


Roadside Ditch

Stormwater Management Practice (Bioretention)

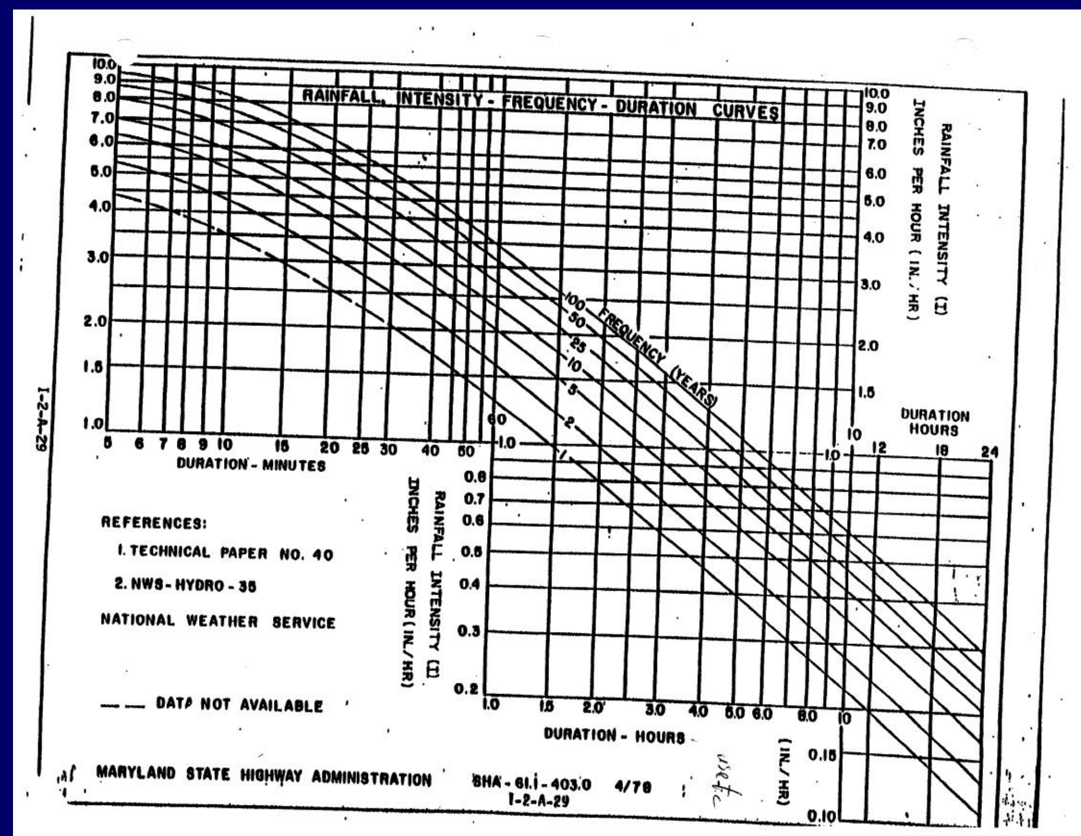
- Narrow, sloped and minimal standing water
- Designed/evolved to have a high conveyance
- Bed is compacted and impervious
- Mowed on a regular basis

- Wide, flat and up to 12” of ponding
- Designed to slow the flow and hold water
- Amended existing soils or imported fill with high K_{sat}
- Planted to increase vegetative uptake

Historic Design Methodology

Theoretical design

- Based on moving water away from the land as quickly as possible
- Limiting value is the erosion potential of the soil/vegetation
- IFD (intensity frequency duration)
- Rational method



