

Engineering Criteria in Farming Practices

CCLN by Nolo Consulting



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Yadkinville, NC

View from Blue Ridge Mountain, Asheville, NC

Professional Summary

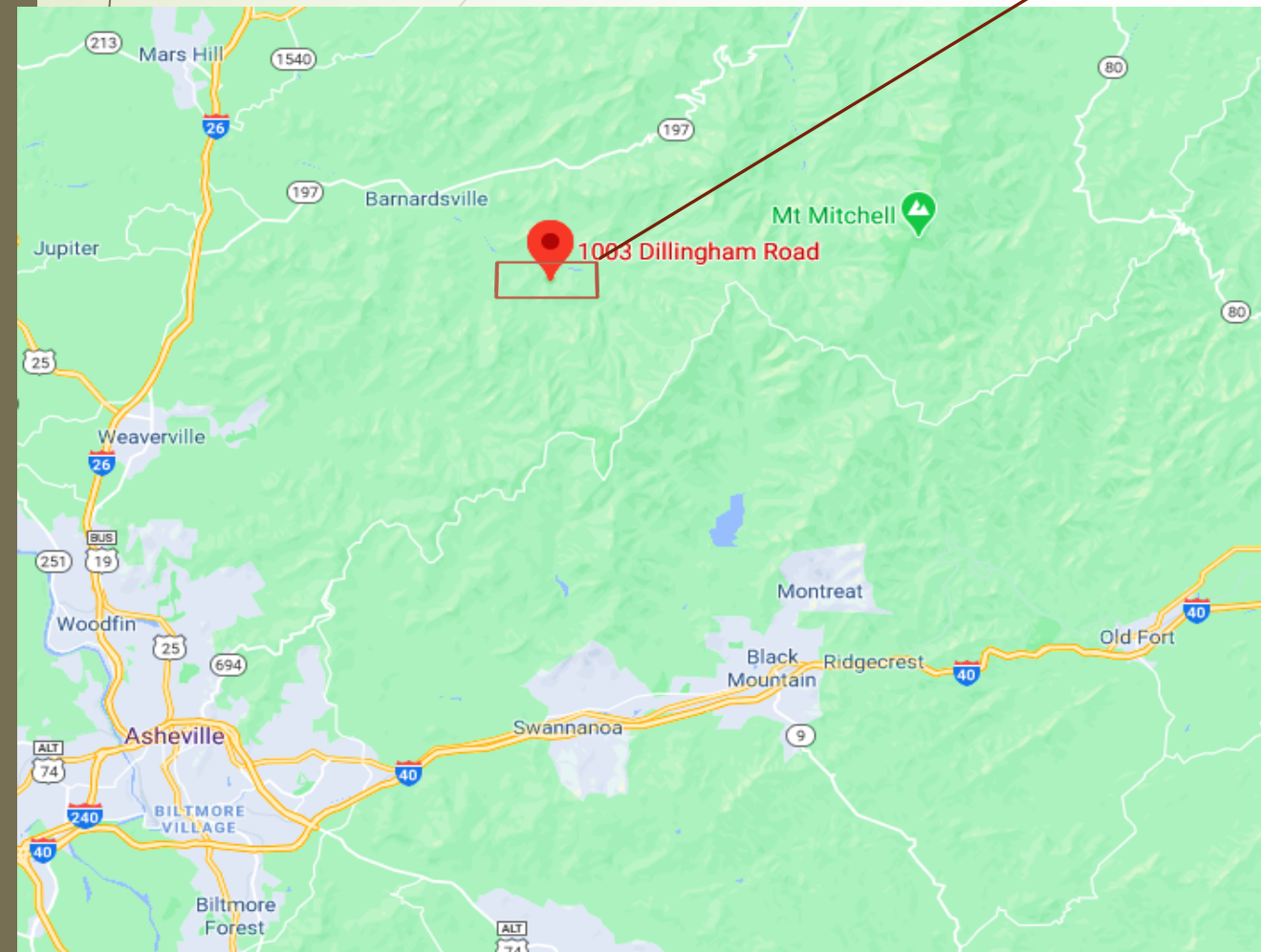
- Bachelor's Degree in Science in Civil Engineering from the University of Puerto Rico – Mayaguez Campus.
- 2018 Nolo Consulting Summer Intern with the USDA-NRCS Buncombe County Field Office in Asheville, North Carolina.
- Started in August as a Civil Engineering Technician for the Yadkin County Field Office in Yadkinville, North Carolina



