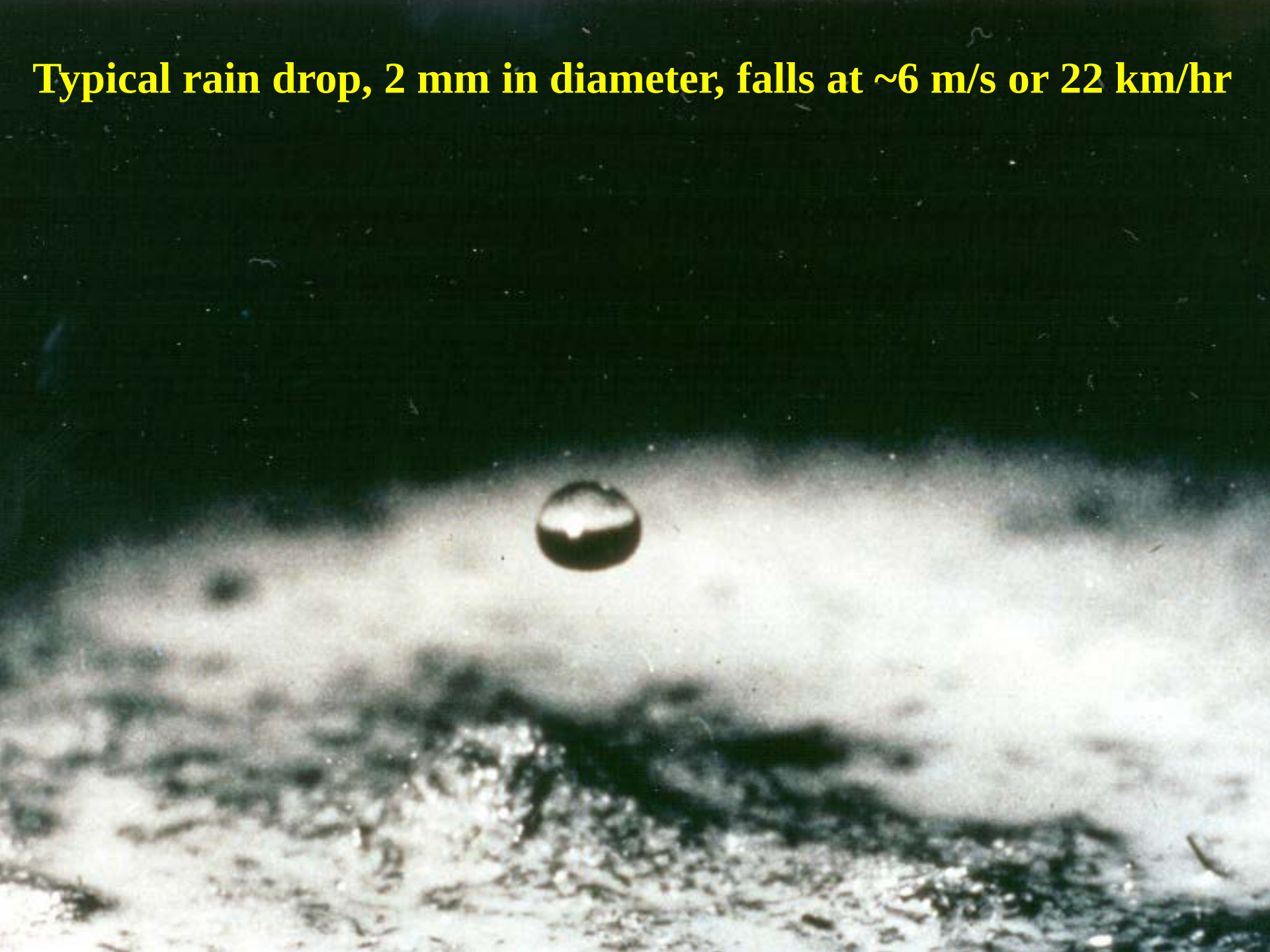
ESC Course – Overall Goals (1)