Historic Design Methodology

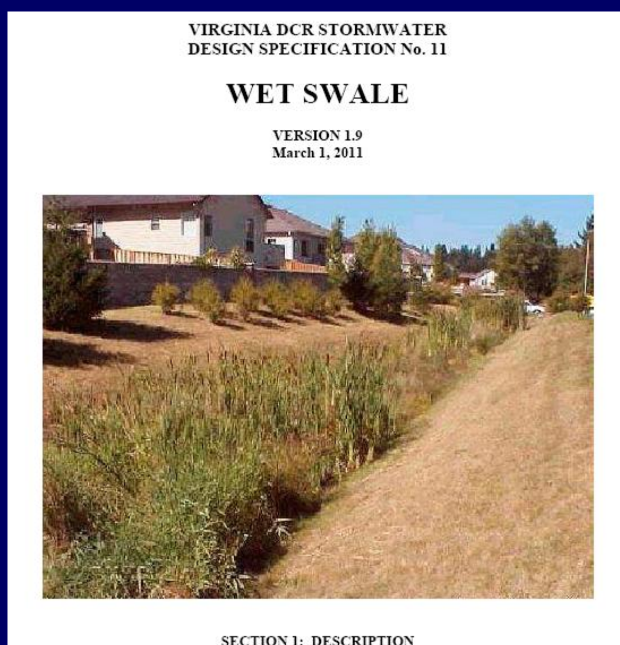
Empirical design

- Based on moving water away from the land as quickly as possible
- Limiting value is when the water starts/stops encroaching on the road
- IFD (it floods? dig)

Design For Water Quality

Is it appropriate to use urban specifications to treat agricultural and highway runoff?

- Based on a treatment volume or a limiting flow velocity
- Check dams used to create ponding and encourage sedimentation and infiltration
- All treatment processes require increased residence time
    - To allow fines to settle – Clay settles at approximately 9” per day
    - To allow for denitrification
    - To allow for infiltration
- All water quality designs will require more land
- Must be sized to prevent re-suspension

