Dirt Gravel and Low Volume Road Program

Estimating Quantities and Costs

WEBINAR

2/16/23

Starts 9am

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Estimating Quantities & Costs

Purpose: To share ideas for estimating materials, to generate projected costs for DGLVR projects

Recommended procedure:

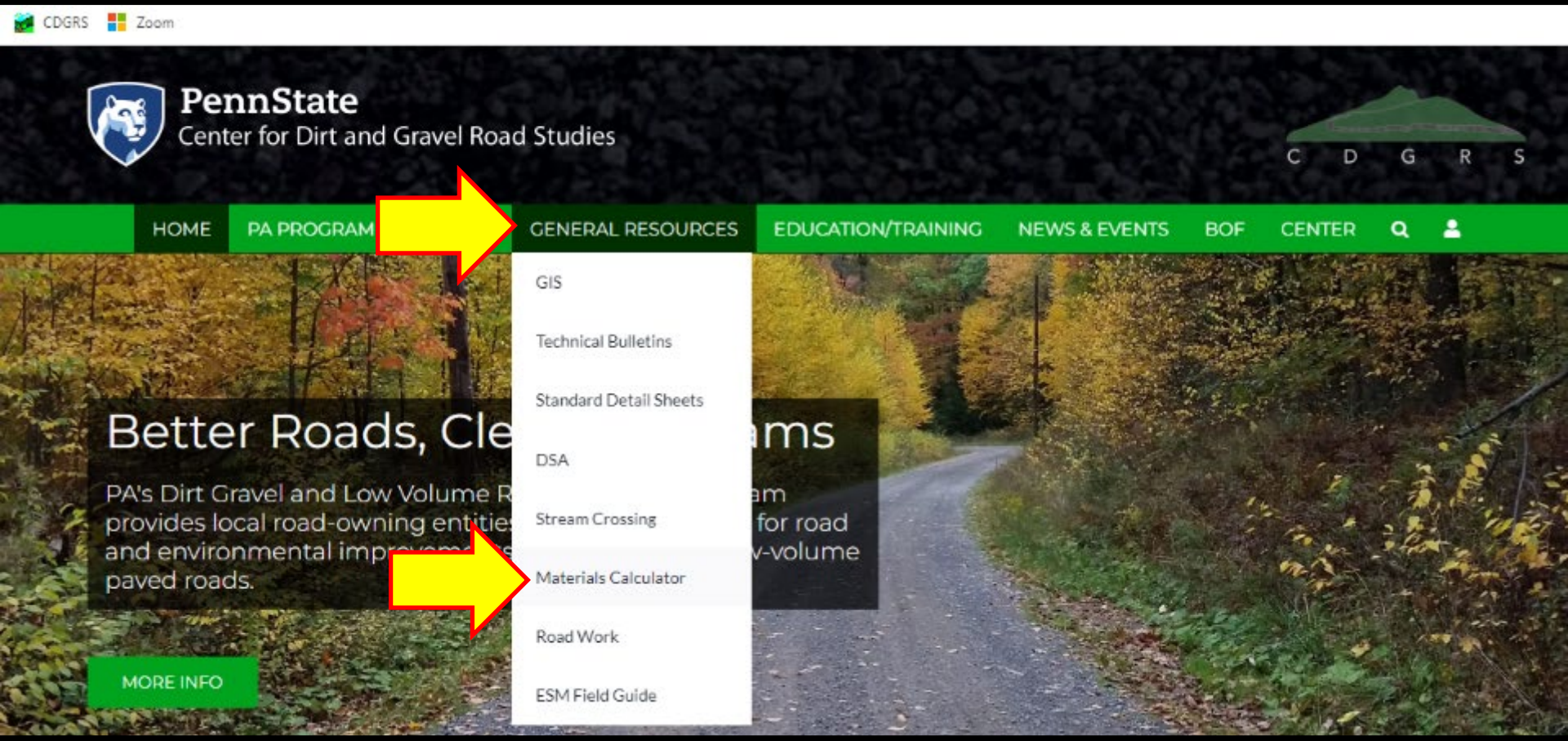
1. Determine road plan and the practices included
2. Determine needed quantities for each practice
3. Itemize and combine quantities for the plan

We will cover:

- Material quantities for common ESM practices
- Commonly overlooked items

Estimating Quantities & Costs

DGLVR Materials Calculator



Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- Road Fill/Road Base
- Crosspipe/Storm Sewer Installation
- Subsurface Drainage
- Driving Surface Aggregate
- Stream Crossing Replacement

Estimating Quantities & Costs

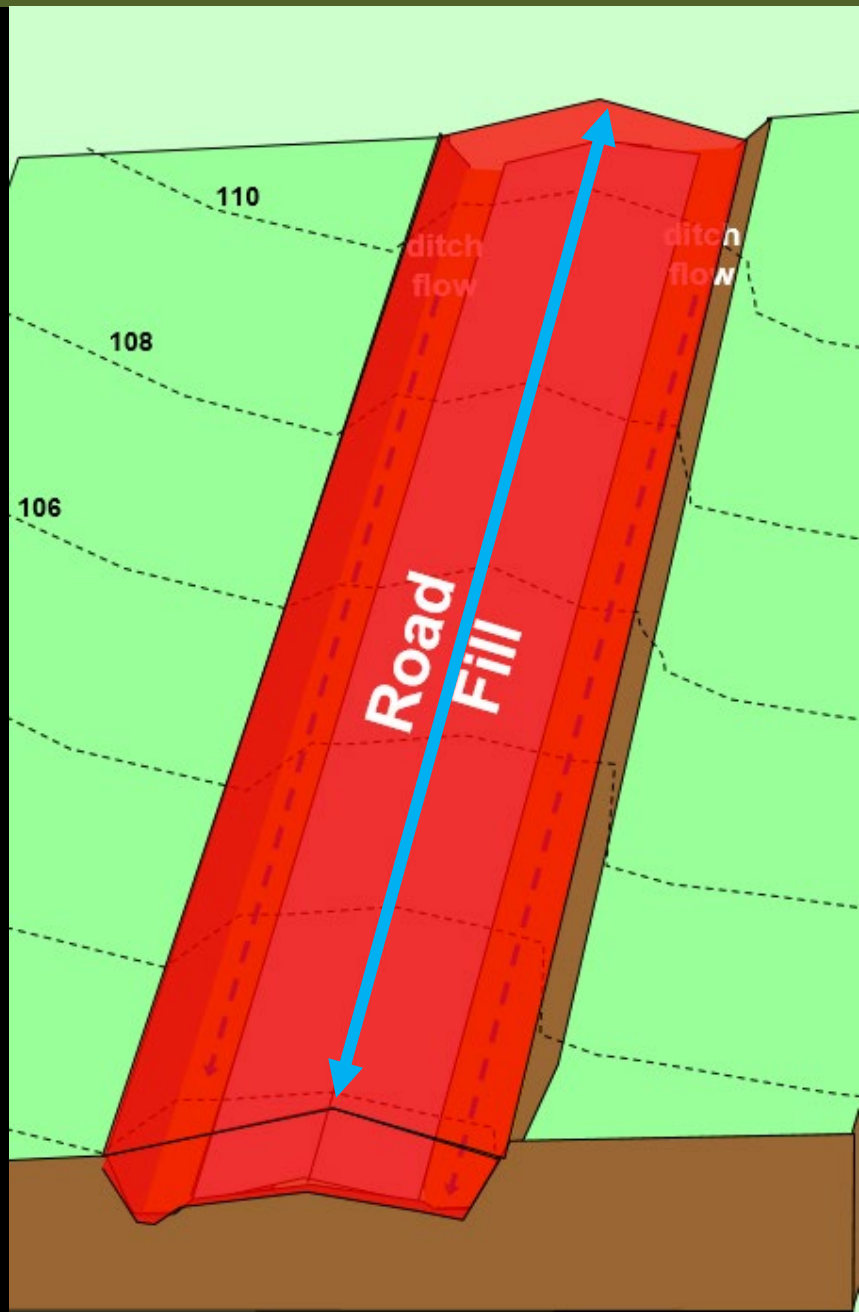
Estimating material quantities for ESM practices:

- **Road Fill/Road Base**

Estimating Quantities & Costs

Data to collect in the field for road fill estimates

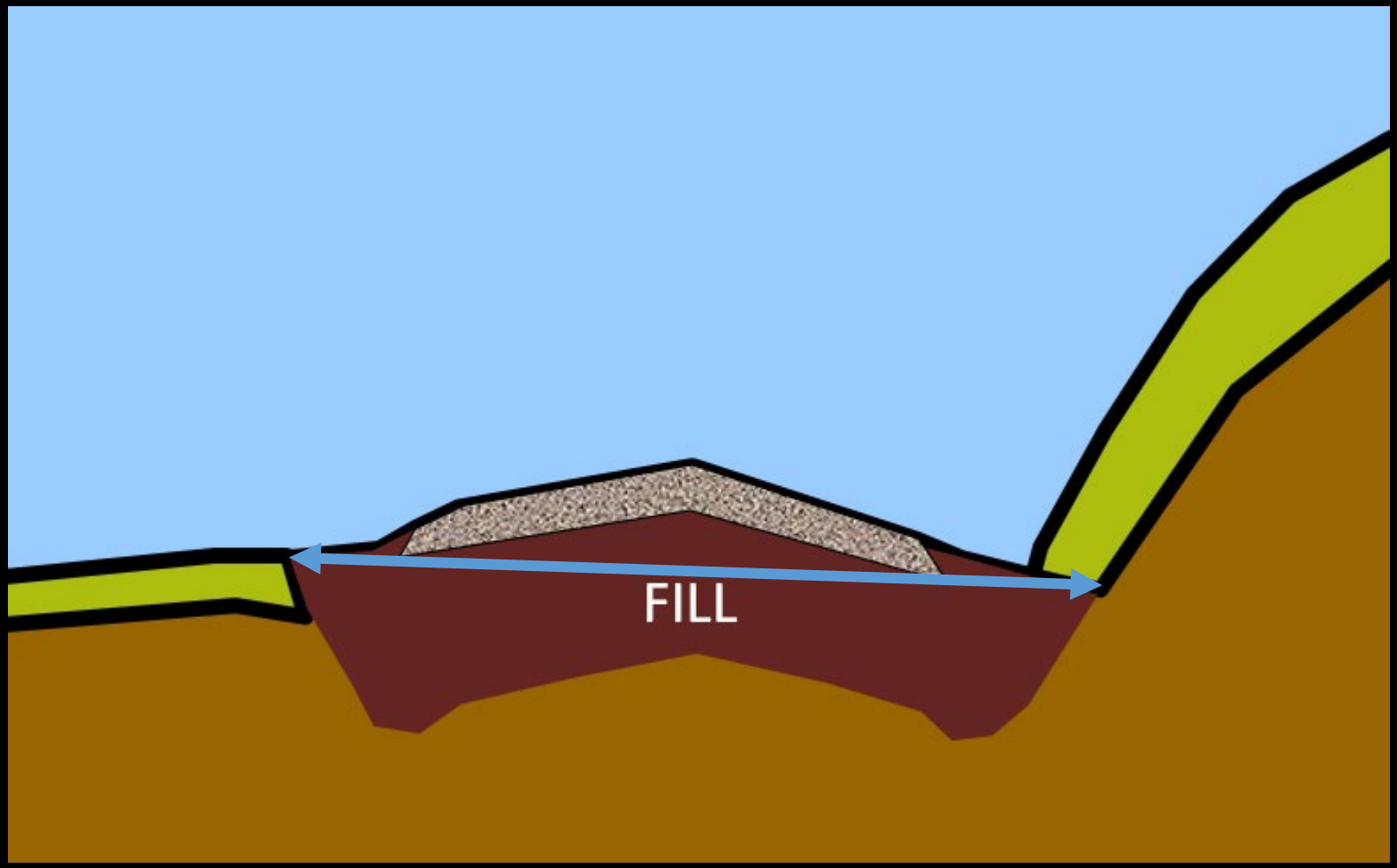
- **Measure Fill Length at road centerline**



Estimating Quantities & Costs

Data to collect in the field for road fill estimates

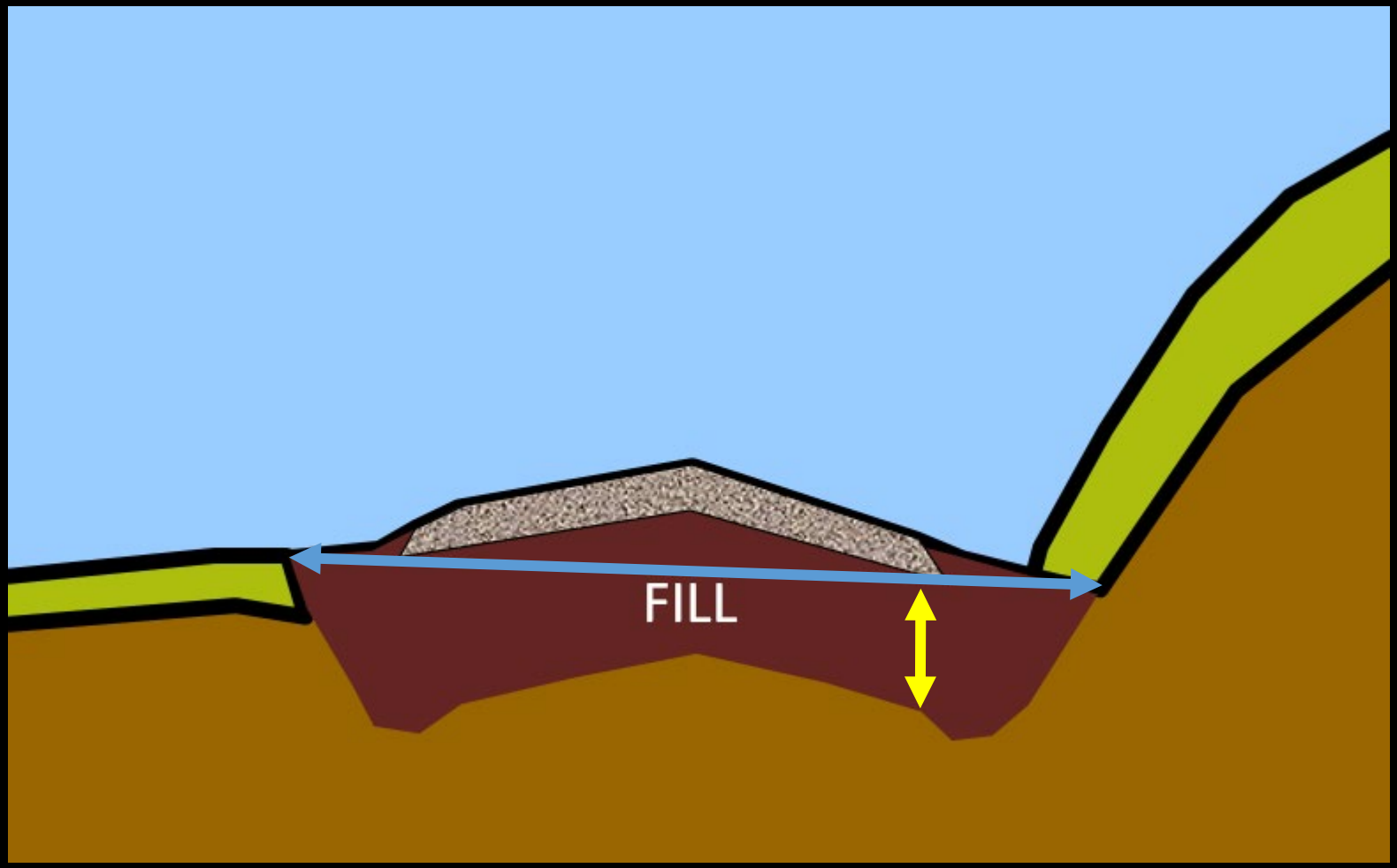
- **Measure Fill Width at the top of bank**



Estimating Quantities & Costs

Data to collect in the field for road fill estimates

- **Measure Fill Depth at road shoulder**



Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Full Fill Option (for sectional fill break into segments)**

  Length x Width x Depth in feet = cubic feet of **compacted** material required (***in place***)

  Cubic feet ÷ 27 = cubic yards required (***in place***)

  Cubic yards x 1.33 = cubic yards of **uncompacted** material required (***as shipped***)

  Cubic yards of uncompacted material x 1.5 = tonnage of material required (***as shipped***)

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

Example fill calculation

1,400’ long project: 900’ needs 2.5’ of fill and 500’ needs 1’ of fill

Calculate for 2.5’ fill segment:

- 900’ L x 25’ W x 30”(2.5’) D = 56,250 ft^3
- 56,250 ft^3 ÷ 27 = 2,083 yd^3 **compacted fill**
- 2,083 yd^3 x 1.33 = 2,770 yd^3 **loose fill required**
- 2,770 yd^3 x 1.5 = **4155 tons required** for 900’

But, there is a simpler way to do this…..