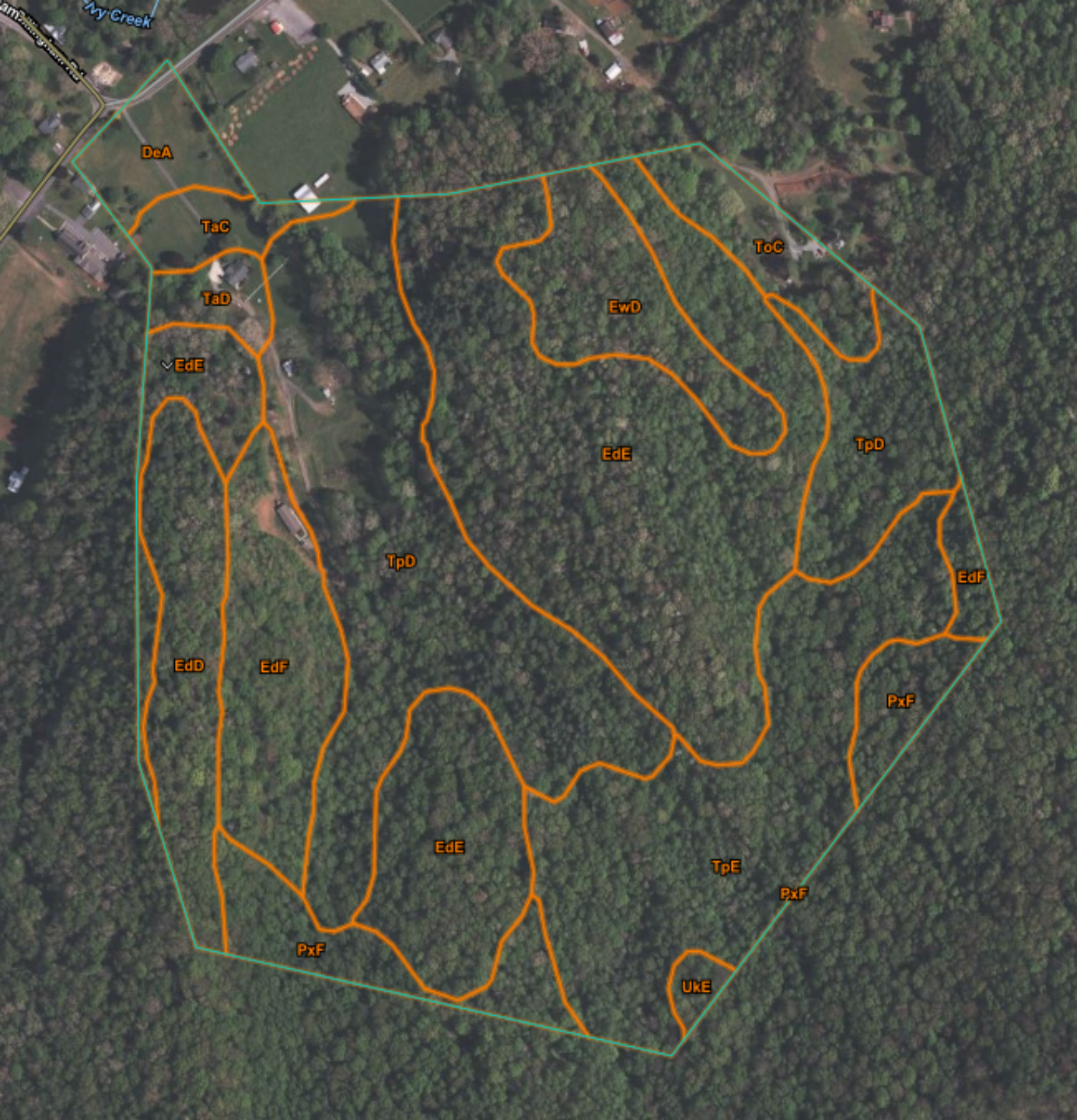


- Established in March of 2020.
- Registered as a “Doing Business As” LLC in PR.
- Achieved from small to medium scale projects such as:
 - Concrete Fences
 - Concrete Floor Pouring
 - Tiles and Bathrooms
 - Epoxy Floors and Finishings
 - Residential Construction
- Competed in a \$3.9M Bid for Reconstruction of Detox Center in Ponce, PR