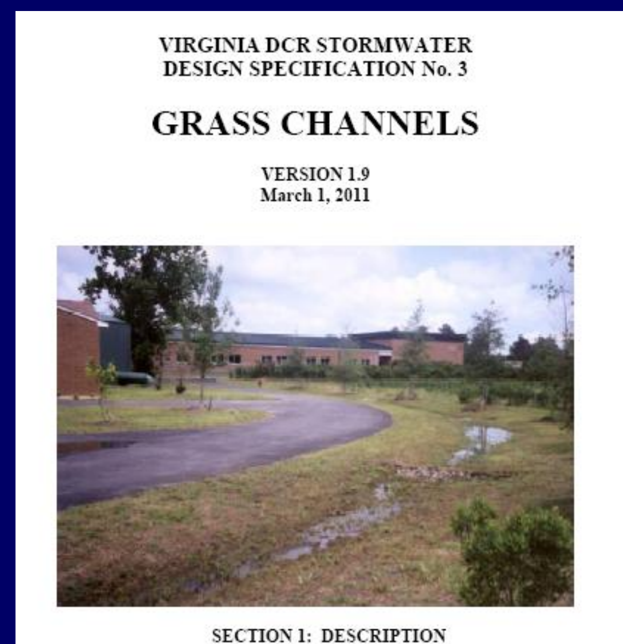


VIRGINIA DCR STORMWATER
DESIGN SPECIFICATION No. 11

WET SWALE

VERSION 1.9
March 1, 2011

SECTION 1: DESCRIPTION



VIRGINIA DCR STORMWATER
DESIGN SPECIFICATION No. 3

GRASS CHANNELS

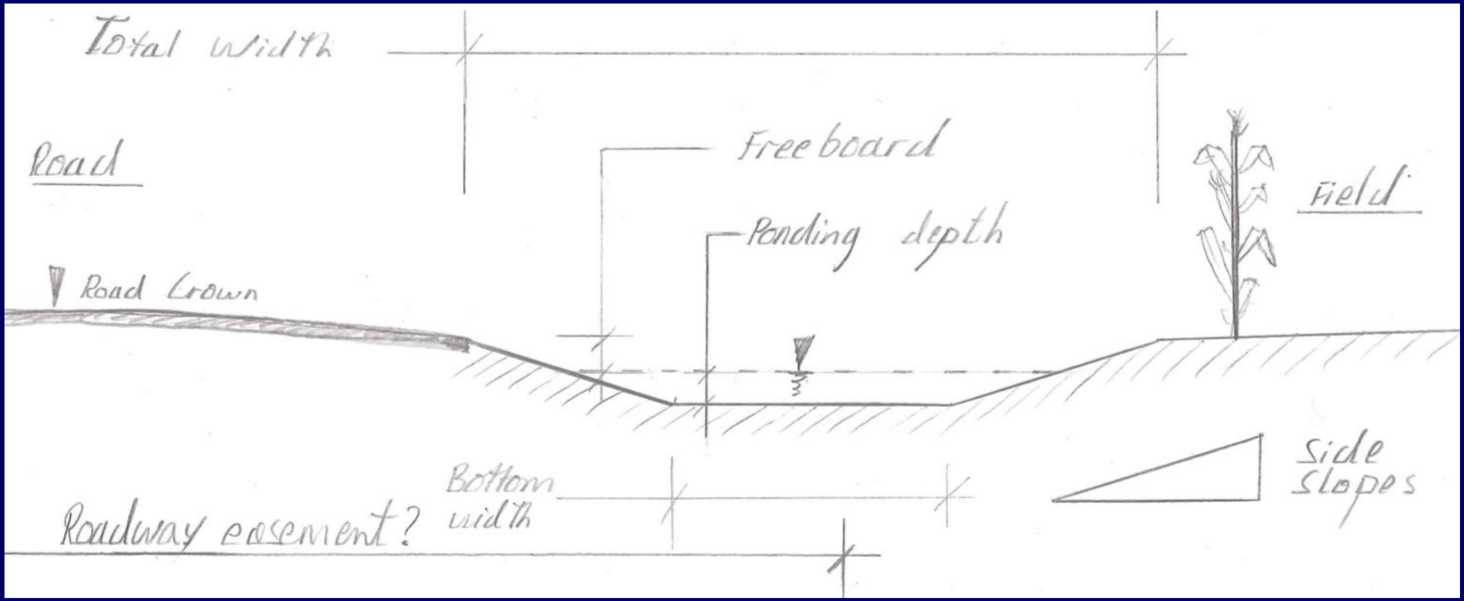
VERSION 1.9
March 1, 2011

SECTION 1: DESCRIPTION

Physical Constraints

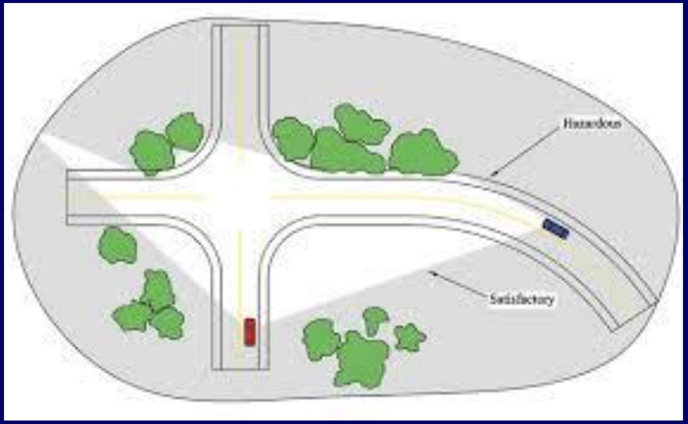
Total width of practice is a function of

- Ponding depth (function of capacity, pollutant removal efficiency, regulations/public perception, drainage) 6”<D<12”
- Bottom width (function of capacity, construction equipment size, flow velocity, available land) 3’<W<∞
- Freeboard 12”<F<18” (function of conveyance and road base drainage)
- Side slopes S<2:1
- Need for check dams (function of ditch slope)
- Desired residence time (9 minutes?)



Design Considerations

- Road base must be drained.
- Sight lines must be maintained, no intrusive vegetation.
  - Fear of dear strikes
- No increase in flooding during 10 year event (climate change?)
- How will this impact future maintenance?
  - Silt from field
  - Invasive vegetation
- How will this affect field drainage?
- Utilities clashes?
  - Mosquitos?