Estimating Quantities & Costs

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Example Road Fill
- 900’ long
- 25’ wide
- 30” deep
- shale
- $ 9/ton

For the 2.5’ fill stretch

Length: 900 feet

Width: 25 feet

Depth: 30 inches

Compaction: ○ Loose ◉ Compacted

Compacted Percentage: 25 %

Material: Shale

Tonnage per cubic yard: 1.50 tons

Price per ton (optional): $ 9

CALCULATE

Results

Estimated cubic yards of material needed (loose):

2,777.78 yd^3

Estimated tons of material needed (loose/as shipped):

4,166.67

Estimated total material cost:

$37,500.00

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

Example fill calculation

1,400’ long project: 900’ needs 2.5’ of fill and 500’ needs 1’ of fill

Calculate for 1’ fill segment:

- 500’ L x 25’ W x 12”(1’) D = 12,500 ft^3
- 12,500 ft^3 ÷ 27 = 463 yd^3 **compacted fill**
- 463 yd^3 x 1.33 = 616 yd^3 **loose fill required**
- 616 yd^3 x 1.5 = **924 tons required** for 500’

Estimating Quantities & Costs

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Example Road Fill
- 500’ long
- 25’ wide
- 12” deep
- shale
- $ 9/ton

For the 1’ fill stretch

Length: 500 feet

Width: 25 feet

Depth: 12 inches

Compaction: ○ Loose ◉ Compacted

Compacted Percentage: 25 %

Material: Shale

Tonnage per cubic yard: 1.50 tons

Price per ton (optional): $ 9

CALCULATE

Results

Estimated cubic yards of material needed (loose):

617.28 yd^3

Estimated tons of material needed (loose/as shipped):

925.93

Estimated total material cost:

$8,333.33

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

Example fill calculation

Add together segments for entire project:

- 900’ at 30”(2.5’) D = 4,167 tons or 2,778 yd^3
- 500’ at 12”(1’) D = 926 tons or 617 yd^3

Total fill amount required for project (***as shipped***):

5,093 tons or 3,395 yd^3

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Good things to know -**
  - A tri-axle truck hauls ~14 yd^3 or 21 tons of fill
  - The previous example will require approx. 243 tri-axle truck deliveries to the project site
  - Shale/bank-run often priced by the truck load (use total $yd^3 \div 14$ to figure truck loads)
  - Don't discount total fill volume for pipes, French Mattresses, underdrains, etc.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Fill for Base Enhancement**

  Calculated the same as Full Fill Option, but…

  fill width is the road width, including shoulders, **not bank to bank**.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- Road Fill/Road Base
- Crosspipe/Storm Sewer Installation
- Subsurface Drainage
- Driving Surface Aggregate
- Stream Crossing Replacement

Estimating Quantities & Costs

Data to collect in the field for pipe estimates

- **Crosspipe/Storm Sewer Information**

  Collect Info for:

  - Length of pipe needed by pipe diameter
  - Each pipe length can vary by desired inlet and outlet locations (keep lengths to 10’ intervals)
  - Number of drop inlets/junction boxes needed
  - Need for and size of outlet protection
  - If pipes will be shallow or standard installation
  - Shallow crosspipes need more fill per pipe

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe/Storm Sewer Pipe Quantity**

  For quantity of pipe:

  - Take the total length of each diameter pipe needed ÷ 20 = # of sticks for each diameter
  - For collared pipe, the number of joints = number of collars needed

  Consider pipe angle when calculating the length of pipe needed. Round individual pipe lengths to nearest 10'. Half sticks are usable, smaller are not.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe bedding and cover needs**

  For typical 15” and 18” pipes:

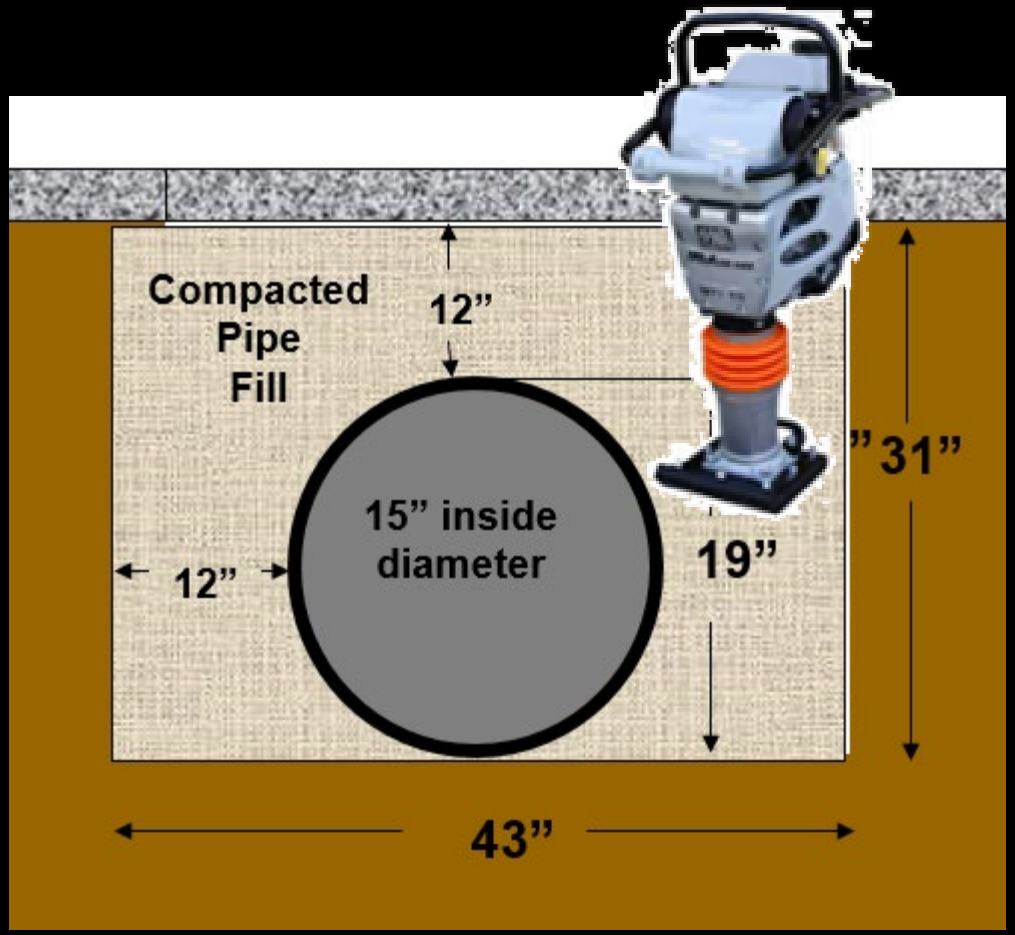
  - Combine total length of 15” and 18” pipe = total length of trench in feet
  - Default to 3.5’ width for pipe trench
  - Use 3’ for trench depth to ensure minimum 12” pipe cover

  - Total trench length x 3.5 x 3 = the volume of pipe backfill needed (solve for tons as with road fill or use Materials Calculator)…

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe bedding and cover needs**



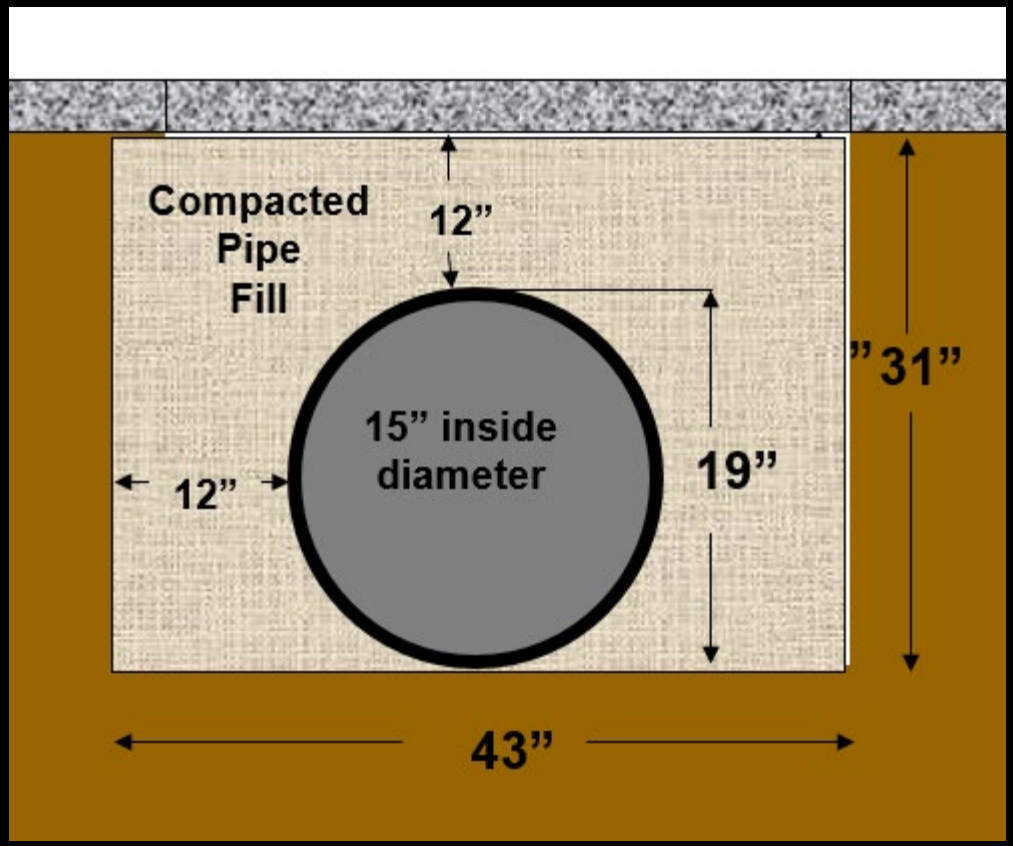
Why this wide and deep you ask?