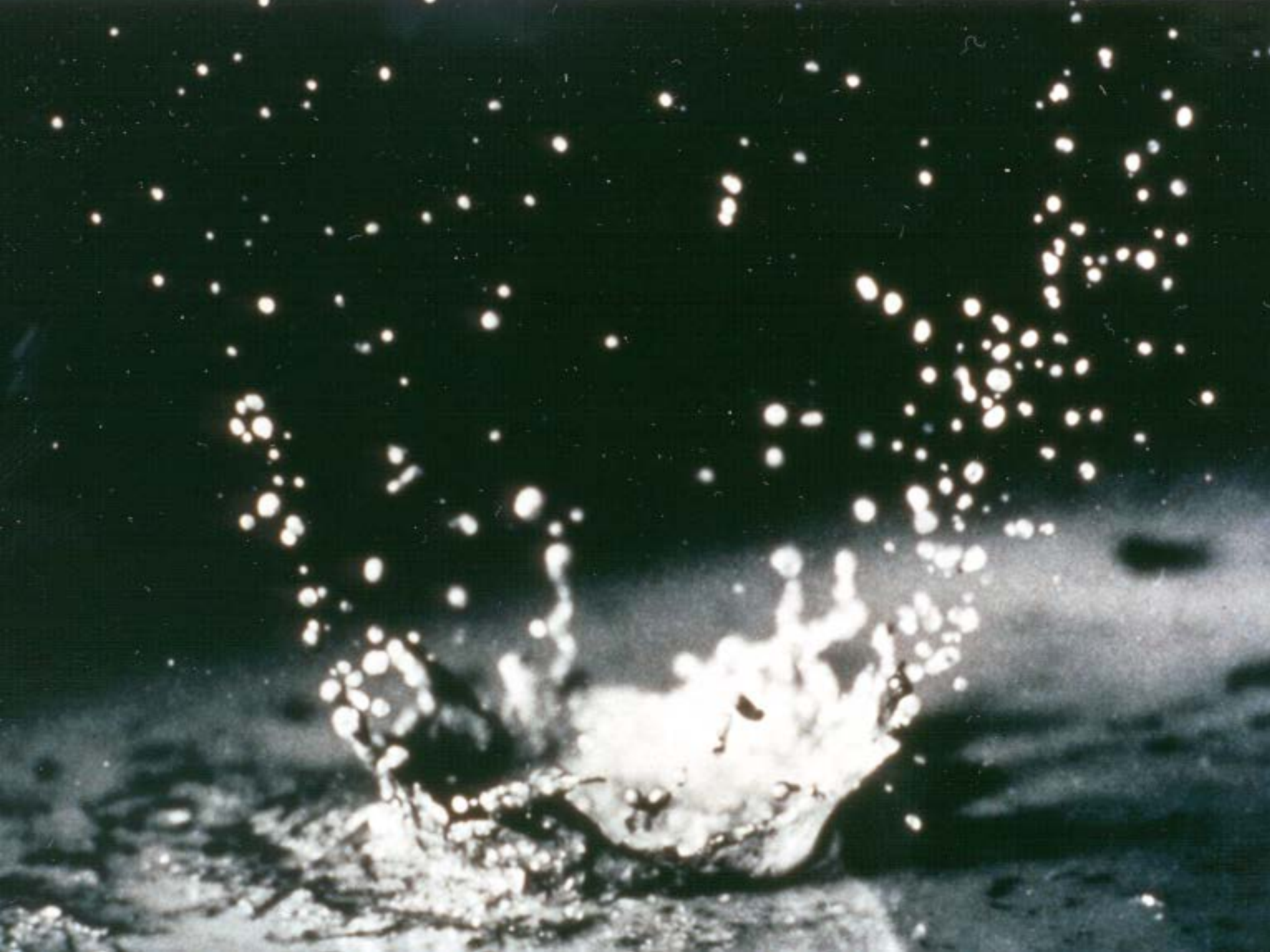
- Avoid the problems of the ‘good old days’ of highway/building construction:
  - Reactive erosion and sediment control;
  - Large areas of exposed soil; and
  - Numerous sediment control BMPs (*e.g.*, sediment ponds, silt fence).

ESC Course – Overall Goals (2)

- Educate construction contractors and NSTIR staff about the principles of ESC and some key applications.
- Provide participants with a resource book.
- Promote an ethic of ***Erosion Prevention*** rather than *Sediment Control*.

http://www.gov.ns.ca/tran/works/enviroservices/enviroErosion.asp


Typical rain drop, 2 mm in diameter, falls at ~6 m/s or 22 km/hr




Photos from IECA website

Catastrophic failure of a culvert on Route 374 (south of Stellarton) on April 2, 2003.

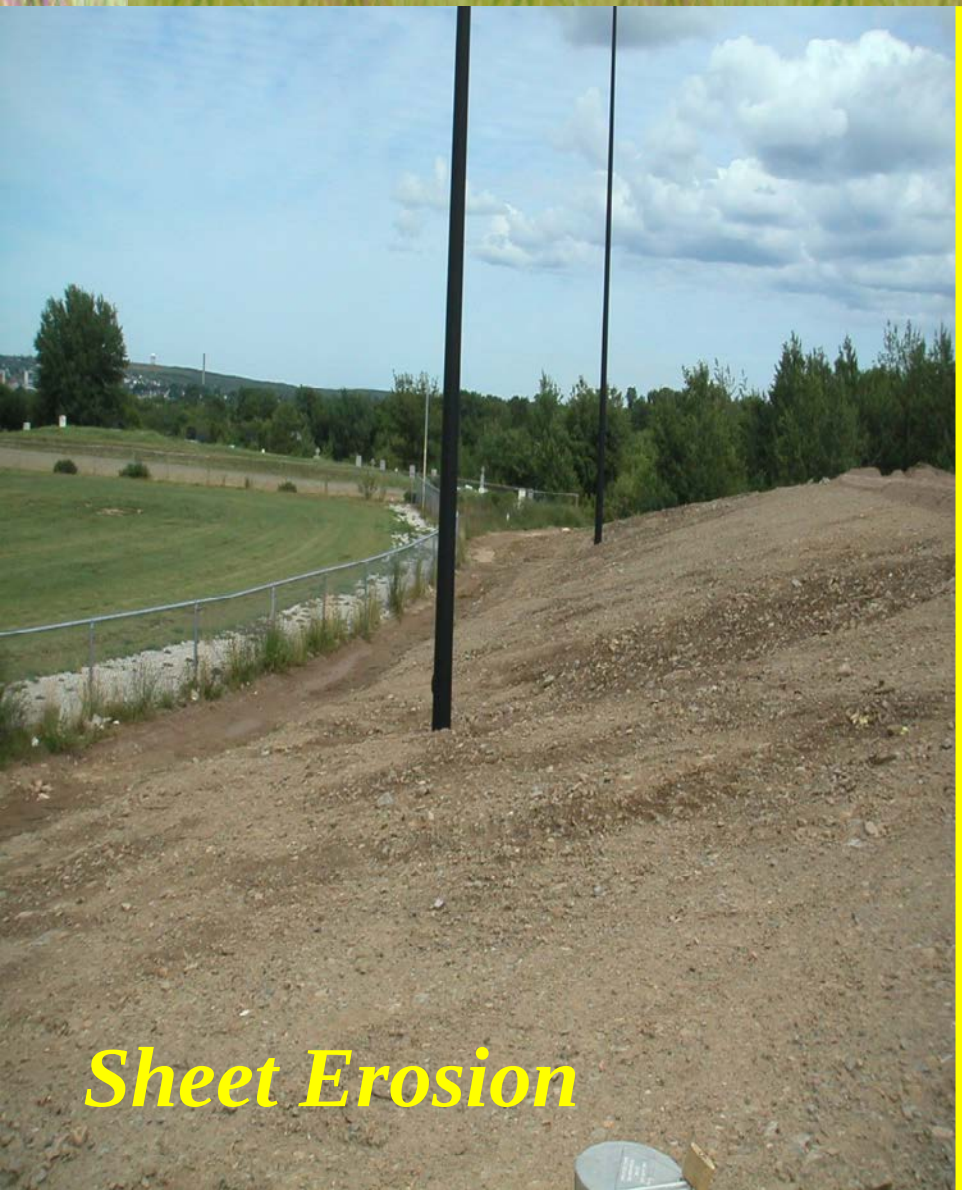
- *torrential runoff*
- *beaver dam breach*
- *small culvert-blocked*