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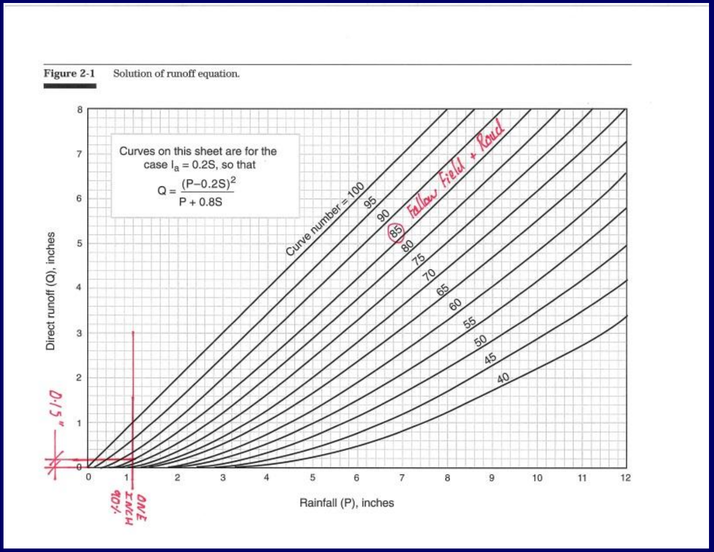
What volume of water should we be targeting?

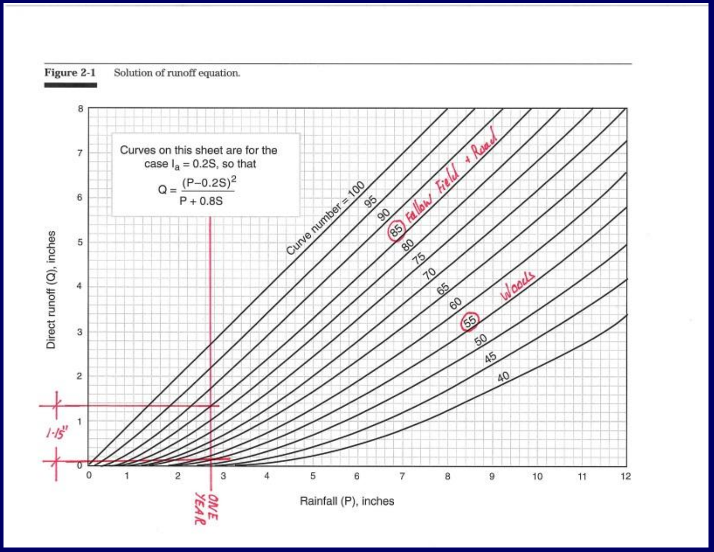
What are we treating?

- Most of the water in the roadside ditch comes from the surrounding area and not the road.
- Water cannot be segregated.
- Low impervious area (turf, agriculture, sometimes woods).

How much are we treating?

- A runoff reduction volume?
  - Make the catchment behave, hydrologically, as if it was completely wooded.
- A water quality volume?
  - Treat and retain 90% of the storms that occur in one year.
  - Does the volumetric runoff coefficient equation apply? Rv = 0.05 + 0.009 (I) with a minimum of 0.2”
- A WYCG (whatever you can get) volume





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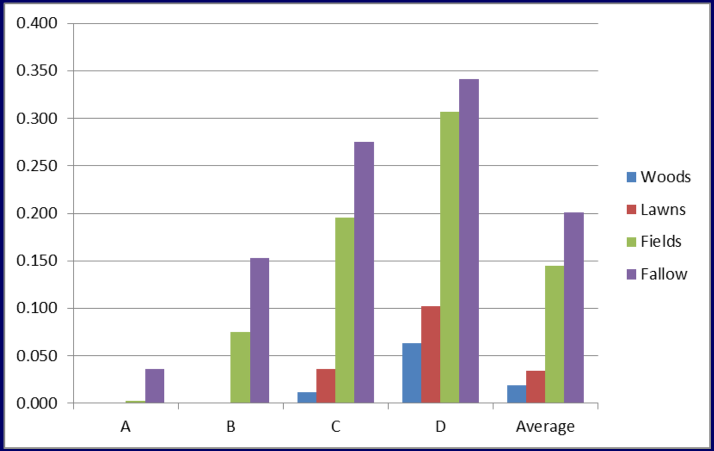
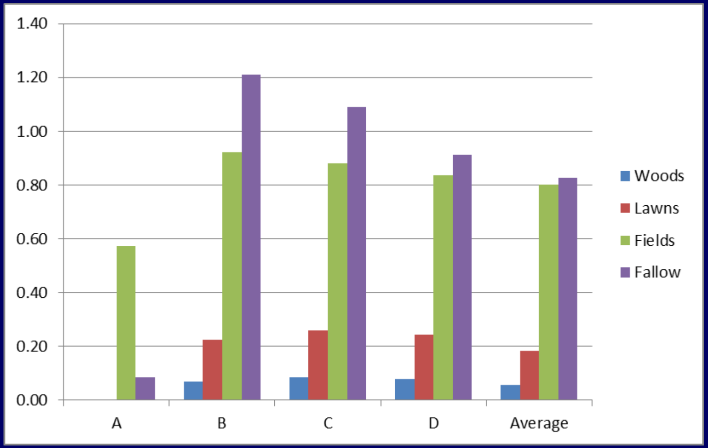




