Erosion & Sediment Control from soils perspective

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Hanes Geo Components

Menomonee Falls WI

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,EQ COMPONENTS"

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solutions

- Ground stabilization
- Drainage Protection
- Erosion Control
- Sed ment Control
- S ope & Channel stabilzation
- s tonnwater Management
- Reinforcement
- Credit Appbation / Tax Exempt Forms
- Scourstop[111]
- Eco Trans" '

Locations

What do we start with?

- Keep existing disturbance to a minimum
- Phasing
- Erosion Control
  - Prevent soil movement establish vegetation
  - Erosion Mat
  - Hydromulch
- Sediment Control
  - Mechanical (sand)
  - Traps and Basins
  - Polymers (everything else)

Revised Universal Soil Loss Equation (RUSLE)

A = R K L S C P

A= average annual soil loss
R= rainfall-runoff erosivity factor
K= soil erodibility factor
LS= slope length and steepness factor
C= cover management factor
P= support practice factor

Soil Erodibility Factor

Generalized Soil Characte11istic	K	
High clay content	0.05 -0.15	resistance to detachment decreases erodibility
Course textured sandy soils	0.05 -0.2	even though these soils are easily detached they produce low runoff
Medium textured silt loam soils	0.25 -0.4	moderately susceptible to detachment and produce moderate runoff
High silt content	> 0.4	most erodible of all sons because they are easily detached; tend to crust and produce high rates of runoff