New stream and radical alteration of riparian zone down to the West Branch East River (~1 km)

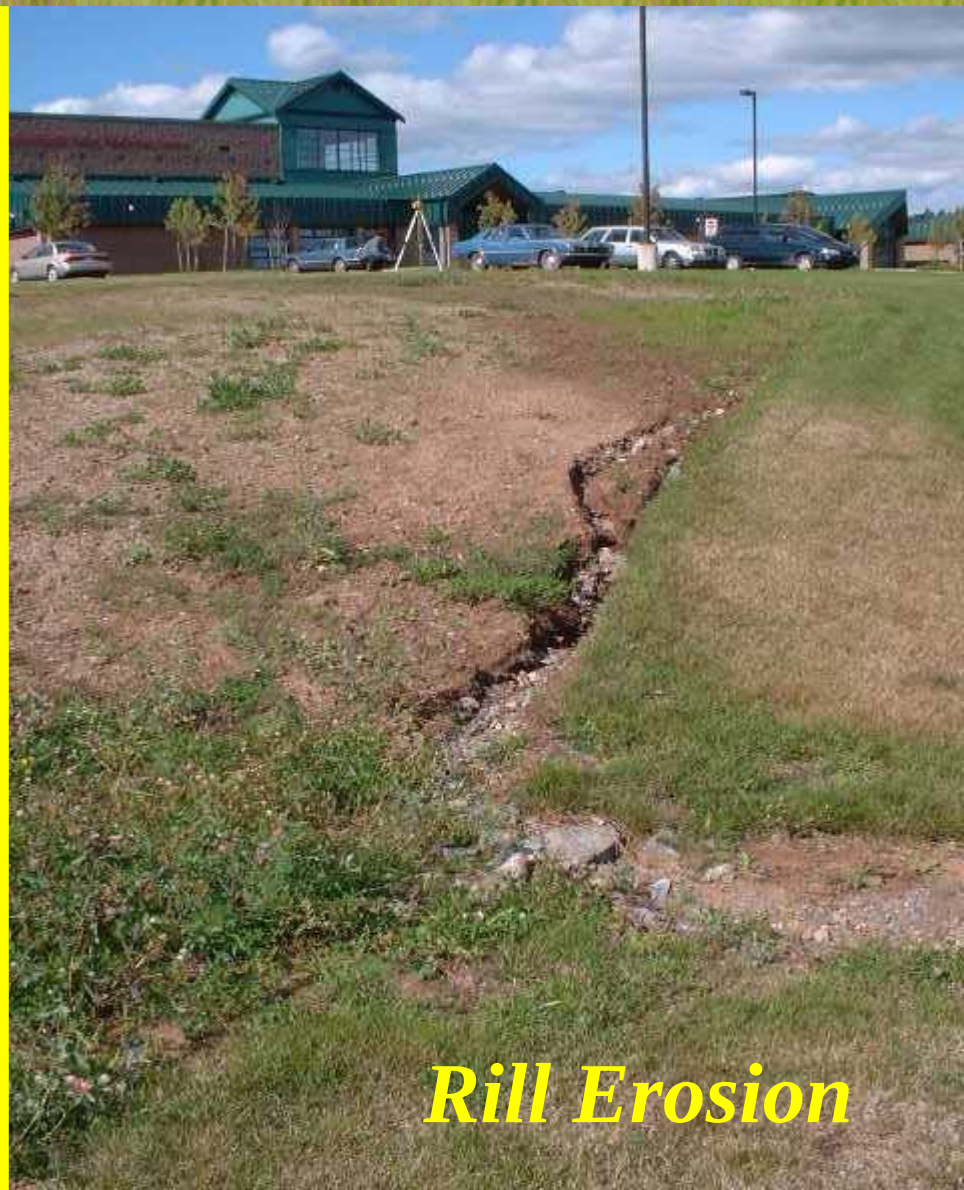
Definitions - Erosion and Sediment

- Erosion:
  - Process by which the land's surface is worn away by water, wind and ice.
- Sediment:
  - Soil washed away and then deposited downstream.
- Suspended Solids, or Suspended Particulate Matter:
  - Soil and other fine materials suspended in water.
  - Many abbreviations, *e.g.*, TSS, SS, SPM, silt, turbidity.