- Jumping Jack has 8” wide foot
- 15” pipe has 19” ID
- 18” pipe has 22” ID
- Crush protection for pipes prior to surfacing

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe bedding and cover needs**



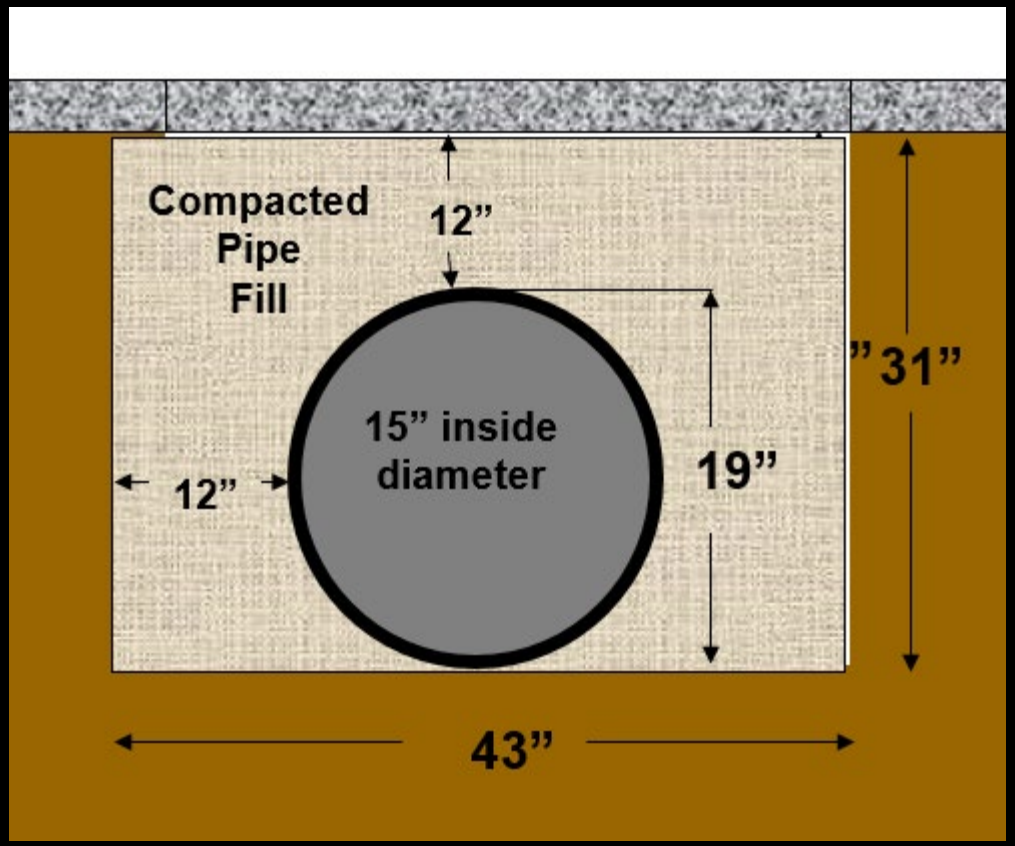
Do not discount for the volume displaced by the pipe. Any extra fill will help to smooth in trench edges.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe bedding and cover needs**

Thumb rule for pipe bedding on standard crosspipes:
Calculate for uncompacted material



240’ of 15” pipe in plan x 3.5’ wide trench x 3’ deep trench = 2,520 ft^3 ÷ 27 = 93 yd^3 x 1.5 (basic conversion factor) = approx. 140 tons (approx. 6.5 tri-axle loads)

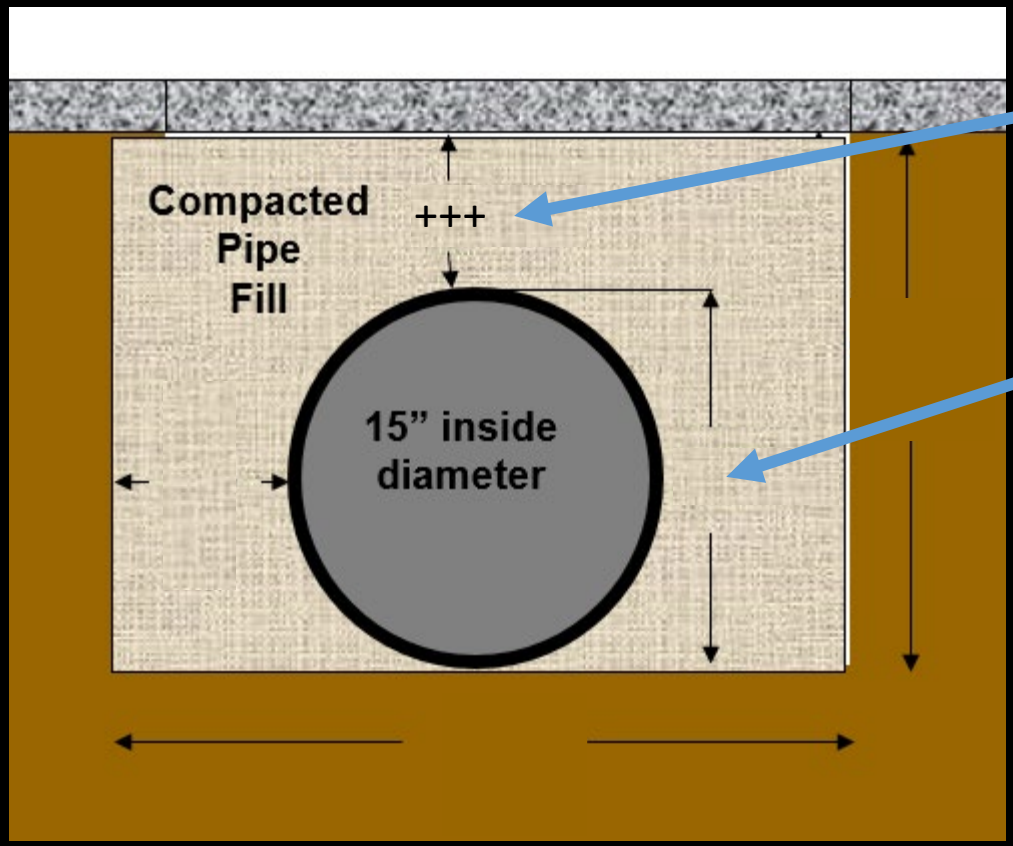
OR

1/2 tri-axle load of fill for each 20’ stick of 15” or 18” pipe used is close enough for small jobs and government work.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Specific to Replacement Crosspipes and Storm Sewer bedding**



Storm sewers and existing deep pipe installations may require greater fill volumes, depending on depth and municipal regulations.

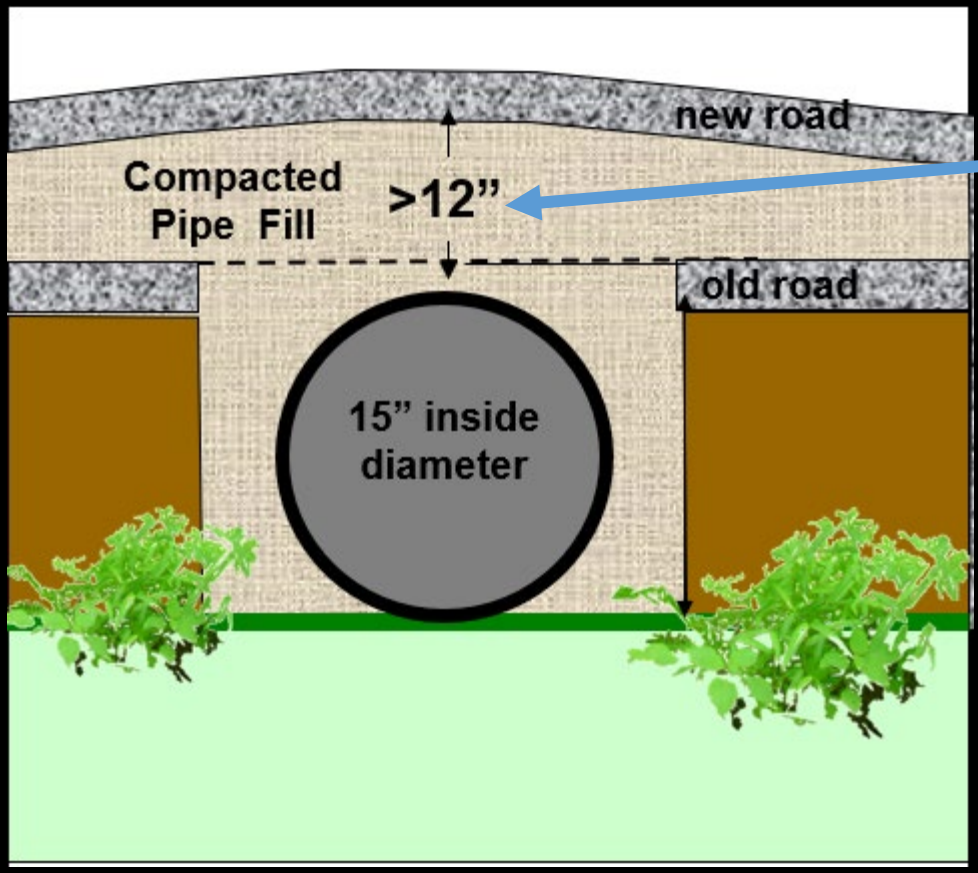
Take field measurements to accurately account for the fill needs of these structures.