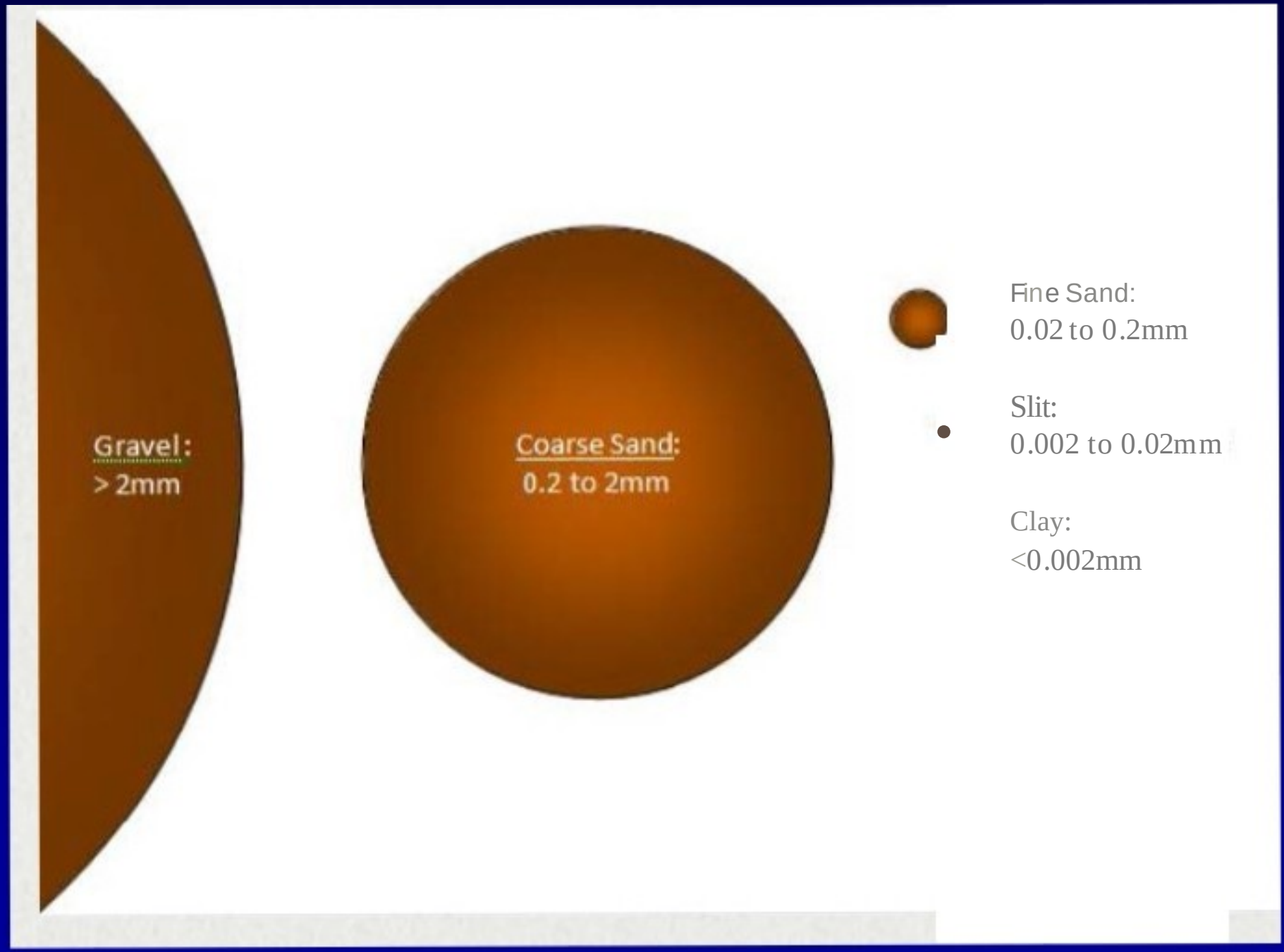
K values range from 0.02 to 0.69

Although a K factor was selected to represent a soil in its natural condition, past management or misuse of a soil by intensive cropping can increase a soil's erodibility.

The K factor may need to be increased if the subsoil is exposed or where the organic matter has been depleted, the soil's structure destroyed or soil compaction has reduced permeability.
From *Technical Guide to RUSLE use in Michigan*, NRCS-USDA State Office of Michigan.

Soils and Particle Size

.05 -2mm	62.5um – 212um
.002 -.05mm	3.9um – 62.5um
< .002mm	< 3.9um


Gravel:
> 2mm
Coarse Sand:
0.2 to 2mm
Fine Sand:
0.02 to 0.2mm
Slit:
0.002 to 0.02mm
Clay:
<0.002mm

Geotextiles

- Woven
  - Silt Fence (slit tape)
  - Monofilament (Type FF)
- Nonwoven
  - Dewatering Bags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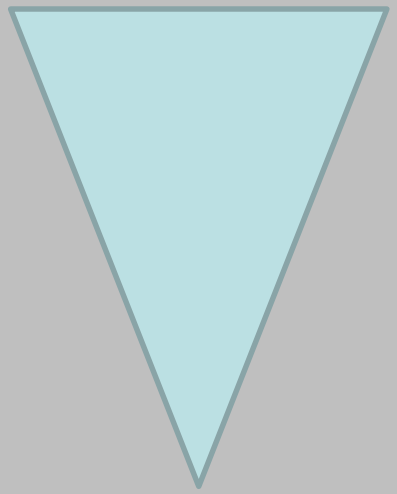
Sieve Designation		Nominal Sieve Opening	
Standard	Alternate	mm	inches
4.75 mm	No. 4	4.75	0.187"
4.0 mm	No. 5	4.00	0.157"
3.35 mm	No. 6	3.35	0.131"
2.80 mm	No. 7	2.80	0.131"
2.36 mm	No. 8	2.36	0.093"
2.00 mm	No. 10	2.00	0.078"
1.70 mm	No. 12	1.70	0.066"
1.40 mm	No. 14	1.40	0.055"
1.18 mm	No. 16	1.180	0.0464"
1.00 mm	No. 18	1.000	0.0393"
850 µm	No. 20	0.850	0.0334"
710 µm	No. 25	0.710	0.0279"
600 µm	No. 30	0.600	0.0236"
500 µm	No. 35	0.500	0.0196"
425 µm	No. 40	0.425	0.0167"
355 µm	No. 45	0.355	0.0139"
300 µm	No. 50	0.300	0.0118"
250 µm	No. 60	0.250	0.0098"
212 µm	No. 70	0.212	0.0083"
180 µm	No. 80	0.180	0.0070"
150 µm	No. 100	0.150	0.0059"
125 µm	No. 120	0.125	0.0049"
106 µm	No. 140	0.106	0.0041"
90 µm	No. 170	0.090	0.0035"
75 µm	No. 200	0.075	0.0029"
63 µm	No. 230	0.063	0.0024"
53 µm	No. 270	0.053	0.0020"
45 µm	No. 325	0.045	0.0017"
38 µm	No. 400	0.038	0.0015"
32 µm	No. 450	0.032	0.0012"
25 µm	No. 500	0.025	0.00098"