Types of Erosion



Sheet Erosion



Rill Erosion

Rills to Gullies

Consider both topography and soil erodibility!
See Tab 18 in your binder

Photo from IECA website; A. Toivanen (2011)

Gullies to Landscape Scars

- Continued growth can create safety hazards and expensive repair bills.
- Gullies can also lead to slumps, landslides, and major damage to roads, adjacent lands (up- and down-gradient), and fish habitat.

Photo from IECA website; JC Lantz (2001)

Erosion and Sediment Loss

- Stop the Silt!!! The average construction site loses 1/4 inch (6 mm) of soil from sheet and rill erosion. Public is aware!
- Topsoil and its nutrients create other watershed problems – *eutrophication*.
- Stop-work orders, fines and legal-action!

Factors that influence erosion

- Vegetative cover
- Soil erodibility
  - Silt content (*bad* = silt, silty loam, loam, and silty sand).
  - Soil origins (*bad* = alluvial, colluvial, and marine deposits).
- Topography
  - slope length (>70 m) and steepness.
- Climate/Microclimate – Hydrogeology Interactions
  - natural soil moisture, springs, water table variations.
- Weather, especially rain intensity and duration.

Erosion Prevention and Control

- Once soil has started moving, it is very difficult and expensive to control.
- Over the past 15 years, we have developed a set of Principles.
- They work,,, but need more diligence!

Principles of Erosion and Sediment Control

1. Go gently into this good site and prevent erosion until permanent ground cover is re-established.
2. Keep clean water clean.
3. Minimize the amount of exposed soil.
4. Minimize the time of exposure.
5. Keep the sediment on site.
6. Avoid steep slopes.
7. Have a *Contingency Plan* and the resources for emergencies.

1. Go Gently Into This Good Site!

- Understand the site drainage before, during and after construction. ***Always manage water flows!***
- Identify critical areas of concern and assess risks.
- Complete/revise ESC and water control plans.
- Think about construction phases and the weather.
- Use appropriate equipment and techniques.
- Minimize disturbance to existing ground cover. ***Cover or revegetate exposed soil ASAP!***

Work Progression Schedule

- Contract requirement for road projects.
- Ensures continuous work and orderly progression.
- Minimizes time and amount of soil exposure.
- Divides the project into ‘work areas’ that can be completed in a reasonable time frame (30 days).
- Size is determined by the area that can be grubbed, graded, and protected by various cover materials.

Limit areas of exposed soil to a maximum of 6 days, or until the next storm comes, whichever is less. Rough-up the surface and spread hay!

2. Keep Clean Water Clean.

- Don’t allow clean water to enter a work site.
- Divert/intercept/direct water around the site.
- Collect and treat dirty water at source before it mixes with clean water.
- Use turbidity curtains.

Divert & Intercept

But, make sure you understand the drainage pattern!

Photo from IECA website (J. Slupecki, 2004)


We need to get the message out!
Be a mentor to your staff / friends!!!

What else could you do here?

Groundwater is very difficult to deal with and can severely hamper your project schedule and budget.

Shubie Canal – near Dartmouth Crossing

3. Minimize Amount of Exposed Soil.

- Less exposed, less to erode.
- Easier to deal with “emergency situations” such as storm events.
- Keep the surface rough and loose.
- Use temporary covers and establish the permanent vegetation ASAP.

4. Minimize Time of Exposure.

- Don’t open up a new area until you are ready to do the work and the erosion controls are in place.
- Conduct the work in phases or stages to minimize time and amount of exposed soil.
- Use temporary covers and establish the permanent vegetation ASAP.

5. Keep Sediment On Site.

- Use sediment fence or grubbings berms.
- Work in isolation of flow. Gravel your access roads.
- Keep loose and rough surfaces to slow-down runoff, promote infiltration, and facilitate later revegetation.
- Spread temporary cover (hay) and revegetate ASAP.
- Use spray-on products in high risk/sensitive areas to bind sediments and armour the surface.

Great to salvage topsoil, but store it carefully!

http://www.forester.net/ecm_images.html

Working in the dry (isolation)