SITE DESCRIPTION



- Located in the small town of Barnardsville, North Carolina.
- Over 100 acres of total area; mostly wooded areas with notable slope changes.
 - 1 acre = 1.02 cords
- Currently developing livestock and pasture practices.



Web Soil Survey

- Dominant soil types are from the Edneyville Series and Tusquitee Series.
- Both classified as fine-loamy soils.
- Loamy soils are soils with high percentage of fine sand with different size cobbles and gravelly area, with very few clay percentage.



Pasture A:

- 2.32 cords
- Used for goats (2) and 1 Horse
- Fence was in process of reconstruction

Pasture B:

- 0.52 cords
- Used for goats (4)
- Was already fenced

Conservation Plan

- **Identifying Process, Objectives and Resource Inventory**
 - Sharpening the Senses
- **Data Analysis and Alternatives Formulation**
 - Practices Adopted and Suggested
- **Plan Evaluation**
 - Practice progress; evaluation of output

Mountain Laurel (*Kalmia latifolia*)



- Poisonous to several animals, including **horses, goats, cattle, deer, monkeys**, and also **humans**.
- Green parts of the plant, flowers, twigs, and pollen are all toxic.
- Some symptoms/effects could be:
 - Cardiac Distress
 - Vomiting
 - Convulsions
 - Paralysis
 - Coma
 - Death

PRACTICES ADOPTED



Lined Waterway

- Practice Standard 468
- Provide management of runoff away from structures.
- Stabilize existing gully and prevents future erosion.

Engineering Criteria

- 10 year – 24 hours Rainfall Event
 - Minimum Capacity for Design.
 - Is the most intense rainfall event recorded for 24 straight hours, in a 10 years span.
 - NOAA Atlas 14