WOVENS

NONWOVENS

Silt & Clays



1–2 mm	0.039–0.079 in	Very coarse sand
½–1 mm	0.020–0.039 in	Coarse sand
¼–½ mm	0.010–0.020 in	Medium sand
125–250 µm	0.0049–0.010 in	Fine sand
62.5–125 µm	0.0025–0.0049 in	Very fine sand

Grab Tensile Strength, lb. ASTM D-4632 200 min.
Puncture Strength, lb. ASTM D-4833 105 min.
Apparent Breaking Elongation, ASTM D-4632 Machine 24% min.
Apparent Breaking Elongation, ASTM D-4632 Cross Direction, 10% min
Apparent Opening Size, µm ASTM D-4751 600 max.
Permittivity, s-1 ASTM D-4491 1.9 min.

628.2.6.1 Geotextile Fabric

TEST REQUIREMENT METHOD VALUE*[1]*

Minimum grab tensile strength ASTM D4632 120 lb (machine direction)

Minimum grab tensile strength ASTM D4632 100 lb (cross machine direction)

Maximum apparent opening size ASTM D4751 No. 30

Minimum Permittivity ASTM D4491 0.05 s-1 Minimum ultraviolet stability ASTM D4355 70%

1. Geotextile bags shall meet the criteria listed in Table 1.

Table 1: Properties for Geotextile Bags

Property	Test Method	Type I Value	Type II Value
Maximum Apparent Opening Sizes	ASTM D-4751	0.212 mm	0.212 mm
Grab Tensile Strength	ASTM D-4632	200 lbs.	300 lbs.
Mullen Burst	ASTM D-3786	350 psi	580 psi
Permeability	ASTM D-4491	0.28 cm/sec	0.2 cm/sec
Fabric	Nominal Representative Weight	8 oz	12 oz

2. Geotextile bags shall be sized according to the particle size being trapped, expected flow or pumping rate (gallons per minute) per square foot of fabric and a 50% clogging factor. The footprint of the bag shall be no smaller than 100 square feet.

Silt Fence

Woven Slit Film

Properties MARV[2]	ASTM TEST	UNIT	GTF 160SF	GTF 170SF	GTF 180SF/190SF	GTF 100	GTF 150	GTF 2008	GTF 200	GTF 250	OTF 270	GTF 300
MECHANICAL PROPERTIES												
Grab Tensile Stirengtth	04632	lbs (N)	80 (356)	90 (400)	123/101 (550/450)	150/100 (668/445)	150 (668)	180 (801)	200 (890)	250 (1110)	270 (1201)	315 (1401)
Elongation	04632	%	15	15	15	20/15	20/15	15	15	15	20/15	15
Trapezoid Tear	04533	lbs (N)	25 (111)	30 (133)	50 (222)	40 (178)	60 (267)	70 (312)	75 (334)	90 (400)	100 (445)	115 (512)
Puncture	04833	lbs (N)	NIA	*NIA*	60 (267)	60 (267)	70 (312)	80 (356)	100 (445)	100 (445)	120 (534)	150 (667)
CIBR Puncture	06241	lbs (N)	NIA	*NIA*	250 (1112)	350 (1558)	475 (2114)	550 (2448)	700 (3115)	900 (4005)	925 (4116)	1000 (4450)
Mullen Burst	03786	psi (kPa)	NIA	*NIA*	280 (1930)	*NIA*	N/A	305 (2103)	400 (2757)	500 (3447)	600 (4137)	630 (4343)
ENDURANCE PROPERTIEB												
UV Stabllity	04355	%@ 500 hlrs	80	80	80	80	80	80	80	80	80	80
HYDRAULIC PROPERTIES												
Permlttlvlty	04491	sec^{-1}	OJJ50	0050	0050	0080	0100	0.080	0080	0050	0050	0050
Water FlO'N Rate	04491	gpm/ft^2 (l/m ln lm2)	NIA	*NIA*	10 (407)	56 (228)	7.4 (302)	60 (244)	60 (244)	40 (163)	40 (163)	4.0 (163)
Permeabillty	D4491	(cm/sec)	0.010[T]	0.010[T]	0.010[T]	0.010[T]	0.010[T]	0.010[T]	0.010[T]	0.005[T]	0.005[T]	0.005[T]
Apparent Opening Size (AOS[3])	D4751	US Sieve Number (mm)	30 (0.600)	30 (0.600)	30 (0.600)	30 (0.600)	30 (0.600)	40 (0.425)	40 (0.425)	40 (0.425)	40 (0.425)	50 (0.300)