Do not discount for the volume displaced by the pipe.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Specific to Shallow Crosspipes with associated grade breaks**



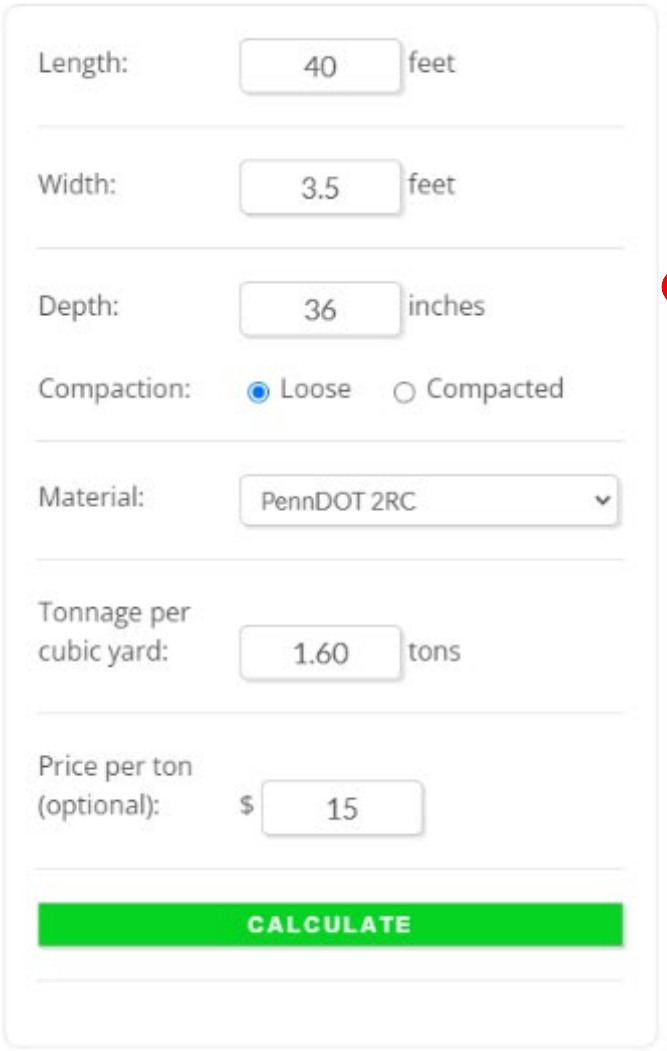
Shallow pipes gain cover by importing material and raising the road over the pipe.
The actual amount of needed fill will depend on road width and the taper into the road surface in each direction. This should be determined in the field. But a thumb rule of Two tri-axle loads of aggregate for each shallow crosspipe works well for estimating.

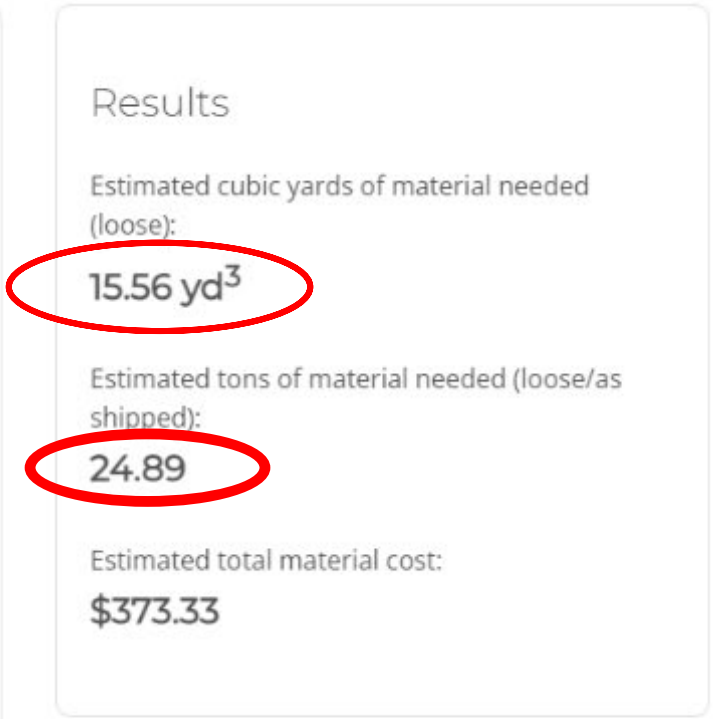
Estimating Quantities & Costs

Example Pipe Bedding
- 40’ long
- 3.5’ wide
- 36” deep
- 2RC
- $15/ton

If you like math, you can use your hand calculator. Or…

You can use the Materials Calculator





For small jobs with ≤ 10 pipes, the thumb rule of ½ truckload per 20’ stick will get you close <u>for standard pipe installations</u>

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe/Storm Sewer inlet/outlet protection**

  Headwalls, endwalls, bank walls and scour aprons:

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe/Storm Sewer headwalls/bank walls**
  - A typical pallet of wall stone is one cubic yard and weighs 1 ½ tons.
  - **Four typical pipe walls can be built out of each pallet of wall stone**.
  - The rule above is for 15” & 18” crosspipes. Larger drainpipes and stream culverts need more stone.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe/Storm Sewer precast inlets & outlets**
  - If you use drop inlets on crosspipes, you must still account for endwalls.
  - Figure inlet numbers and any needed junctions.
  - Note that inlet grates are sold separately.
  - Headwalls and endwalls constructed of materials other than natural stone (i.e., pre-cast blocks, poured in-place concrete, pre-cast headwalls, etc.) require site specific estimates. Consult local suppliers.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Crosspipe/Storm Sewer outlet scour protection**
  - The need for scour protection aprons is typically a judgement call based on anticipated flow, soil stability, and steepness at the outlet.
  - The size of the apron is also a judgement call.
  - R-4 & R-5 riprap over geofabric is commonly used.
  - For tons of rip-rap required multiply the apron length x width x depth (1.5’ for R-4 and 2’ for R-5) ÷ 27 to get yd^3 x 1.4 = tons to order.
    Or plug figures into the Materials Calculator…

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- Road Fill/Road Base
- Crosspipe/Storm Sewer Installation
- Subsurface Drainage
- Driving Surface Aggregate
- Stream Crossing Replacement

Estimating Quantities & Costs

Field data to get for subsurface drainage practices

- Length, width, and depth of the underdrain or French Mattress.
- The above is determined by site conditions:
  - For underdrain ask what is peak flow anticipated, consider number of outlets and physical site constrictions
  - For Mattresses account for desired road width, road elevation, base stability, embedded pipes

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

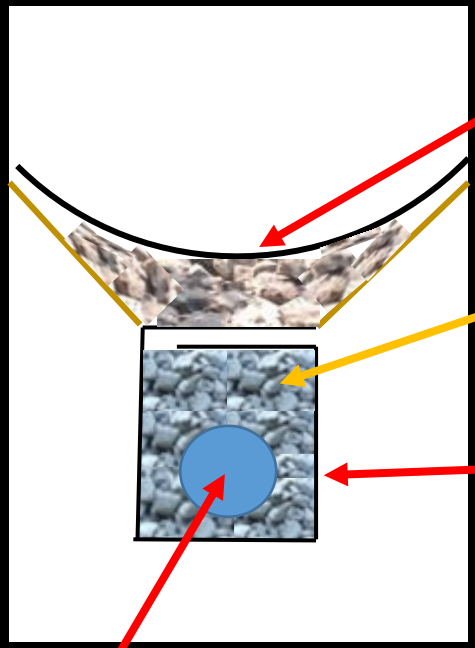
- **Underdrain design/estimating considerations**
  - Perforated flexible pipe is available in rolls or more rigid sections in different diameters. Estimate required amount by the linear foot.
  - AASHTO 1 stone recommended for subsurface drainage applications.
  - Non-woven separation fabric is recommended for subsurface drainage applications.
  - Separation fabric for constructed underdrain requires a double layer on the top.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Underdrain design/estimating considerations**

Example of underdrain material estimation:



Factor a minimum of 1' of cover over underdrain
(R-4 or AASHTO 1 often recommended)
Length' x 2X the UD Width' x 1' ÷ 27 x 1.4 = ~tons

Calculate rock needs per method for crosspipe fill
(disregard the pipe displacement)

Determine geotextile needs by:
Length x 3X Width x 2X Depth = ft^2 required
(5,400 ft^2 or 600 yd^2 per roll)

Determine pipe diameter desired and length required

Estimating Quantities & Costs

Example Underdrain
- 150’ long
- 1.5’ wide
- 18” deep
- AASHTO #1
- $22/ton

Length: 150 feet

Width: 1.5 feet

Depth: 18 inches

Compaction: ○ Loose ◉ Compacted

Compacted Percentage: 0 %

Material: AASHTO 1 (PennDOT 4) 1.4

Tonnage per cubic yard: 1.40 tons

Price per ton (optional): $ 22

CALCULATE

Results

Estimated cubic yards of material needed (loose):

12.50 yd^3

Estimated tons of material needed (loose/as shipped):

17.50

Estimated total material cost:

$385.00

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **French Mattress estimating considerations**

Example of French Mattress material estimation:

Remember to factor in 1’ of compacted cover over Mattress. Don’t cover inlet/outlet of mattress.