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.350 (0.318-0.384)	0.416 (0.379-0.458)	0.498 (0.453-0.549)	0.562 (0.510-0.618)	0.645 (0.582-0.710)	0.707 (0.634-0.778)	0.771 (0.686-0.849)	0.833 (0.736-0.921)	0.915 (0.799-1.02)	0.979 (0.847-1.10)
10-min	0.558 (0.508-0.614)	0.665 (0.606-0.732)	0.798 (0.725-0.879)	0.898 (0.815-0.989)	1.03 (0.928-1.13)	1.13 (1.01-1.24)	1.22 (1.09-1.35)	1.32 (1.17-1.46)	1.45 (1.26-1.61)	1.54 (1.33-1.72)
15-min	0.698 (0.635-0.767)	0.835 (0.762-0.920)	1.01 (0.917-1.11)	1.14 (1.03-1.25)	1.30 (1.18-1.43)	1.43 (1.28-1.57)	1.55 (1.38-1.71)	1.67 (1.47-1.84)	1.82 (1.59-2.02)	1.94 (1.67-2.16)
30-min	0.957 (0.871-1.05)	1.15 (1.05-1.27)	1.43 (1.30-1.58)	1.65 (1.50-1.81)	1.93 (1.74-2.12)	2.15 (1.93-2.36)	2.37 (2.11-2.61)	2.60 (2.29-2.87)	2.90 (2.53-3.22)	3.13 (2.71-3.50)
60-min	1.19 (1.09-1.31)	1.45 (1.32-1.60)	1.84 (1.67-2.03)	2.14 (1.95-2.36)	2.57 (2.32-2.83)	2.91 (2.61-3.20)	3.27 (2.91-3.60)	3.64 (3.22-4.02)	4.16 (3.63-4.62)	4.58 (3.96-5.12)
2-hr	1.34 (1.22-1.48)	1.63 (1.49-1.80)	2.09 (1.90-2.30)	2.46 (2.23-2.71)	2.97 (2.68-3.27)	3.39 (3.03-3.73)	3.83 (3.40-4.22)	4.29 (3.77-4.73)	4.93 (4.28-5.47)	5.45 (4.68-6.08)
3-hr	1.43 (1.30-1.58)	1.72 (1.57-1.91)	2.19 (1.99-2.42)	2.58 (2.33-2.84)	3.14 (2.81-3.45)	3.60 (3.21-3.97)	4.09 (3.61-4.51)	4.62 (4.03-5.11)	5.38 (4.62-5.98)	6.00 (5.09-6.70)
6-hr	1.77 (1.62-1.95)	2.11 (1.93-2.32)	2.63 (2.39-2.89)	3.07 (2.78-3.36)	3.71 (3.34-4.07)	4.26 (3.81-4.67)	4.84 (4.28-5.33)	5.47 (4.79-6.04)	6.39 (5.49-7.09)	7.15 (6.05-7.95)
12-hr	2.24 (2.05-2.45)	2.67 (2.44-2.93)	3.30 (3.01-3.62)	3.81 (3.47-4.18)	4.53 (4.10-4.96)	5.10 (4.60-5.59)	5.68 (5.09-6.24)	6.29 (5.58-6.94)	7.11 (6.25-7.91)	7.75 (6.75-8.67)
24-hr	2.60 (2.40-2.84)	3.15 (2.90-3.44)	3.98 (3.66-4.34)	4.63 (4.25-5.04)	5.53 (5.05-6.01)	6.24 (5.69-6.79)	6.97 (6.34-7.58)	7.73 (6.99-8.40)	8.75 (7.88-9.51)	9.55 (8.57-10.4)
2-day	3.12 (2.88-3.37)	3.75 (3.47-4.07)	4.69 (4.33-5.09)	5.42 (4.99-5.87)	6.41 (5.88-6.94)	7.18 (6.58-7.78)	7.97 (7.28-8.64)	8.77 (7.98-9.51)	9.84 (8.91-10.7)	10.7 (9.63-11.6)
3-day	3.34 (3.09-3.61)	4.02 (3.72-4.35)	4.99 (4.61-5.40)	5.74 (5.30-6.21)	6.76 (6.22-7.30)	7.56 (6.94-8.17)	8.37 (7.65-9.05)	9.19 (8.38-9.95)	10.3 (9.34-11.2)	11.2 (10.1-12.1)
4-day	3.57 (3.31-3.85)	4.28 (3.97-4.63)	5.28 (4.89-5.70)	6.07 (5.61-6.54)	7.12 (6.56-7.67)	7.94 (7.29-8.56)	8.77 (8.03-9.46)	9.61 (8.78-10.4)	10.8 (9.77-11.6)	11.6 (10.5-12.6)
7-day	4.25 (3.96-4.56)	5.08 (4.74-5.45)	6.17 (5.75-6.63)	7.01 (6.52-7.52)	8.12 (7.54-8.71)	8.98 (8.31-9.64)	9.85 (9.09-10.6)	10.7 (9.86-11.5)	11.9 (10.9-12.8)	12.8 (11.6-13.8)
10-day	4.90 (4.58-5.24)	5.83 (5.46-6.24)	7.00 (6.54-7.48)	7.87 (7.35-8.41)	9.03 (8.41-9.65)	9.92 (9.22-10.6)	10.8 (10.0-11.6)	11.7 (10.8-12.5)	12.9 (11.8-13.8)	13.7 (12.6-14.8)
20-day	6.67 (6.27-7.10)	7.88 (7.41-8.40)	9.29 (8.72-9.89)	10.4 (9.72-11.0)	11.8 (11.0-12.6)	12.9 (12.0-13.7)	14.0 (13.0-14.9)	15.1 (14.0-16.1)	16.5 (15.2-17.6)	17.6 (16.2-18.8)
30-day	8.32 (7.87-8.82)	9.78 (9.26-10.4)	11.2 (10.6-11.9)	12.3 (11.6-13.1)	13.7 (12.9-14.5)	14.7 (13.8-15.6)	15.6 (14.7-16.6)	16.6 (15.5-17.6)	17.8 (16.6-18.9)	18.6 (17.4-19.8)
45-day	10.6 (10.0-11.1)	12.4 (11.7-13.0)	13.9 (13.2-14.7)	15.1 (14.4-15.9)	16.5 (15.7-17.4)	17.6 (16.7-18.6)	18.6 (17.6-19.6)	19.6 (18.5-20.7)	20.8 (19.6-22.0)	21.6 (20.4-22.9)
60-day	12.7 (12.1-13.3)	14.7 (14.1-15.5)	16.5 (15.7-17.3)	17.8 (17.0-18.7)	19.5 (18.5-20.4)	20.7 (19.6-21.7)	21.8 (20.7-22.9)	22.9 (21.7-24.0)	24.2 (22.9-25.5)	25.2 (23.8-26.5)