Properties MAR\12	ASTM TEST	UNIT	120EX	125EX	130EX	140EX	145EX			180EX	225EX	245EX	250EX	275EX	350EX
MECHANICAL PROPERTIES															
Grab Tensile Strength	04632	lbs (N)	80 (356)	90 (401)	105 (467)	120 (534)	140 (623)	165 (734)	180 (801)	205 (912)	215 (957)	250 (1112)	270 (1202)	300 (1335)	380 (1691)
Elongation	04632	%	50	50	50	50	50	50	50	50	50	50	50	50	50
Trapezoid Tear	04533	lbs (N)	35 (156)	40 (178)	45 (200)	50 (223)	60 (267)	65 (289)	75 (334)	80 (356)	85 (378)	100 (445)	100 (445)	115 (512)	145 (645)
Puncture	04833	lbs (N)	45 (200)	55 (245)	65 (289)	70 (312)	85 (378)	90 (401)	105 (467)	120 (534)	125 (556)	155 (690)	155 (690)	175 (779)	240 (1068)
CBR Puncture	06241	lbs (N)	220 (979)	265 (1179)	300 (1335)	340 (1513)	360 (1602)	400 (1780)	475 (2114)	535 (2380)	600 (2670)	700 (3115)	725 (3226)	830 (3694)	1050 (4673)
Mullen Burst	03786	psi (kPa)	160 (1103)	185 (1275)	210 (1448)	230 (1586)	280 (1930)	310 (2137)	330 (2275)	350 (2413)	360 (2482)	460 (3171)	460 (3171)	580 (3999)	750 (5171)
ENDURANCE PROPERTIES															
UV Stability	04355	% @500 hrs	70	70	70	70	70	70	70	70	70	70	70	70	70
HYDRAULIC PROPERTIES															
Permittivity	04491	sec-'	2.2	2.1	2.0	1.8	1.5	1.5	1.5	1.5	1.3	1.2	1.2	0.9	0.7
Water Flow Rate	04491	pm/ft^2 (l min/m2)	160 (6519)	155 (6315)	145 (5908)	135 (5501)	115 (4886)	110 (4482)	110 (4482)	110 (4482)	95 (3871)	85 (3463)	85 (3463)	65 (2648)	50 (2037)
Permeability	04491	cm/sec	0.22	0.22	0.22	0.22	0.22	0.25	0.25	0.30	0.30	0.25	0.25	0.20	0.20
Apparent Opening Size (AOS3}	04751	US Sieve Number (mm)	70 (0.212)	70 (0.212)	70 (0.212)	70 (0.212)	70 (0.212)	80 (0.180)	100 (0.150)	100 (0.150)	100 (0.150)	100 (0.150)	100 (0.150)	100 (0.150)	100 (0.150)