Example

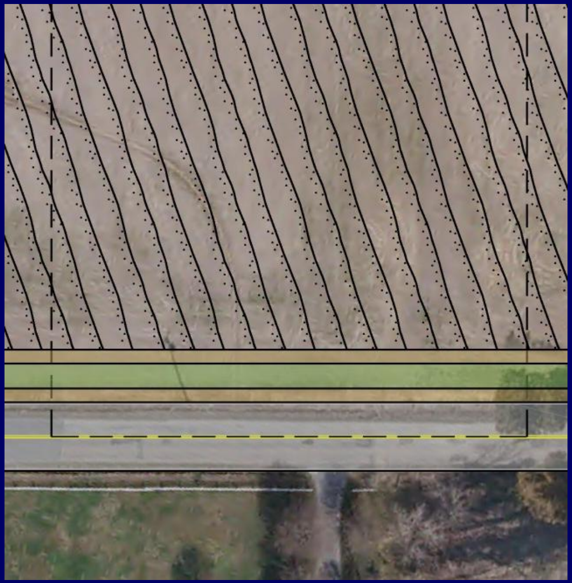
- Based on a treatment volume.
- Hypothetical acre of land, 208’ x 208’ .
- 86% Agricultural land and 14% impervious.
- Runoff depths are averages for all soils (A to D).
- RRV is ± 2,900 cu-ft based on 0.8” of runoff.
- WQV is ± 725 cu-ft based on 0.2” of runoff.
- WYCG volume is whatever you can get!

This ditch could probably store about
200 cu-ft of water with 6” of ponding.

Runoff Reduction Swale

(2,904 cu-ft)

Total width	20’
Ponding depth	12”
Freeboard	12”
Bottom width	12’
Side slope	2:1
Area	4,160 sq-ft



Water Quality Swale

(726 cu-ft)

Total width	12’
Ponding depth	6”
Freeboard	12”
Bottom width	6’
Side slope	2:1
Area	2,496 sq-ft

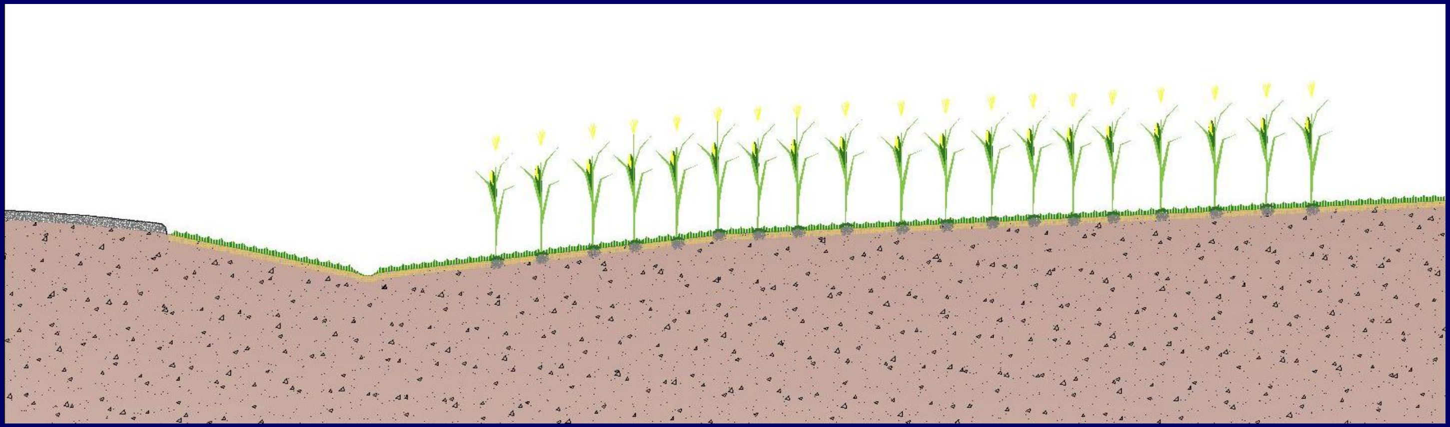
Is the road easement wide enough?