Terms and Parameters

► t_c

- Time that it takes for a drop of water from a rainfall event to reach the catchment area.
- Depends on Area of Watershed

► Intensity

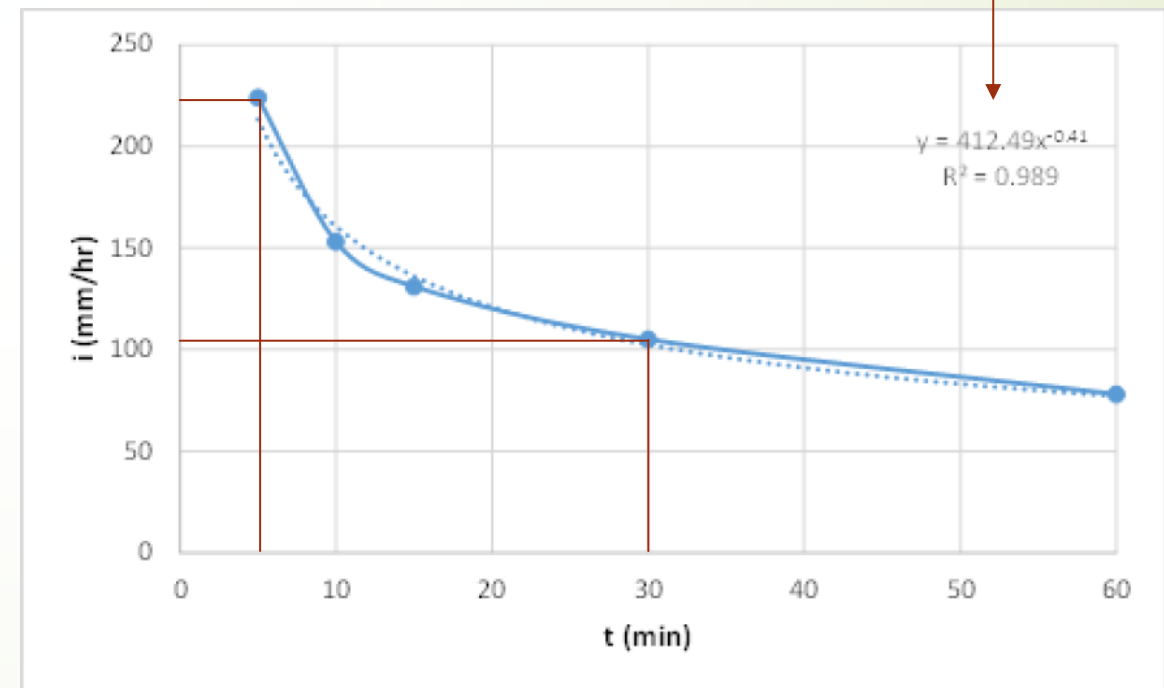
- Rainfall intensity decreases with time.
- Depends of t_c
- $Q = C * i * A$

$$i = \frac{412.5}{t^{0.41}}$$

► Manning's N

- Coefficient of Roughness
- Value is higher as surfaces are more pervious.