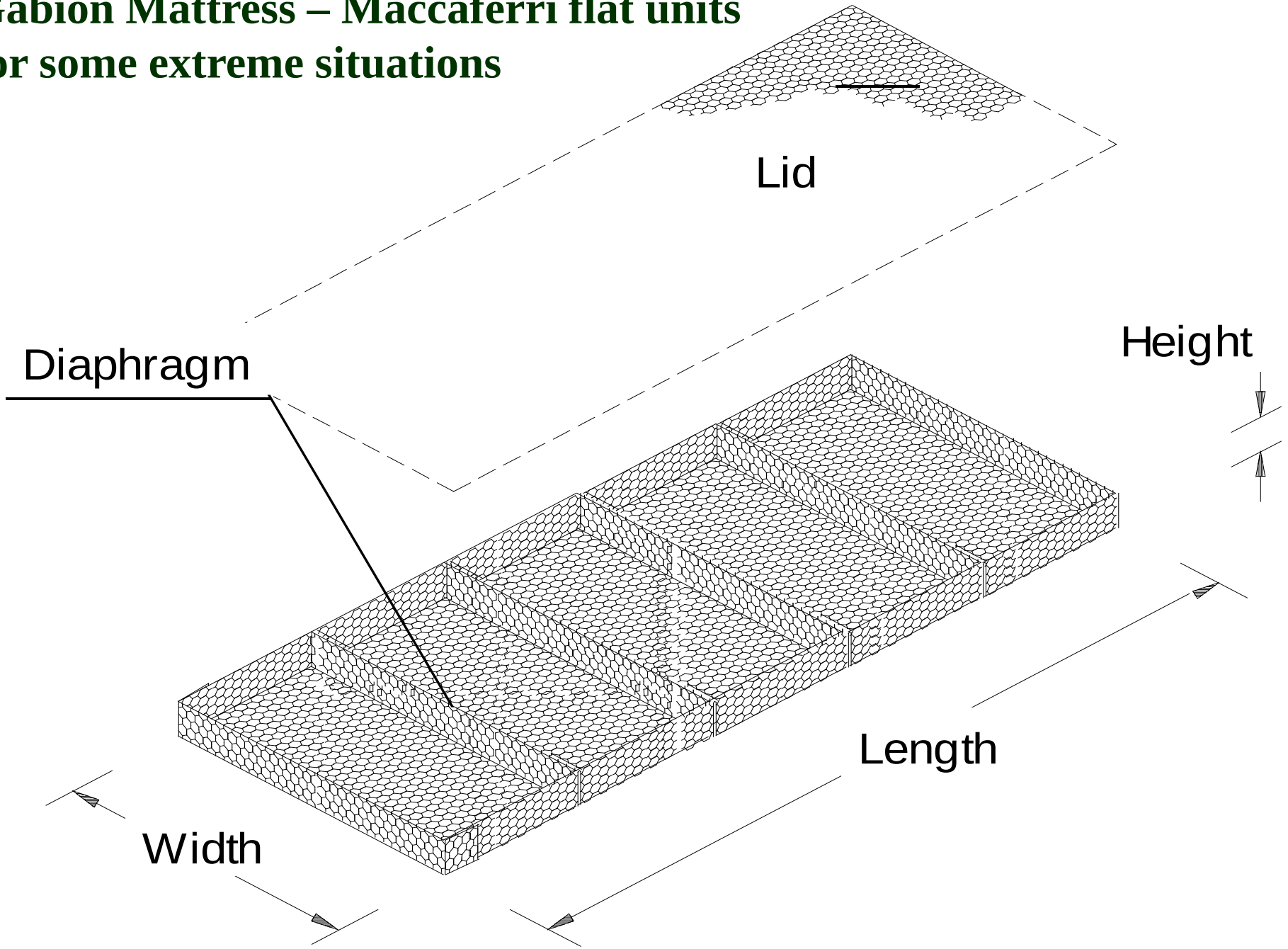
- Multiple layers of protection to ensure protection/prevention!
- Coffer dams, caissons, booms, turbidity curtains, dam and pump,,,
- Changing drainage patterns during construction – where will the pumped water go? What's at-risk or vulnerable?

6. Avoid Steep Slopes – If Possible.

- Water moves faster, promotes rills and gullies, and may lead to catastrophic failures.
- Shallower slopes – slower water flow, more time to infiltrate, less seed loss, safer, cheaper.
- If you cannot avoid the slope, need to consider means to **armour** the surface and slow the water flow (mulch or rock blankets, sod, salvaged veg'n, spray-on products, TRM/ECB).


KOMATSU
PC220LC

Gabion Mattress – Maccaferri flat units for some extreme situations



Maccaferri Gabion Mattress

and other robust alternatives for the more extreme situations!