Calculate rock needs by:
Length’ x Width’ x Depth’ = ft^3 ÷ 27 = yd^3 required
X 1.4 = tonnage required

Determine geotextile needs by:
2X Length’ x 2X Width’ (accounts for top and bottom) x 2X Depth’ (accounts for each end) + 2X Length’ if linear overlap is required, and 1X Width’ for each lateral overlap required = ft^2 required
*(*rolls come in 12.5’ x 432’, 15’ x 360’, 17.5 x 308’)*

Determine length of mattress (specified linear distance in the road)

Estimating Quantities & Costs

Example French Mattress

- 100’ long
- 22’ wide
- 12” deep
- AASHTO #1
- $22/ton

Length: 100 feet

Width: 22 feet

Depth: 12 inches

Compaction: ○ Loose ◉ Compacted

Compacted Percentage: 0 %

Material: AASHTO 1 (PennDOT 4) 1.4

Tonnage per cubic yard: 1.40 tons

Price per ton (optional): $ 22

CALCULATE

Results

Estimated cubic yards of material needed (loose):

81.48 yd^3

Estimated tons of material needed (loose/as shipped):

114.07

Estimated total material cost:

$2,509.63

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- Road Fill/Road Base
- Crosspipe/Storm Sewer Installation
- Subsurface Drainage
- Driving Surface Aggregate
- Stream Crossing Replacement

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Driving Surface Aggregate**

DSA estimates are generally calculated on a cost per ton in-place. This figure includes the cost of material, hauling to site, paver placement, compaction, and traffic control.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Driving Surface Aggregate**

DSA Tonnage Estimation

4 ½” compacted lift (6” loose): **L’ x W’ x .030 = tons**

6” compacted lift (8” loose) use: **L’ x W’ x .040 = tons**

Estimating Quantities & Costs

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Example DSA
- 3,500’ long
- 18’ wide
- 6” deep (loose)
- DSA
- $38/ton

Length: 3500 feet

Width: 18 feet

Depth: 6 inches

Compaction: (•) Loose ( ) Compacted

Material: DSA

Tonnage per cubic yard: 1.65 tons

Price per ton (optional): $ 38

CALCULATE

Results

Estimated cubic yards of material needed (loose):

1,166.67 yd^3

Estimated tons of material needed (loose/as shipped):

1,925.00

Estimated total material cost:

$73,150.00

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **DSA pre-placement considerations**

  Road base preparation is often overlooked on jobs with DSA placement. The road base must be graded to reflect the finished road shape desired. This may require supplemental road base material to be included in the plan.

  Anytime a grant application includes only DSA, further investigation is warranted. Few project sites won't benefit from drainage, base improvements, and other ESMs prior to DSA paving.

  "You've got to bake the cake before you can ice it!"

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- Road Fill/Road Base
- Crosspipe/Storm Sewer Installation
- Subsurface Drainage
- Driving Surface Aggregate
- Stream Crossing Replacement

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacement**

Comprehensive Projects:

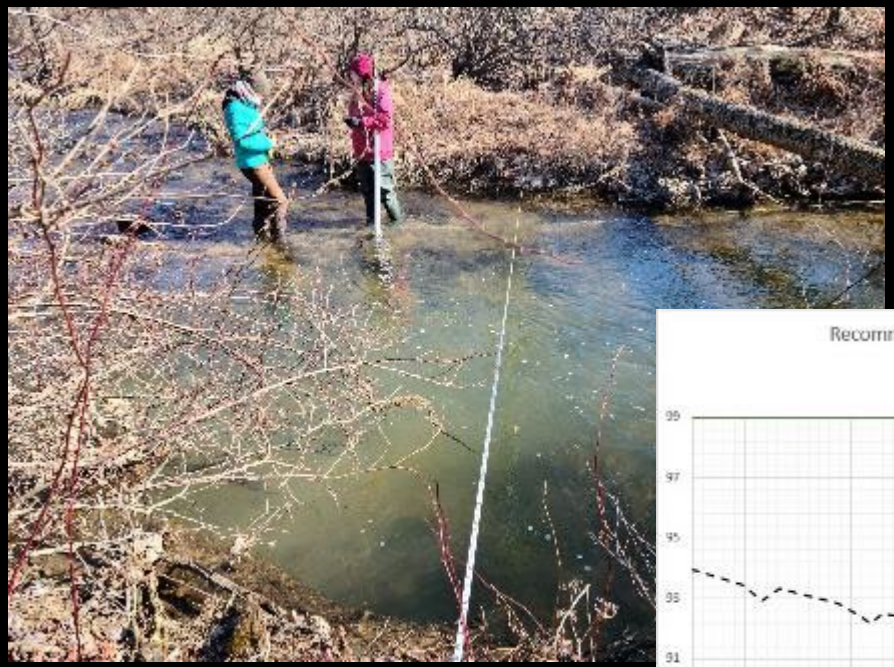
- Replacement Structure
  - Structure
  - Foundation (Bedding)
  - Footings (if bottomless)
  - Backfill
- Instream Restoration
  - Streambed material
  - Grade Control features
  - Bank Margins
  - Bank Stabilization
- Roadway
  - Road base
  - Surfacing
  - Drainage, etc.

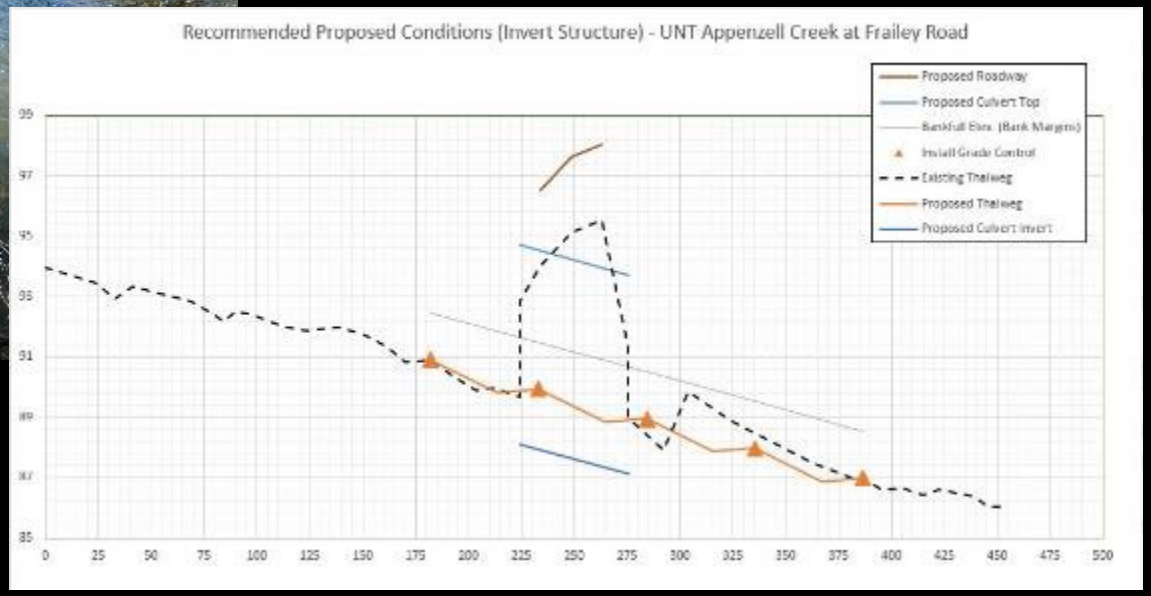
Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacement**

The Site Assessment Tool is your most valuable resource!





Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure**

- First must allow for:
  - bankfull channel width
  - properly-sized (stable) bank margins
  - adequate bury depth
  - Q100 / 80% rule.
- After these are met:
  - cannot be less than 125% bankfull width at bank margin elevation.