A different aspect ratio will result in less land take.

Runoff Reduction Swale (2,904 cu-ft)		Water Quality Swale (726 cu-ft)	
Total width	20’	Total width	12’
Ponding depth	12”	Ponding depth	6”
Freeboard	12”	Freeboard	12”
Bottom width	12’	Bottom width	6’
Side slope	2:1	Side slope	2:1
Area	4,160 sq-ft	Area	2,496 sq-ft

Efficiency

- Will depend on ratio of total runoff to treatment volume
- Soil K_{sat} and water table depth will determine if the swale is permanently wet, or dries out
- Wet swale efficiency (VA-DCR Level 1)
  - TP – 20%
  - TN – 25%
- Grass channels (VA-DCR Level 1)
  - TP – 32%
  - TN – 36%
- Can we increase efficiency?



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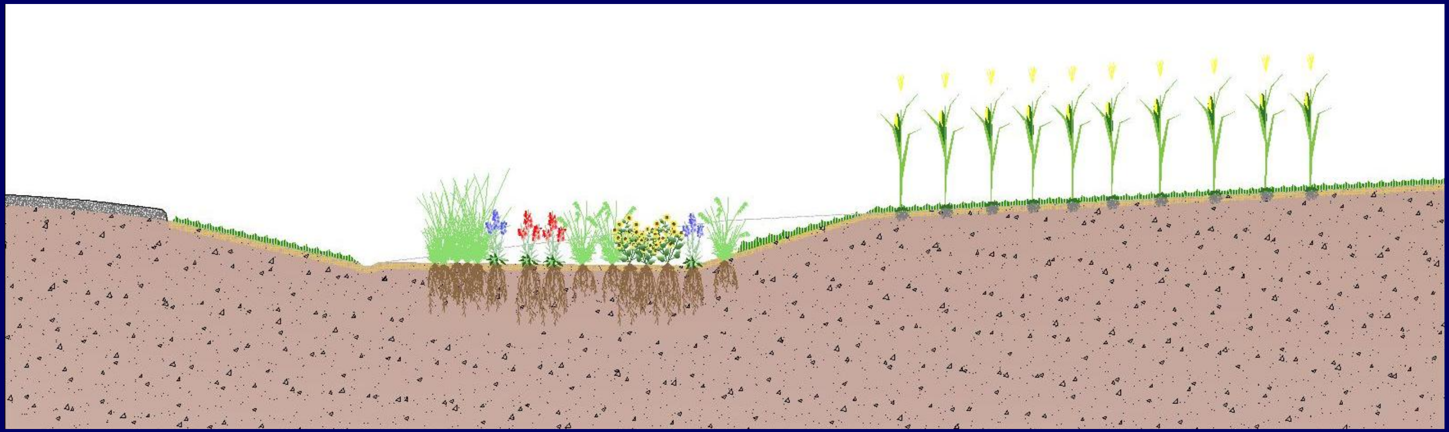