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WOVENS

NONWOVENS

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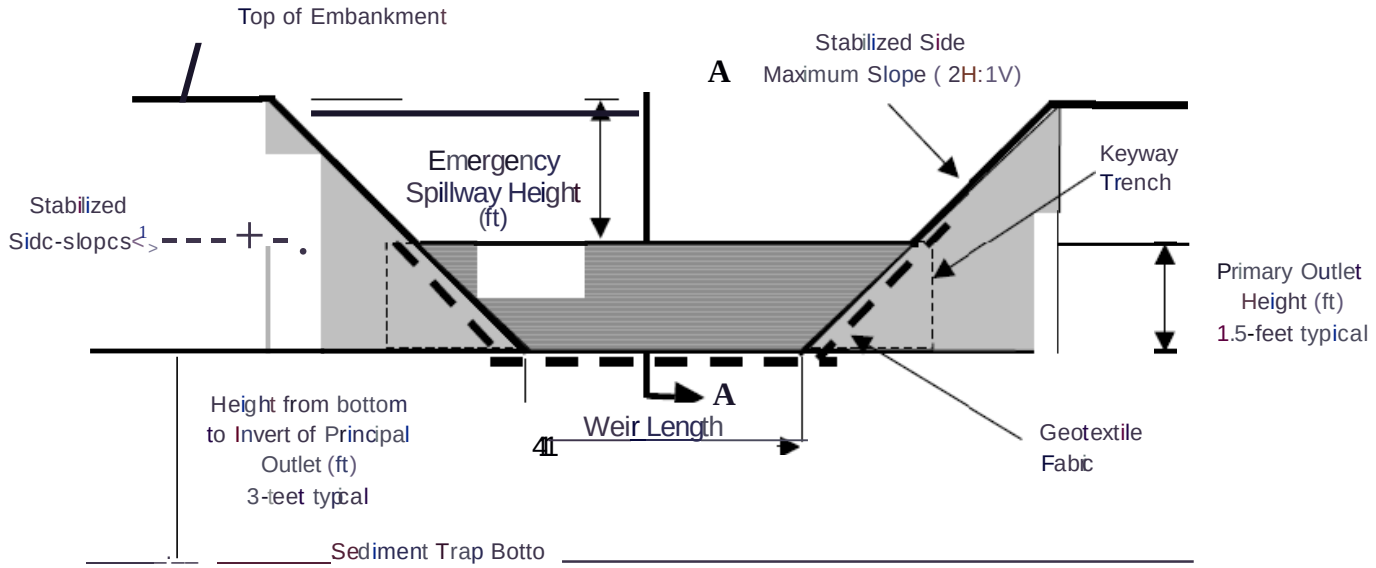
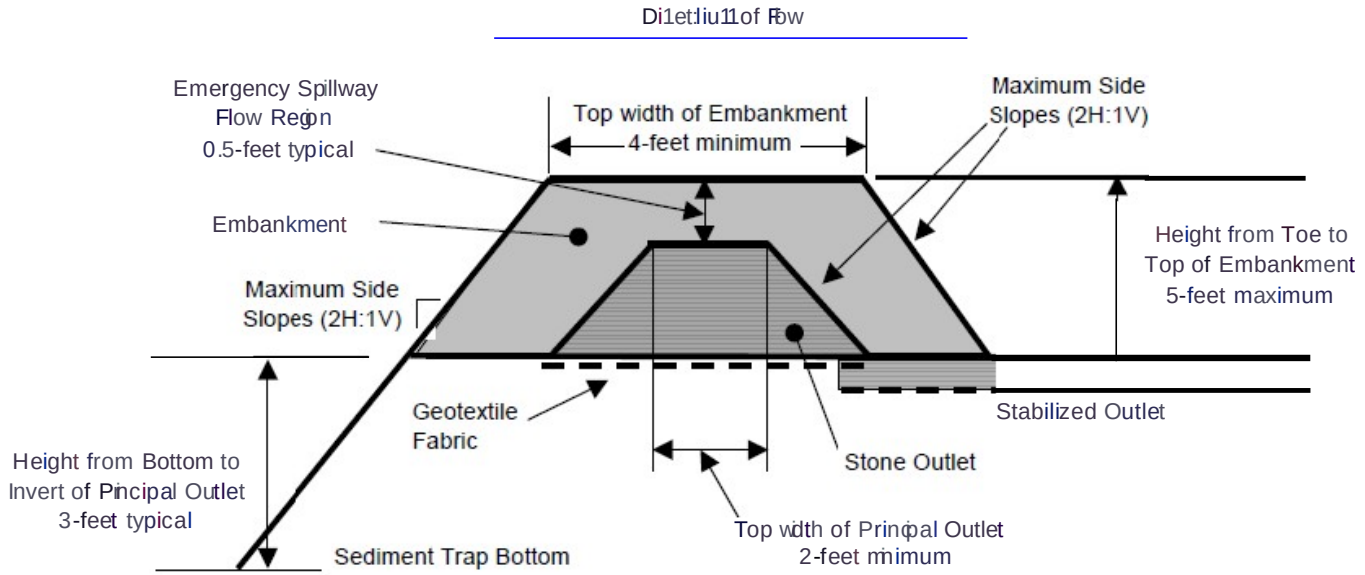
Sediment Trap Design and Soils