Duración (min.)	Intensidad (mm/hr)
5	224
10	153
15	131
30	105
60	78

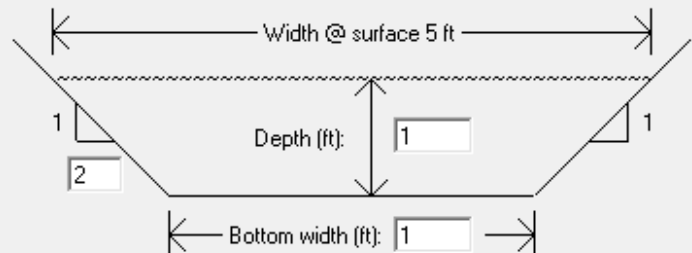


Images from Rafael Segarra, PhD, PE

➤ Velocity

- Using Manning's Formula: $V = \frac{\phi}{n} R^{0.66} S^{0.5}$; where $\phi = 1.486$ for English Units, 1 for SI

- Trapezoidal Section -



The diagram shows a trapezoidal channel cross-section. The top width is labeled 'Width @ surface 5 ft'. The bottom width is labeled 'Bottom width (ft): 1'. The depth is labeled 'Depth (ft): 1'. The side slopes are indicated by a 1:2 ratio (1 horizontal to 2 vertical). The channel is shown with a dashed line representing the water surface.

Calculated values:

- Slope (ft/ft): 0.0005
- Mannings N: 0.044
- Hydraulic Radius: 0.55
- Area: 3.00 sq ft
- Capacity: 1.52 cfs
- Velocity: 0.51 ft/sec
- Critical Depth: 0.33 ft

n = Manning's n value

$$R = A / P$$

$$S = \text{slope}; S = \frac{\text{Change in elevations}}{\text{Length}}$$

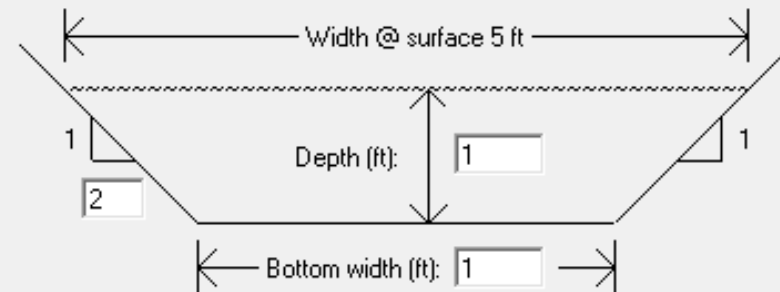
Example: Elev 1 = 50ft, Elev 2 = 47ft, L = 120ft, S = 0.025

- Must meet requirements of:
 - National Engineering Handbook (NEH), Part 650 or Part 654.14C
 - Engineering Field Handbook, Chapter 16, Appendix 16A

Construction Notes

- Waterway bottom lining – Concrete, Flagstone, Rip-Rap, Synthetic Turf
- Side Slopes – Depends on lining
- Freeboard
- Considerations – Bioengineering, Wildlife Resources

- Trapezoidal Section -



Slope (ft/ft): 0.0005

Mannings N: 0.044

Hydraulic Radius: 0.55

Area: 3.00 sq ft

Capacity: 1.52 cfs

Velocity: 0.51 ft/sec

Critical Depth: 0.33 ft



Fencing

- Practice Standard 382.
- Enables to maintain cattle inside a desired area or pasture.
- Can be permanent, temporary or movable.