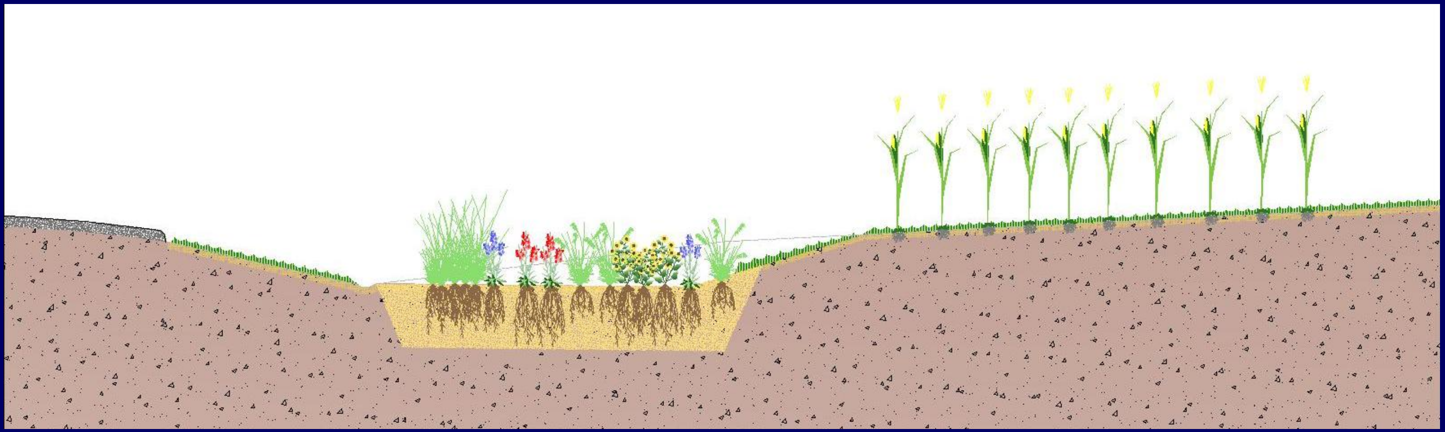
Further Enhancements

Groundwater interception

- Width of ditch is just as important as depth
- Deep rooted plants

Soil amendment

- Soil can be amended with ligneous materials to increase carbon content
- Soil can be amended to a depth of 3’ without excavation, reducing cost
- Soil amendment will reduce K_{sat} along ditch bottoms to create underground preferential flow paths.