- Use Site Assessment Tool to predict a suitable structure size

- **With Your Applicant:**
- Discuss pros / cons of invert vs. bottomless vs. bridge options
- Agree on a preferred structure type and size for the grant application
- Slope >4.0% or width >20' is bottomless

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure**

- **Cost estimate**
  - Use a recent quote – similar type/size
    - ($ per linear foot)
  - Contact the vendor
    - Lane Enterprises
    - Contech Engineered Solutions

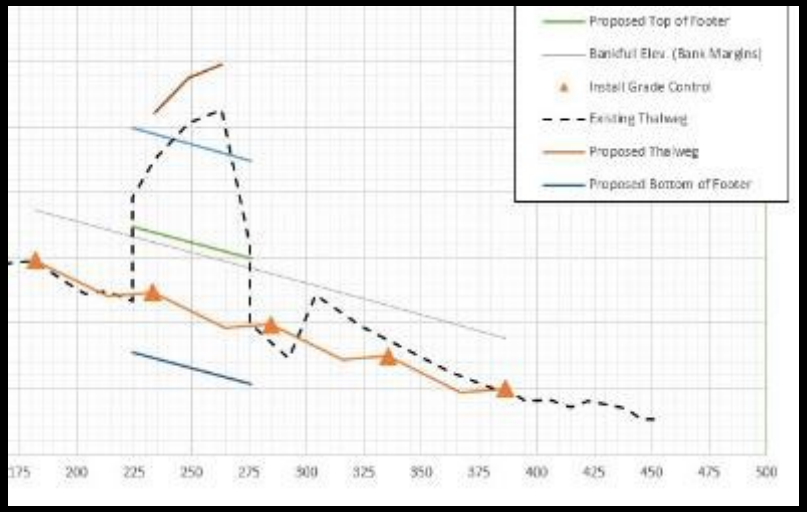
- **Full invert structure** – only need a quote for the structure (delivered)

- **Bottomless structure** – need a quote for the structure and for footings
  - Pre-cast
  - Pour-in-place
  - Express footer
- Contact a local concrete supplier for pricing
- Structure vendor or applicant may be able to help

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure - Footings**



- **Use the Site Assessment Tool!**

- On "Bottomless Recommendations" tab:
  - Provides footer height
  - Assume a footer width (Width)
  - Use Proposed Structure Length (Length)
  - Volume = H x W x L

52		ST	Bottom of Footer Elev.	Top of Footer Elev.	Culvert Top Elev.
53	Recommended structure inlet (ft)	224	88.11	91.96	94.96
54	Recommended structure outlet (ft)	276	87.11	90.96	93.96
55					

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

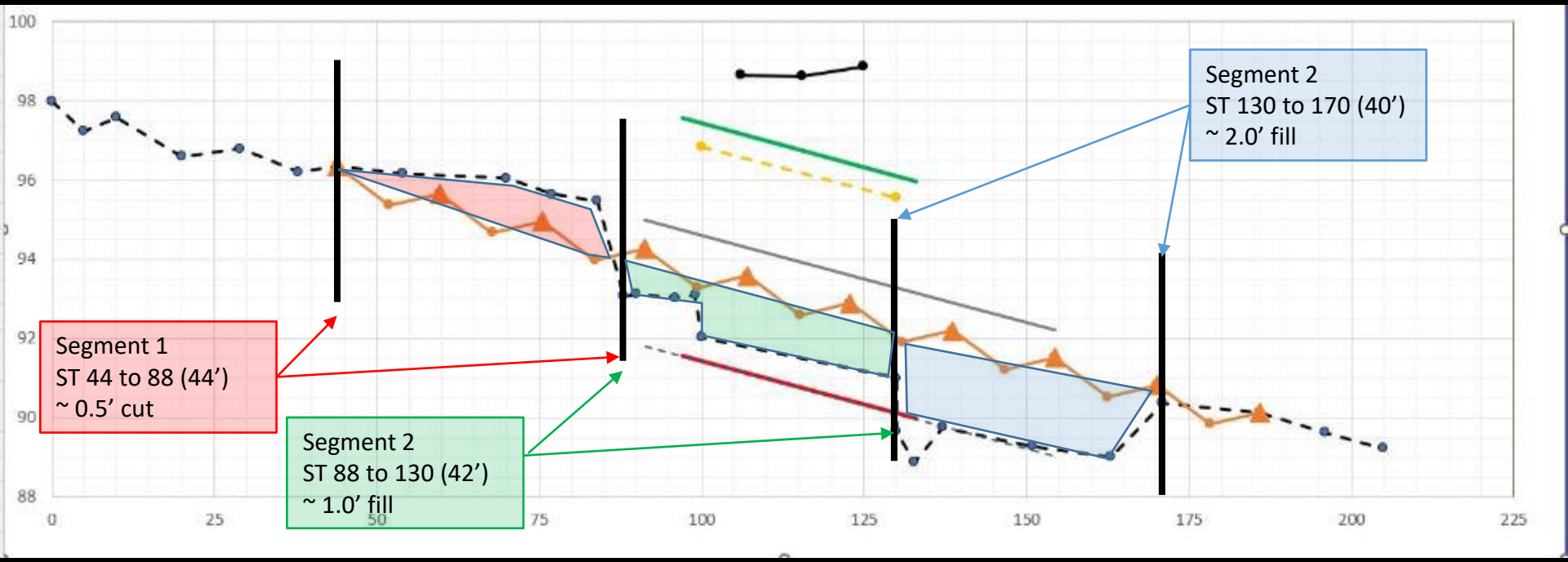
- **Stream Crossing Structure – Foundation / Bedding**

- Typically a 2”-minus stone
  - 2A Modified, or 2RC (where available)
- For a full invert structure
  - Width = Structure width + 6’ (3’ on each side)
  - Length = Structure length
  - Depth = 6” (0.5’)
  - Use the materials calculator to determine volume (W x L x D)
- For bottomless structure
  - Width = 3’ (assumed for base of footing)
  - Length = Structure length
  - Depth = 8” (0.67’)
  - Volume x 2 (two footings)

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure – Streambed Material**
- **How Much Material Do I Need?**
  - Use the Site Assessment Tool (either of the Recommendations graphs)
  - Determine length of reconstructed reach
  - If depths vary significantly, break the reconstructed reach into segments (Length)
  - Estimate an average depth of fill required for each segment (Depth)



Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure – Streambed Material**

How Much Material Do I Need?

- Assume channel will be reconstructed to the bankfull width (Width)
- Use (Length) and average fill (Depth) from each segment
  - Remember the Scour Pool cross-section
- Use the materials calculator (V = W x L x D)

What Material Do I Need?

- Pebble counts give the most reliable basis
- Usually a 3-part mix, in equal parts
  - Reference Reach
    - Largest material size
    - Material size moveable at bankfull flow
    - Finer materials
- May be able to use fines from excavated onsite ("project reach" pebble count)

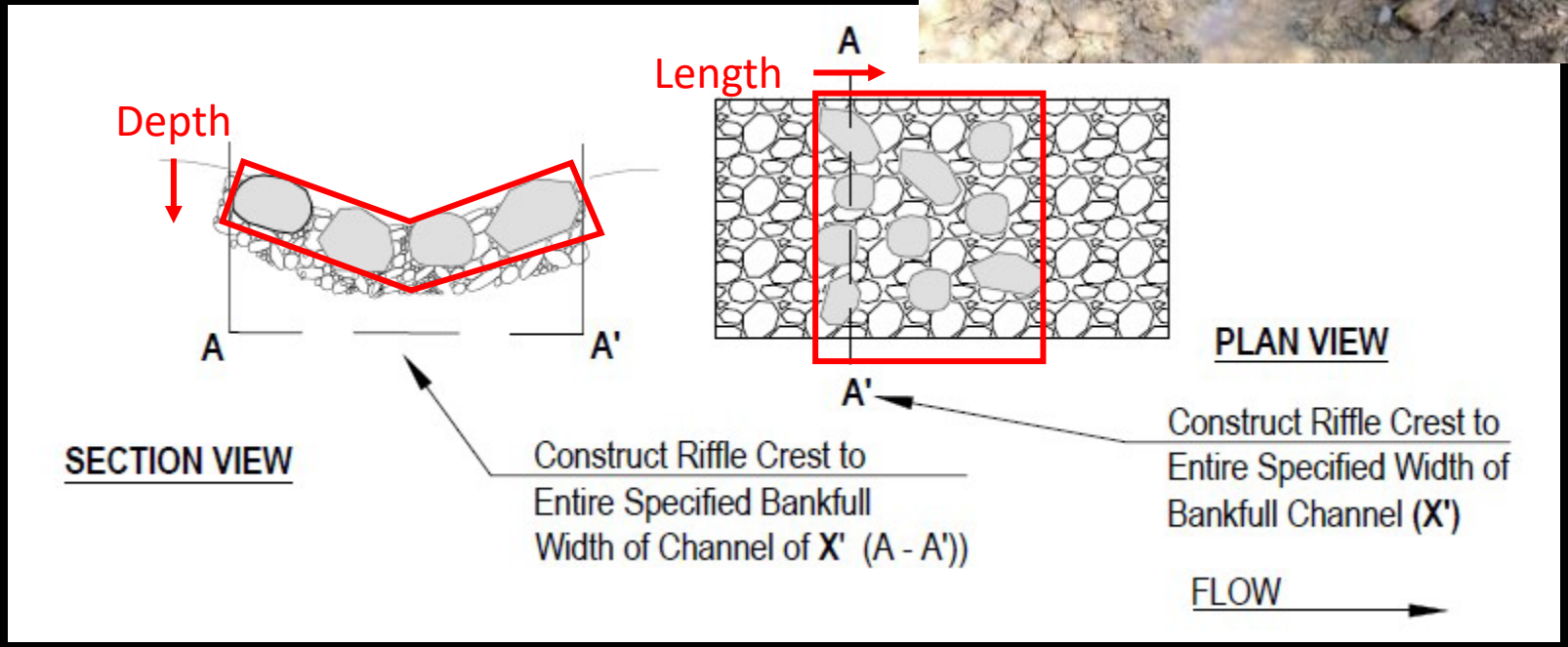
Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure – Grade Controls**

What Material Do I Need?