- Temporary sediment control device
- Drainage area 1-5 acres
- Intended to trap medium and coarse-grained particles
- Requires polymer or large surface area to trap fine-grained particles
- General form is 3-ft depression with embankment and stone weir, which detains runoff long enough for some sedimentation to occur
- WDNR Conservation Practice Standard 1063



Cross-section View of Principal Outlet

Notes: (1) Side-slopes and faces of earthen embankment around outlet shall be armored with riprap or stabilized with erosion mat sufficient to handle flows from the 10-year storm.



Sediment Trap Sizing Criteria

- Surface area is based on dominant textural class of soil entering device
- Design aimed at 80% TSS removal

Sediment Trap Sizing

- Formula is:

  Area of trap (sq. ft.) = C * Drainage area (acres), where

Soil Texture	Area Coefficient C (sq. ft. / ac.)
Coarse: Loamy sand, sandy loam, sand	625
Medium: Loams, silt loams, silt	1560
Fine: Sandy clay, silty clay, silty clay loam, clay loam, clay	5300

Polymers and Sediment Traps

- For fine-textured soils, may use polymer to reduce surface area. Refer to WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051)
- When employing polymers, size the surface area for controlling fine particles using the criteria for medium soils (1560) and when controlling medium sized particles use the criteria for coarse soils (625)
- For fine-textured soils, sediment basin may also be more-effective alternative (DNR Conservation Practice Standard Sediment Basin 1064)

Water-Applied Polymer Sources

- Water-applied polymer needs to be on the DNR approved list
- Request list from DNR staff - not available on DNR website
- 21 different products or delivery systems available from 8 vendors.
- Water-applied polymers not included on WDOT PAL

Sediment Trap Examples

- 2-acre site and watershed. No run-on. Topsoil completely stripped exposing loamy sand subsoil. Treatment is to keep sediment out of storm sewer and regional detention basin.
  - Sediment trap area = 625 * 2 ac. = 1,250 sq. ft.
- Subdivision where 5-acre subwatershed drains to sediment trap, used to treat diverted runoff, protecting infiltration prairie during establishment. Silt loam topsoil is disturbed during infrastructure and home construction.
  - Sediment trap area = 1560 * 5 ac. = 7,800 sq. ft.