Shaw Precast Solutions – CONTECH Armorflex®

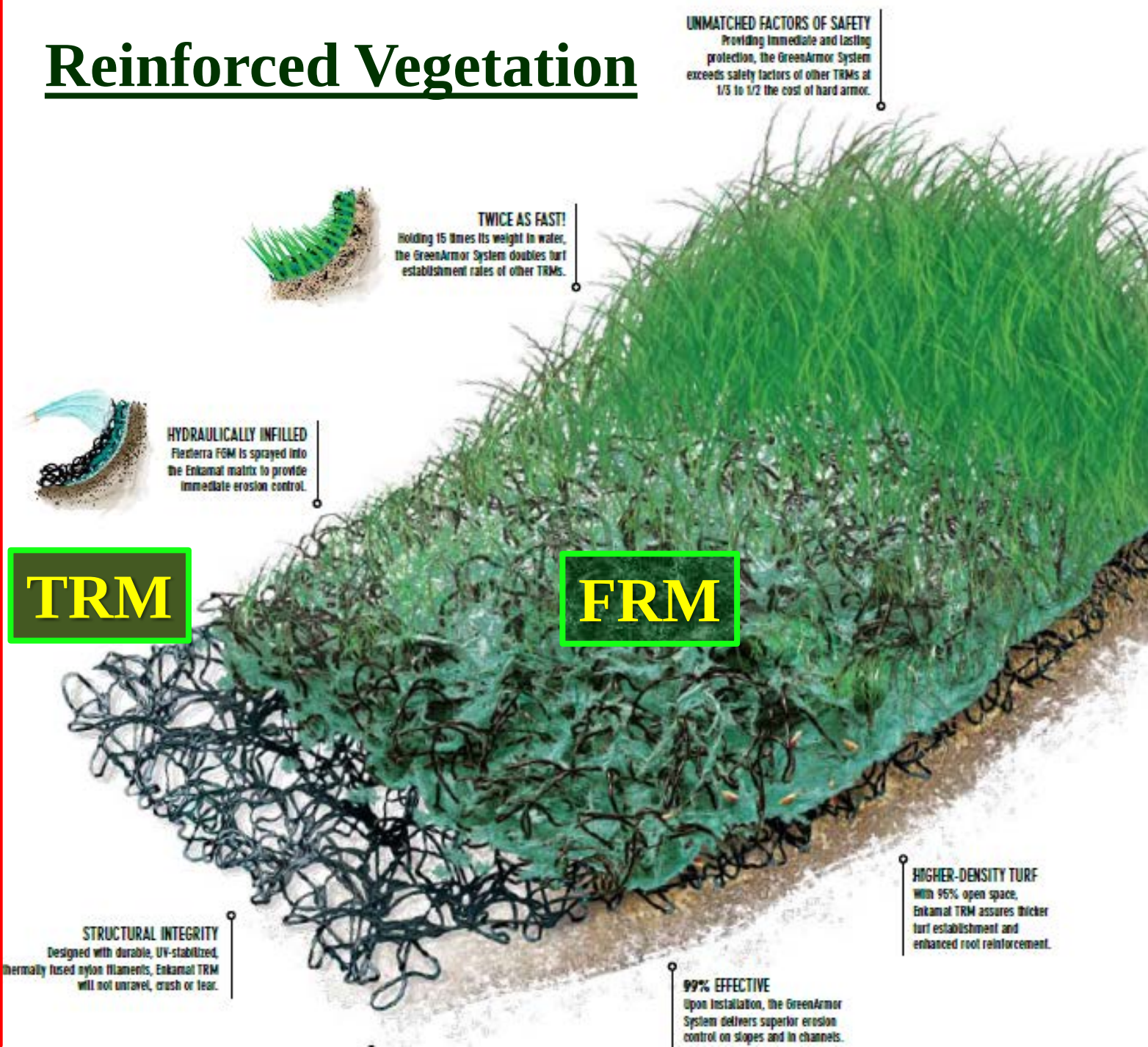

Armorflex®
➡ 20%
Open Area


Spray-on products, like *Flexterra FGM*, bond to soil, armour the surface and stimulate plant growth
Terra-Tubes™
2008/12/14 05:01
DEVCO – VJ

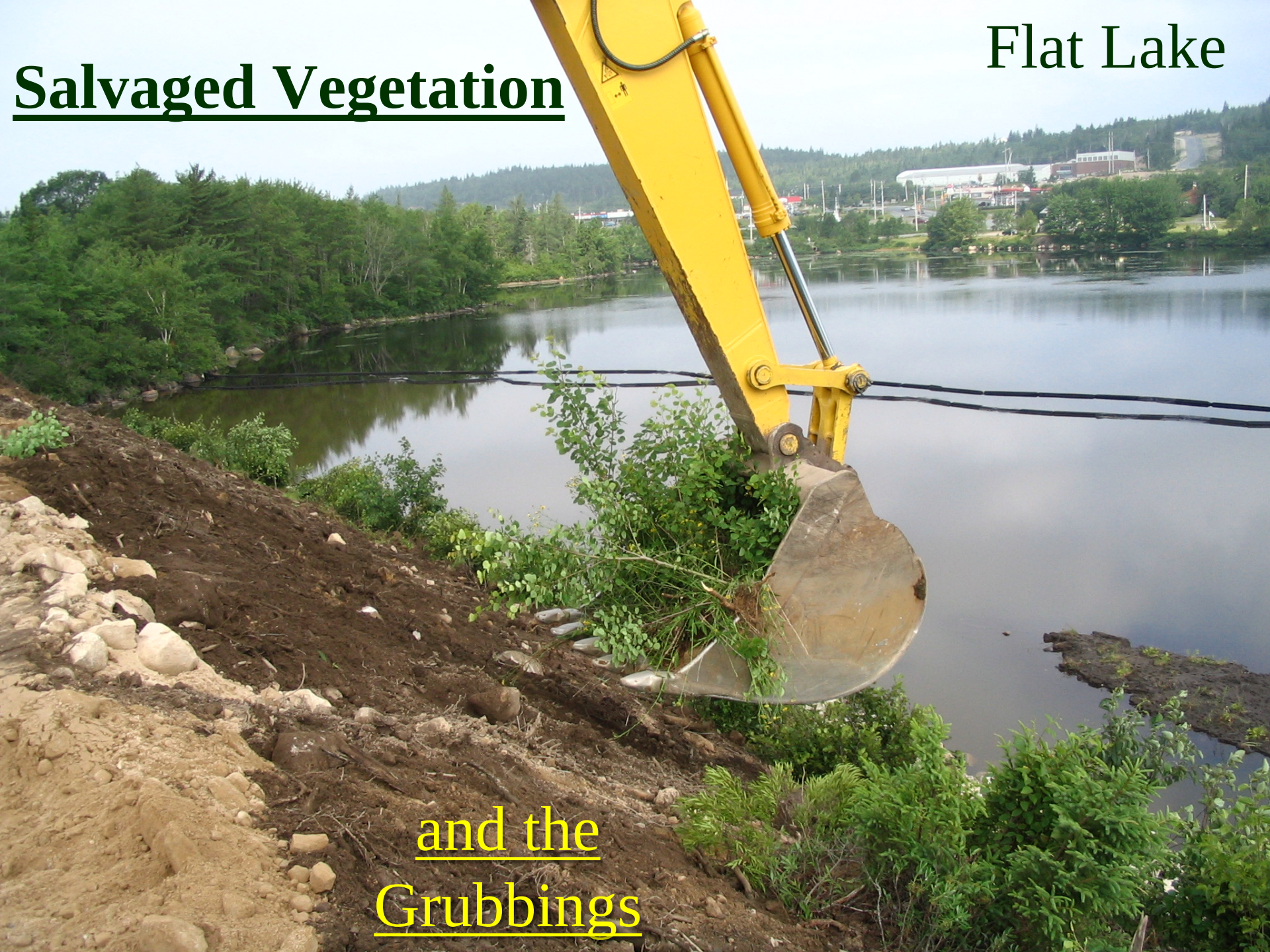
Combo provides as much protection as rock blankets plus:

- Cheaper
- Not toxic
- Absorbs pollutants
- Promotes infiltration & evap'n
- Cools the runoff.