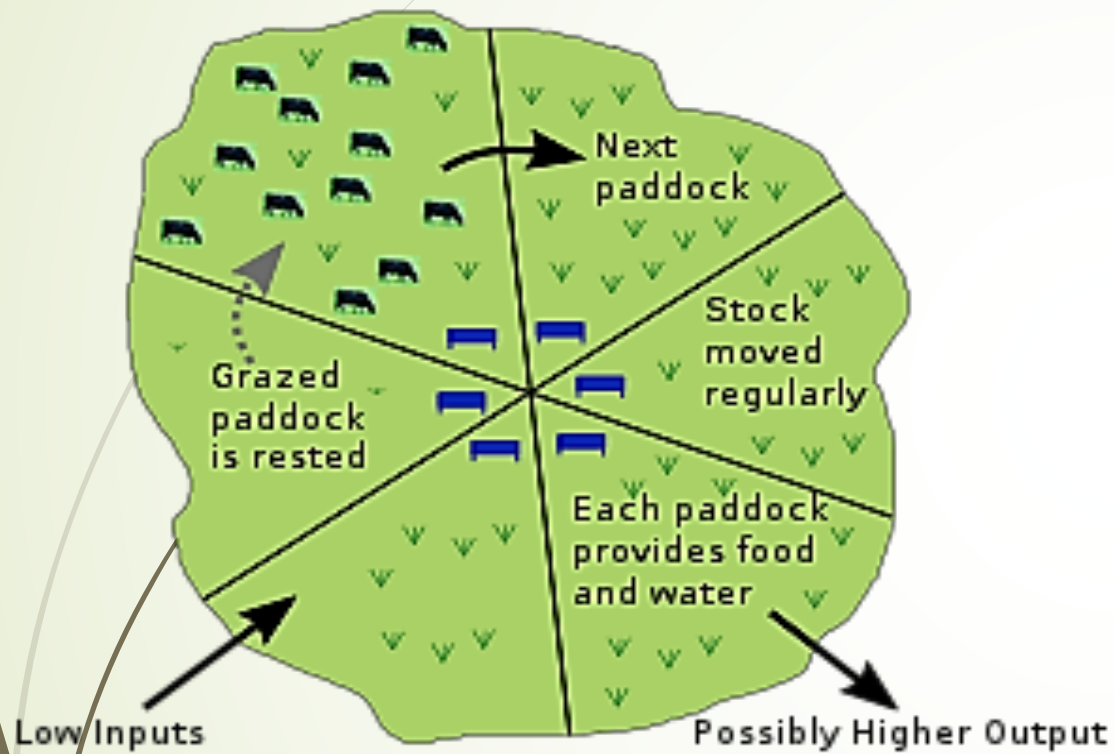
Materials and Construction Specifications

- Setting and Post Lines
- Post Bracing
- Wire Selection and Installation
- Gates and others

Line Post Type	Minimum Diameter/ Weight	Minimum Setting Depths (inches)			Other
		Rocky Soils	Sandy Soils	All Other	
Wood: red cedar (>50%heartwood), black locust, catalpa, bois-d-arc,	3-1/2"	18	30	24	Minimum lengths will allow for minimum setting depth and fence height plus at least 2 inches of post above top wire.
Pressure treated. Wood Material Specification 585	3-1/2" Treatment in accordance with /FED. Spec No.TT-W-571i	18	30	24	Posts will have appropriate treatment for rust and deterioration.
Standard steel "T" "Y", "U"	1.25 lbs/ ft of length, exclusive of anchor plates	Anchor plate must be fully below ground surface (Post is Approx. 15-18 inches deep)			Steel fence posts shall conform to the requirements of Federal Specification RR-F-221/3A.
Steel Pipe, galvanized	2" OD	18	30	24	
Fiberglass "T"	1 inch cross section	12 –18 inches or depth recommended by manufacturer, whichever is deeper.			Electric fences only. Must be UV stabilized.
Fiberglass Round	7/8 inch				
Manufactured "Tread-in" Type posts; or fiberglass round	Rigid Plastic, PVC, fiberglass or other synthetic posts	For temporary fences only			
Stays (also called Battens, Droppers or Spacers)	Wire stays are of 12 Ga twisted for use on Barb wire. Fiberglass shall be ½ inch dia. Steel T Post. Wood 1.5" x1.5"	Stays may or may not be designed to touch the soil surface, but should be sufficient to maintain wire spacing.			Wire is usually used on barbed wire and does not touch the ground. Fiberglass, wood and steel may sit on soil surface and be non-conductive for electrical powered wire.
Live trees	8 inches	Only to be used in areas difficult to maintain or to erect conventional posts, such as rocky areas or frequently flooded areas. The tree should be of durable wood type, relatively straight and free of rot and knots. Swaying trees could potentially cause the fence to sag or stretch, thus adversely affecting function of the fence. Frequent observation and maintenance will be critical to the continued success of fence that uses trees for posts. Fence wire may be threaded through durable insulated tubing around the tree an attached to an end strain insulator. Alternatively, fence wire or insulators shall be stapled into a 2"x4" treated board secured to the tree by wrapping wire around 4 to 6 2"x4" boards and the tree. Trees shall only be used in situations where the use of posts is technically infeasible.			