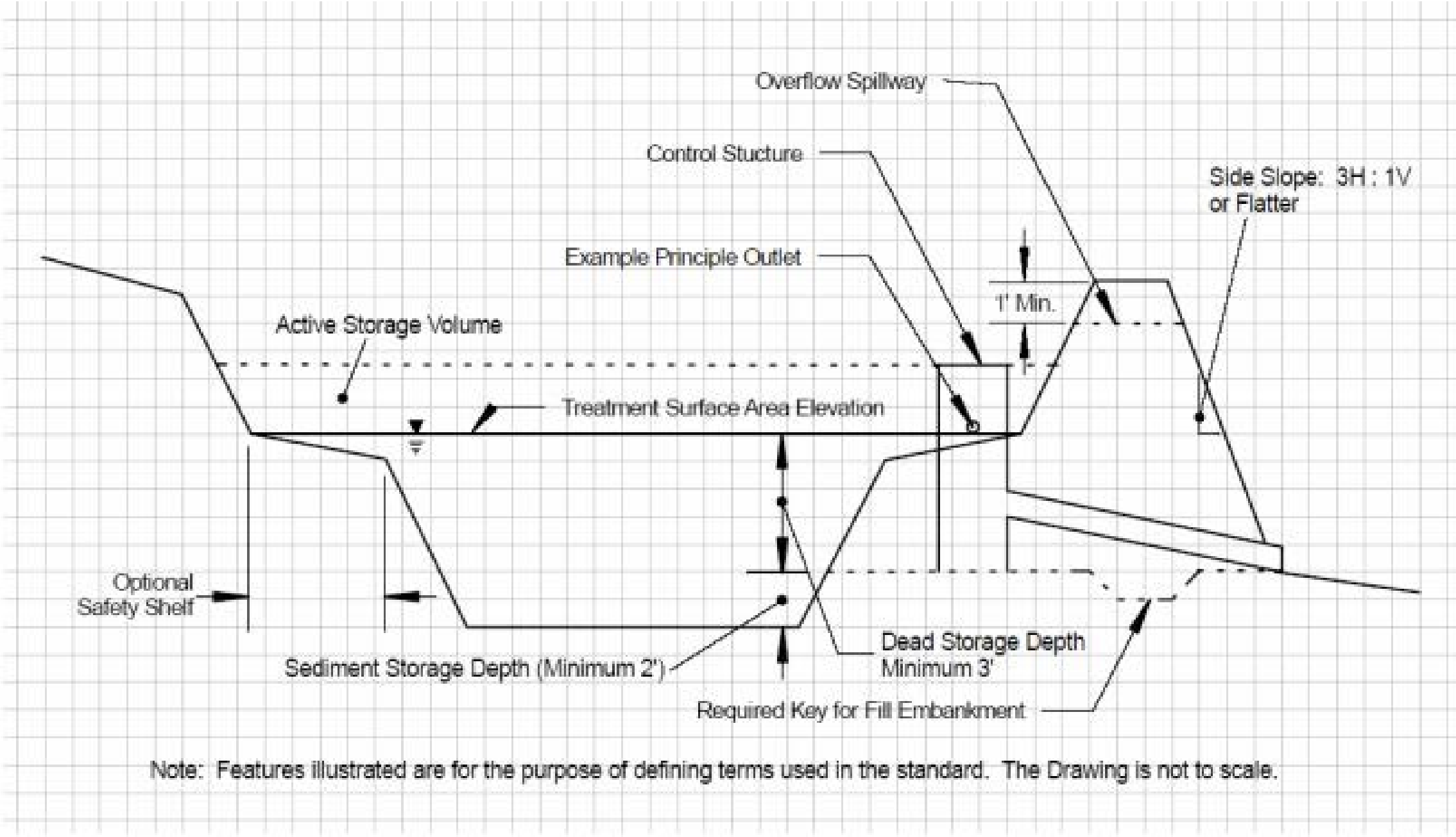
Sediment Trap Example

- 4-acre watershed in silty clay loam is disturbed.
  - Sediment trap area = 5,300 * 4 ac. = 21,200 sq. ft.
- However, this large a trap area is deemed infeasible, so water application of polymer is planned, reducing the size of the trap by 70%:
  - Sediment trap area = 1,560 * 4 ac. = 6,240 sq. ft.