Reinforced Vegetation




Hwy 104 – West River
crossing at Antigonish


Flat Lake
Salvaged Vegetation
and the
Grubbings

View of Slope from Across Lake

7. Have a Contingency Plan for Emergencies.

- Expect the worst and be prepared for it!
- Staff training! Pre-storm preparation meetings!
- Protocols for inspection, monitoring and spill notification to senior managers and regulators.
- Equipment and operators that can be mobilized on short notice to create and fix ESC measures.
- Stockpiles of ESC materials.

Storm coming – cover-up!

Additional Information Sources

- **International Erosion Control Association (IECA):** ***http://www.ieca.org/Resources/Resources.asp***

- **TAC (2005)** ***National Guide to Erosion and Sediment Control for Roadway Projects*** ***http://www.tac-atc.ca/***

- **TPW (2007)** ***Generic Environmental Protection Plan (EPP) for the Construction of 100 Series Highways***

  http://www.gov.ns.ca/tran/enviroservices/100seriesEPP.asp

NSTIR website (ESC Course Materials)

http://www.gov.ns.ca/tran/enviroservices/enviroErosion.asp

- Principles of Erosion and Sediment Control
- Provincial Mandate and Requirements
- Federal Mandate and Requirements
- ESC Applications: Highway Projects
- ESC Applications: Building Sites
- Erosion Prevention and ESC Plans
- Vegetation Strategies
- Adaptive Management

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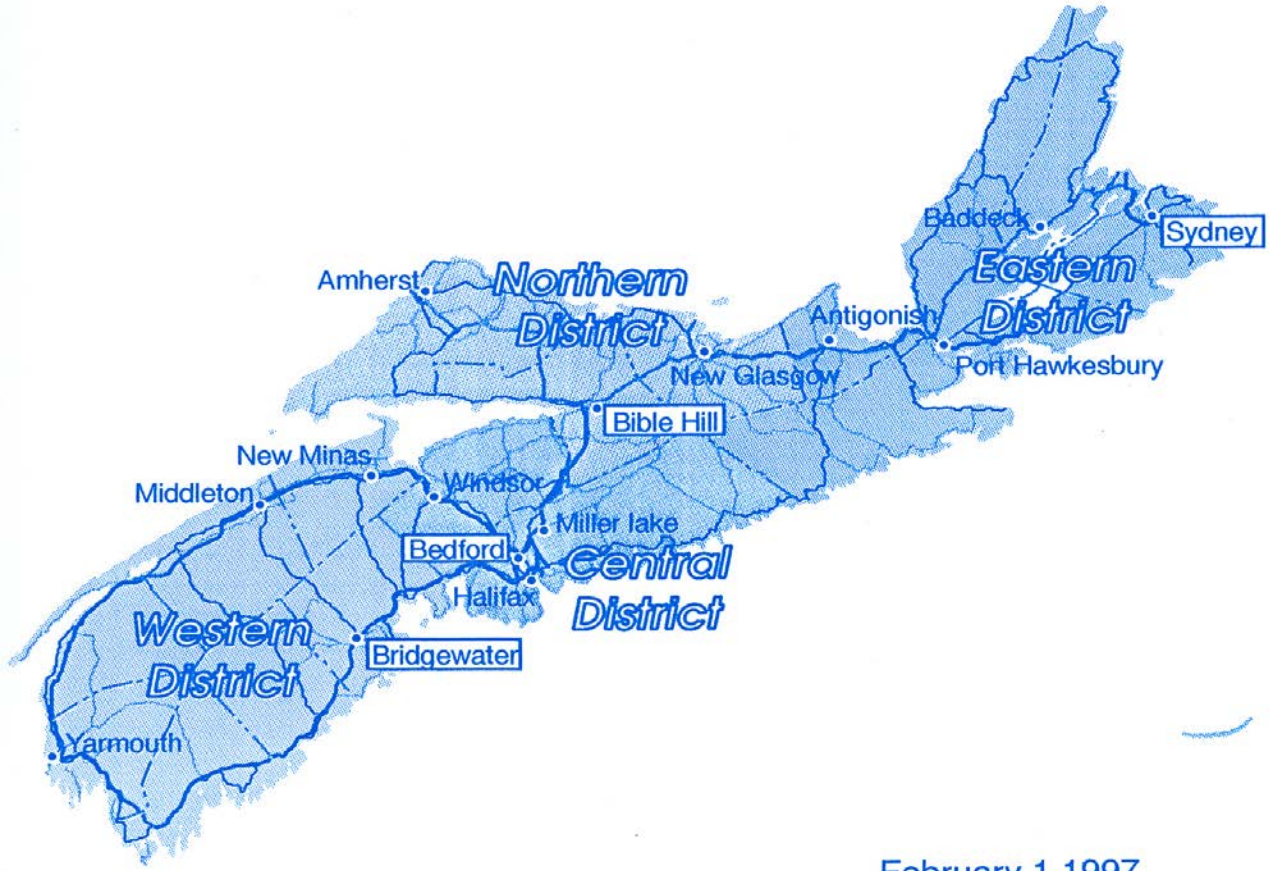
Transportation and Public Works