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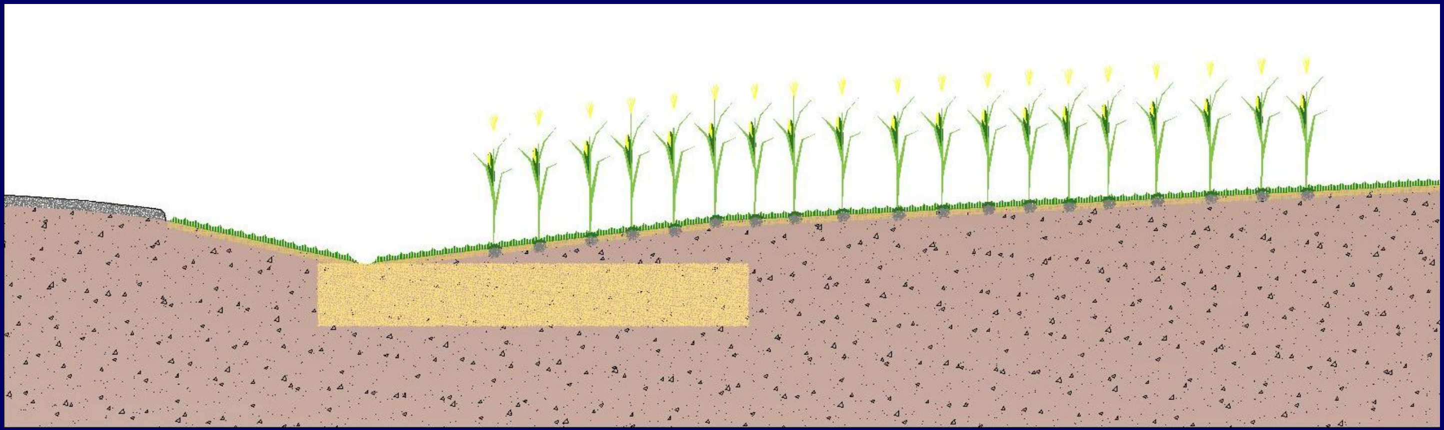
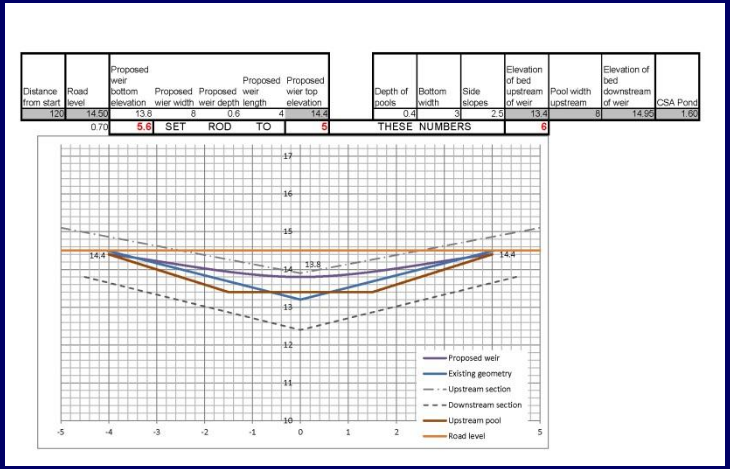
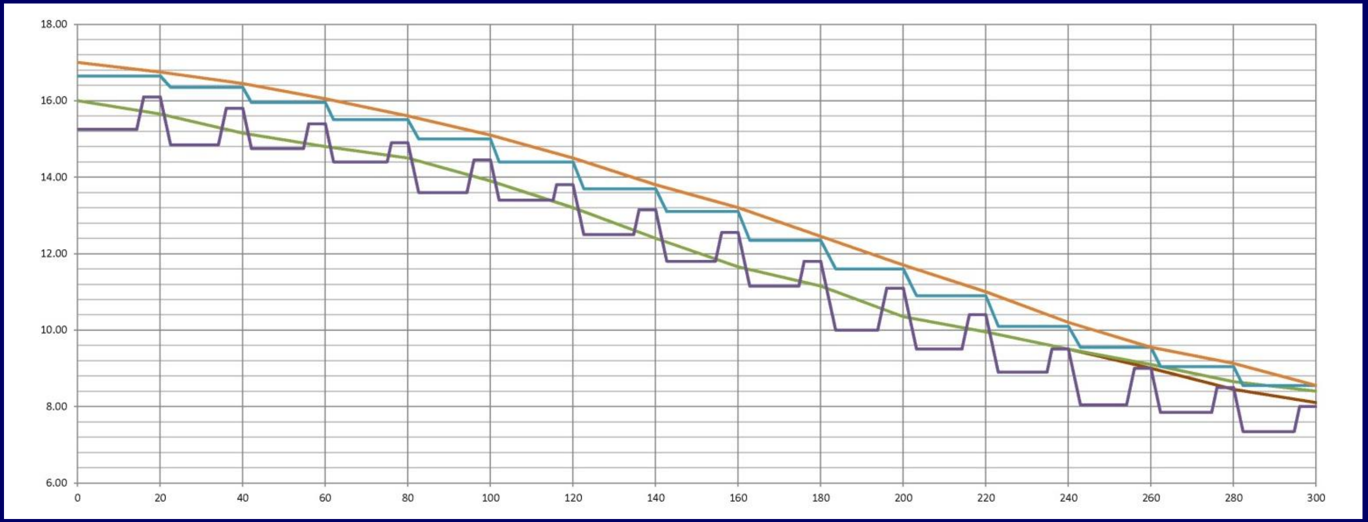


Accelerated Design and Construction

Roadside ditches all have similar geometries

- Design can be reduced to few variables.
- Flow velocities and runoff volumes can be calculated from Aerial photography and LiDAR.
- Analysis and layout can be spreadsheet based.
- With design build, detailed survey, design and layout can be done in the field in the same day as construction



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