Sediment Trap

Sediment Basin Design and Soils

- Temporary sediment control device. Often converted to wet detention basin for post-construction storm water management following construction (compare the sizes of the construction- and post-construction BMPs, and choose the larger)
- Drainage area 5-100 acres
- Intended to trap up to fine-grained particles
- General form is 5+ foot depression with outlet orifice(s) and emergency spillway
- WDNR Conservation Practice Standard 1064



Note: Features illustrated are for the purpose of defining terms used in the standard. The Drawing is not to scale.

Sediment Basin Sizing Criteria

- Surface area is based on dominant textural class of soil entering device, as well as the discharge rate
- Different from trap in that formula accounts for storage (via the discharge rate in the following formula), and not solely surface area
- Design aimed at 80% TSS removal

Sediment Basin Sizing Criteria

- Formula is

Surface area at outlet invert elevation (sq. ft.) = 1.2 * Outflow (cfs) / v_s

Where v_s is the particle setting velocity of the representative soil class, and

Soil Texture	V_s (ft / sec)
Coarse: Loamy sand, sandy loam, sand	$1.2 * 10^{-3}$
Medium: Loams, silt loams, silt	$7.3 * 10^{-5}$
Fine: Sandy clay, silty clay, silty clay loam, clay loam,	$1.2 * 10^{-5}$

Polymer Application and Soils

- Water application of polymers can be used to reduce the surface area of the basin, using the same process as with the trap.

Soil Texture	V_s (ft / sec)
Coarse: Loamy sand, sandy loam, sand	$1.2 * 10^{-3}$
Medium: Loams, silt loams, silt	$7.3 * 10^{-5}$
Fine: Sandy clay, silty clay, silty clay loam, clay loam, clay	$1.2 * 10^{-5}$

Sediment Basin Design Example

- Subdivision where 5-acre subwatershed drains to sediment basin, used to treat diverted runoff, protecting infiltration prairie during establishment. Silt loam topsoil is disturbed during infrastructure and home construction. TR55 model gives release rate of 0.5 cfs with 4-inch orifice in 1-yr 24-hr design storm
  - Sediment basin area = 1.2 * 0.5 cfs / ($7.3 * 10^{-5}$ ft/s) = 8,219 sq. ft.
- Adding polymer in the same scenario would reduce the required surface area dramatically
  - Sediment basin area = 1.2 * 0.5 cfs / ($1.2 * 10^{-3}$ ft/s) = 500 sq. ft.

Sediment Basin

1064

Dewatering issues

What type of fabric can be used to create dirty water into clear water?

What is the most effective way to treat a lot of dirty water?

POLYMERS

- The generic name for these products is PAM
- Anionic (-)
- WI DNR Std 1050 for Land application
  - Temporary short term fix
  - Dry or Wet
  - Plain (Soil stabilizer Type B)
  - Hydromulch (Soil stabilizer Type A)
- WI DNR Std 1051 for Water application
  - Silt and Clay
- Work best when used in conjunction with other BMP’s.

Polyacrylamides

Cationic (+)

- Used in closed systems due to toxicity
- Are positively charged and are therefore toxic to aquatic organisms. This occurs because is caused by an electrostatic interaction between the cationic polymer and anionic parts of the gill mucus.

Anionic Polyacrylamide

Anionic polyacrylamide has no systemic toxicity to aquatic organisms or microorganisms. The polymer is much too large to be absorbed into tissues and cells.

The functional anionic groups do not interfere with the functioning of fish gills or daphnia respirators.

Polyacrylamides

Anionic

polymers are negatively charged they will repel against the negative charge of the anionic parts of the gill mucus and will not be able to attach, suffocate, and kill the aquatic life.

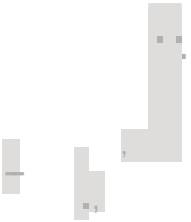
Anionic (-)

Safe to use in field applications

Use restriction

Before using Water Applied

- Toxicity report NOT MSDS
  - Report from EPA Lab
  - Site specific soil type
    - test lab or tailgate testing.



QUESTIONS

Thank you!