Construction Materials

- Wood line posts – 4 “diam.
- Wood brace posts – 6” top diam.
- Brace Wires
- #4 reinforcement steel bars (to make tight corner posts)



Rotational Grazing

- Provides nutritious forage to rested paddocks while rotating cattle in place.
- Implemented to mitigate parasite reproduction in pasture.
- Bedrock to sustainable agriculture.



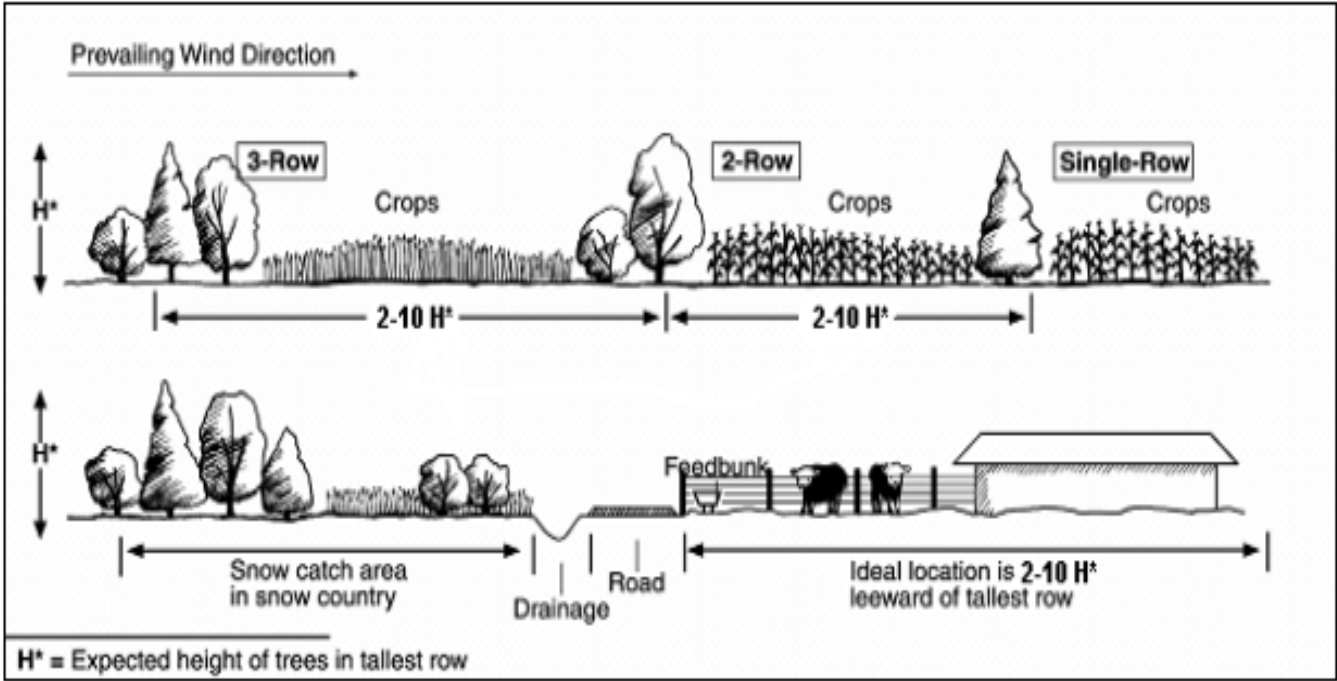
Goats were moved from Pasture A to Pasture B.

Intermediate fencing would enable grazing rotation at Pasture B.



Windbreak/Shelterbelt Establishment

- Practice Standard 380.
- Developing growing vegetation.
- Wind erosion barrier.



Plan Evaluation

- 3 of 4 practices were already being developed or completed.
 - Lined Waterway, Rotational Grazing and Fencing were successful.
- 1 practice suggested: Windbreak/Shelterbelt Establishment.
- Upcoming predictions: cattle size growth, goat house construction.

CONCLUSION

- Complete USDA-NRCS preparation for individuals.
- Development of TSP.
- Entrepreneurship Tools.
- Q&A