- Measure largest grade control rock in reference reach
- Use this as a basis for estimating
  - Engineer will determine actual size in design
- (Length) and (Depth) of rock sill



Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure – Grade Controls**

How Much Material Do I Need?

- Use the Site Assessment Tool!
  - Grade control (Length)
  - Assume constructed to bankfull (Width)
  - (Depth) from largest Grade Control rock in reference reach
  - Use materials calculator to determine volume for each sill (V = W x L x D)

STREAM RECONSTRUCTION and GRADE CONTROL STRUCTURES

Dominant Bedform	Riffle/Pool	Grade Control Feature Type to Construct	Constructed Riffle
Dominant Grade Control Type	Riffle Crest	Typical Grade Control Feature Length	31.5 ft
Recommended # of Grade Controls (Between Tie-In Points)	3		
Recommended spacing (ft)	51.1		

PROFILE OF RECONSTRUCTED STREAM REACH — *Reconstructed stream segment upstream, through, and downstream of culvert to reestablish channel continuity and AOP*

NOTE: IN THE TABLE BELOW, HIDE ALL ROWS BELOW LP STA 386.5

LP STA	Thalweg Elevation	Bed Feature	ASD Elevation	Bkf Elevation	Construction Notes
182.0	90.92	Riffle Crest	88.92	92.47	*Install constructed riffle @ existing elevation*
213.5	89.83	Pool			
233.1	89.94	Riffle Crest	87.94	91.49	*Install constructed riffle*
264.6	88.84	Pool			
284.3	88.96	Riffle Crest	86.96	90.51	*Install constructed riffle*
315.8	87.86	Pool			
335.4	87.97	Riffle Crest	85.97	89.52	*Install constructed riffle*
366.9	86.88	Pool			
386.5	86.99	Riffle Crest	84.99	88.54	*Install constructed riffle @ existing elevation*

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Structure – Bank Margins**

What Material Do I Need?

- Same as for grade control features…
- Measure largest grade control rock in reference reach
  - Use this as a basis for estimating
    - Engineer will determine actual size in design

How Much Material Do I Need?

- Use the Site Assessment Tool!
- Bank Margin width
- Bank Margin height above invert or bottom of footer
- Length of replacement structure
  - (may need additional length to tie into existing banks)

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

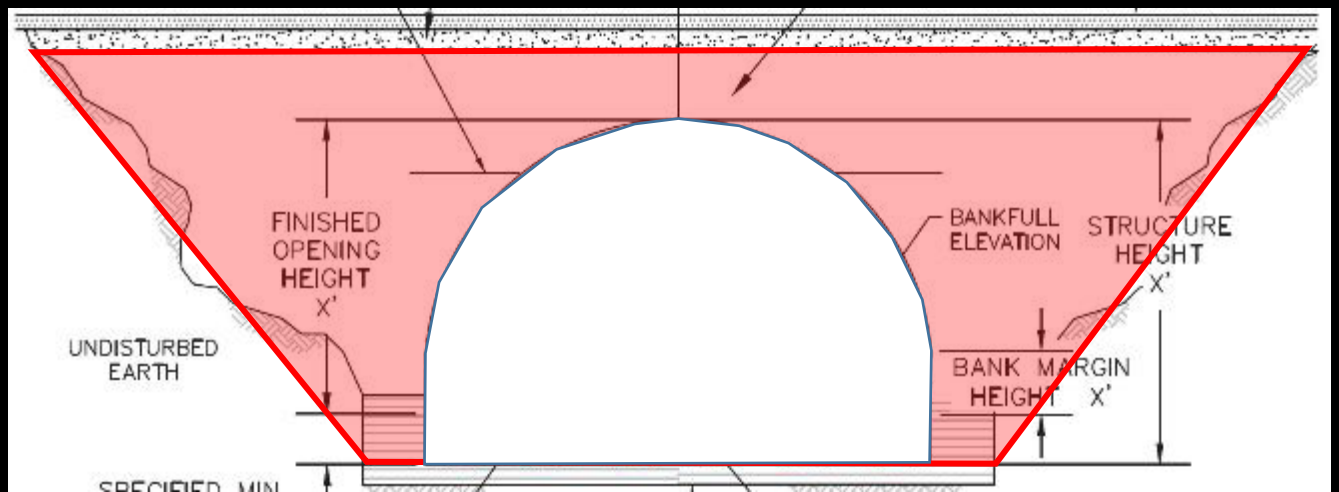
- **Stream Crossing Structure – Backfill / Road Base**

How big is the road cut?

- Figure the area of a trapezoid
  - Depth = road elevation – invert of Bottom of Footer Elev.
  - Bottom width = structure width +6’ (3’ each side)
  - Assume side slopes 1:1
  - Calculate top width
  - Length = structure length

How much backfill?

- Use structure “Area” from vendor’s brochure
- Cut “area” – structure “area” = backfill quantity needed



Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacements**

TEMPLATE REQUEST FOR PROPOSALS (RFP)

ENGINEERING DESIGN OF ROAD/STREAM CROSSING REPLACEMENT

_____ ROAD over _____ CREEK – _____ TOWNSHIP, _____ COUNTY

_____ ("Municipality") is soliciting cost proposals for engineering services to support replacement of an existing road/stream crossing structure (culvert) carrying _____ ROAD over _____ CREEK. Crossing is located at latitude/longitude coordinates _____ °; -_____ °.

A channel's bankfull width is the width of flow at a "dominate channel forming flow stage" where sediment and bed material is moved most effectively through the stream system. Although it varies, bankfull width is typically evidenced through field indicators reflecting the width of the natural channel corresponding to this dominant channel-forming flow (which commonly occurs between the one- and two-year recurrence streamflow event). Stream crossing structures with a width significantly less than the channel's bankfull width are typically associated with many issues that affect both stream- and roadway stability and performance, including gravel deposition above the road and excessive stream scour and erosion below the road. These undersized structures are more prone to obstruction by sediment and debris, roadway flooding and washout of the roadway surface, adding significant maintenance burden upon the Municipality. To alleviate the negative impacts associated with the existing crossing structure, this project will provide a replacement structure that, at minimum, conveys the channel's bankfull width. Bankfull-width structures have been shown to be both cost-effective over their lifetime and provide significant aquatic benefits. In addition, installing bankfull structures helps reduce annual maintenance costs, and can prevent road damage and road closures due to flooding.

- ***The new replacement structure MUST (all four):***
  1. Have a structure width at least equal to bank full width (100 percent ratio).
  2. Be properly aligned with the channel when possible.
  3. Consider additional floodplain connectivity when possible.
  4. Be designed and constructed to accommodate the passage of aquatic organisms through the structure.

Because they are not readily compatible with accommodating (at minimum) the full channel bankfull width at the effective bankfull elevation, round pipes shall not be used as replacement structures through this Program.

Use actual installation costs for recent jobs in your region and collect quotes and cost estimates from manufacturers/suppliers.

Use the RFP for enigineering quotes.

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacements**

Remember stream diversion needs.

Include required cover for selected structure and taper of fill each direction.

Ensure actual extent of excavation and backfill are accounted for.

How will the job be broken down?
Who is responsible for what?
What materials and services were quoted?

Make sure that you know the breakdown and don't overlook the basics

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacements**

Be sure to include ancillary structures to the crossing structure, including:

- Headwalls
- wing walls
- bank stabilization structures

… and how it's going to get done

- Labor & equipment

Estimating Quantities & Costs

Estimating material quantities for ESM practices:

- **Stream Crossing Replacements**

Don’t forget E&S Requirements!

Estimating Quantities & Costs

In conclusion:

Determine plan and practices. Then determine material needs for each practice. Combine the itemized quantities for a total plan estimate.

This will help you:

- Determine accuracy of grant applications
- Compare bids and recognize bid miscalculations
- Monitor material usage, overruns, and potential misappropriation of grant funds
- Correlate material amounts with total project costs to estimate contractor costs.

Estimating Quantities & Costs

From beginning to end,
What's it going to take?

Estimating Quantities & Costs For DGLVR Projects

Reference sites for estimating material needs:

- https://www.dirtandgravel.psu.edu/general-resources/dglvr-materials-calculator
- https://www.calculatorsoup.com/calculators/construction/roadway.php

DGLVR Materials Calculator