STANDARD SPECIFICATION

Highway Construction and Maintenance



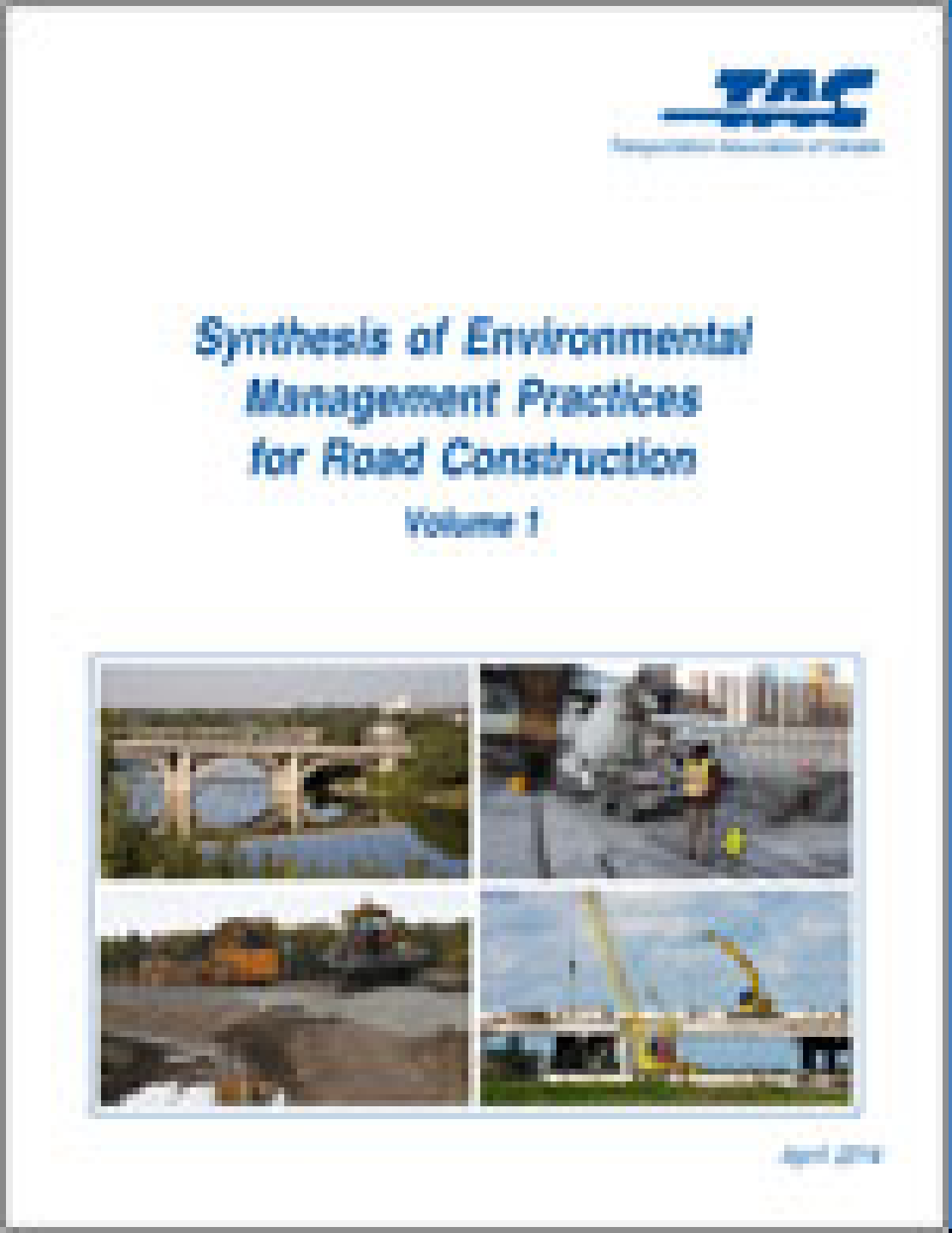
February 1,1997

Division 1, Section 5

and

Division 7

Updates to February 1, 2014



TAC (April 2014)

Synthesis of Environmental Management Practices

Vol. 1 – Road Construction

Vol. 2 – Road Operation and Maintenance

http://tac-atc.ca/en/bookstore-and-resources/bookstore

Thanks!

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Small Group Exercise

Principle 1 – Go Gently Into this Good Site!

Tender for a new school requires you to submit an ESC Plan. Based on your understanding of Principle #1, discuss with those around you, some of the key items that you need to determine during a site visit and then afterwards as you conduct information searches for your Plan.

Take **5 minutes** to list the key items and then we'll quickly review some of your responses.

Small Group Exercise – Key Items

Site Visit

- Topography (slopes)
- Drainage pattern
- Shallow groundwater
- Soil type(s)
- Environmental features and constraints (on-site and adjacent)
- Adjacent properties
- Preferred access point(s)

Information Searches

- Climate (best time window)
- Local knowledge Re: storms
- Erosion potential [*see* ***Tab 18***]
- Environmental / economic consequences of erosion and sedimentation
- Risk (if either consequence or erosion potential is low, then so is the risk)
- Options for permanent cover