

Modeling Ground Water Recharge Under Vetiver Hedgerows



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Summary



Vetiver hedgerows do increase Ground Water Recharge

- DeeSaeng et al. 2006 measured it. But not how?

Need Answer for how vetiver recharges GW.

- Quantify contribution of different components
- Shoots, water levels, velocity, backwater, infiltration, root system

Infiltration

- Diffusive flow
- Preferential flow

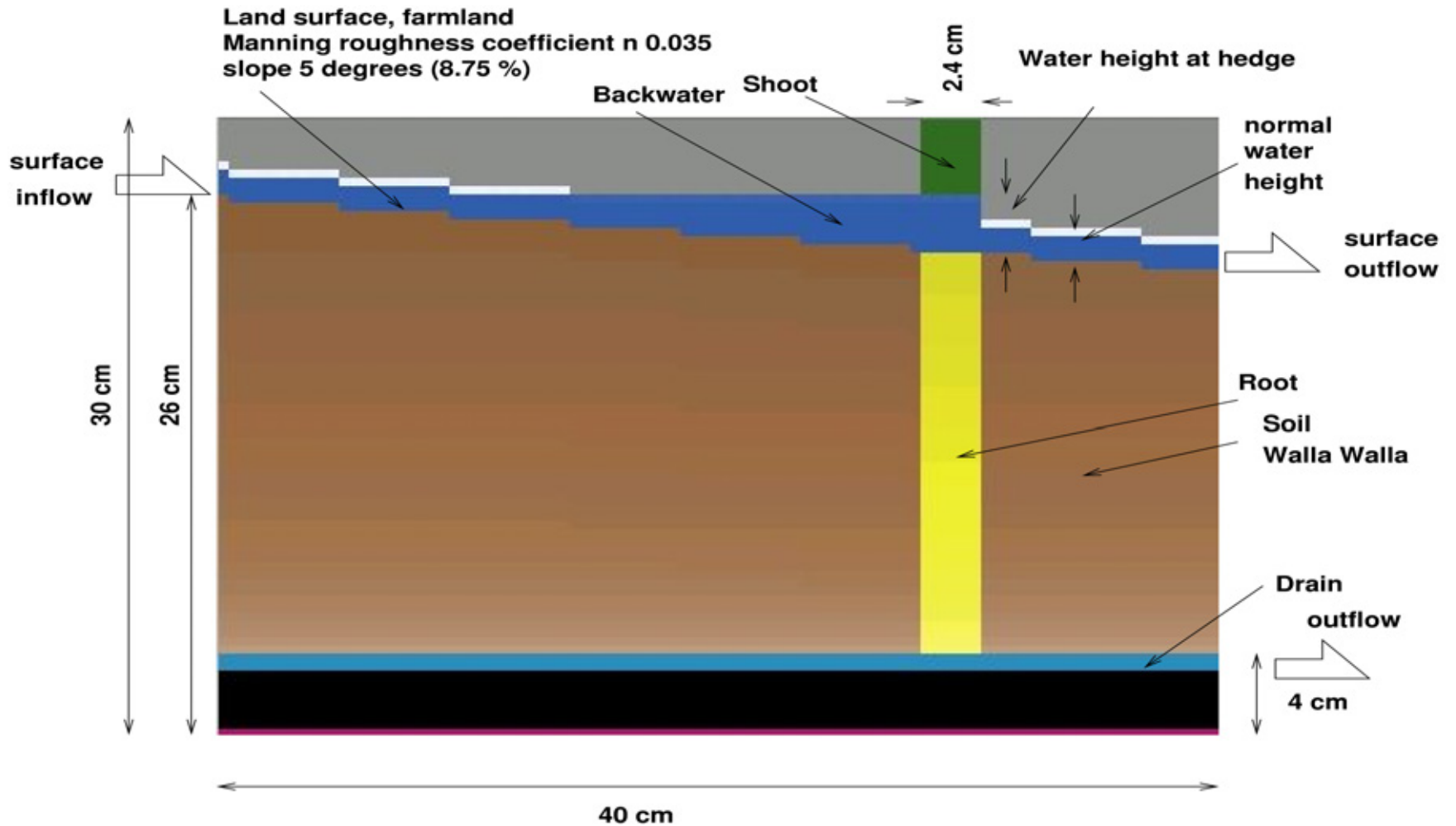
Mathematical models

- For hedgerow
- For backwater
- For Laminar Film flow on roots

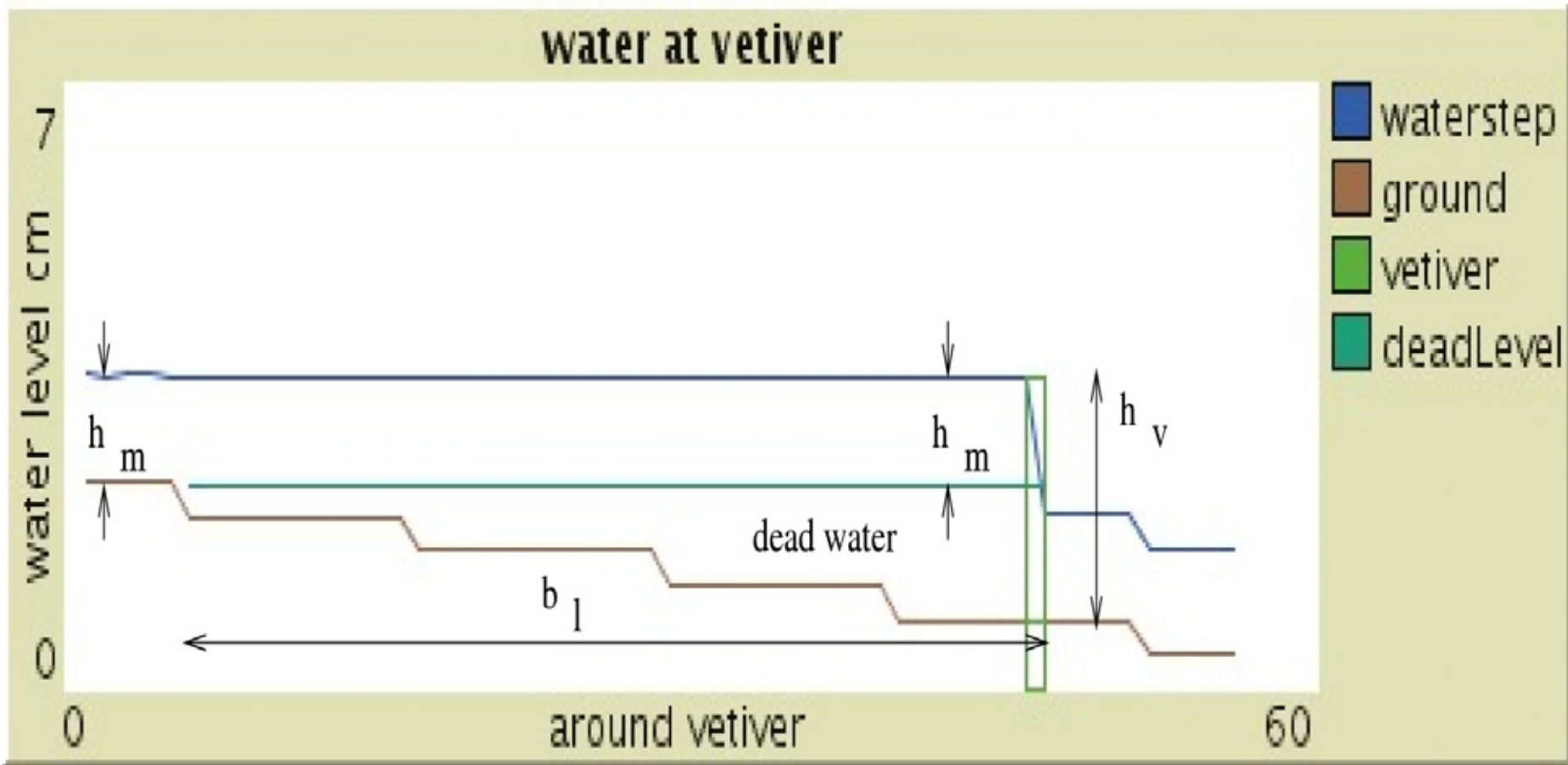
Computational model to tie them up

Result: The vetiver patch has 5 times conductivity than normal patch.

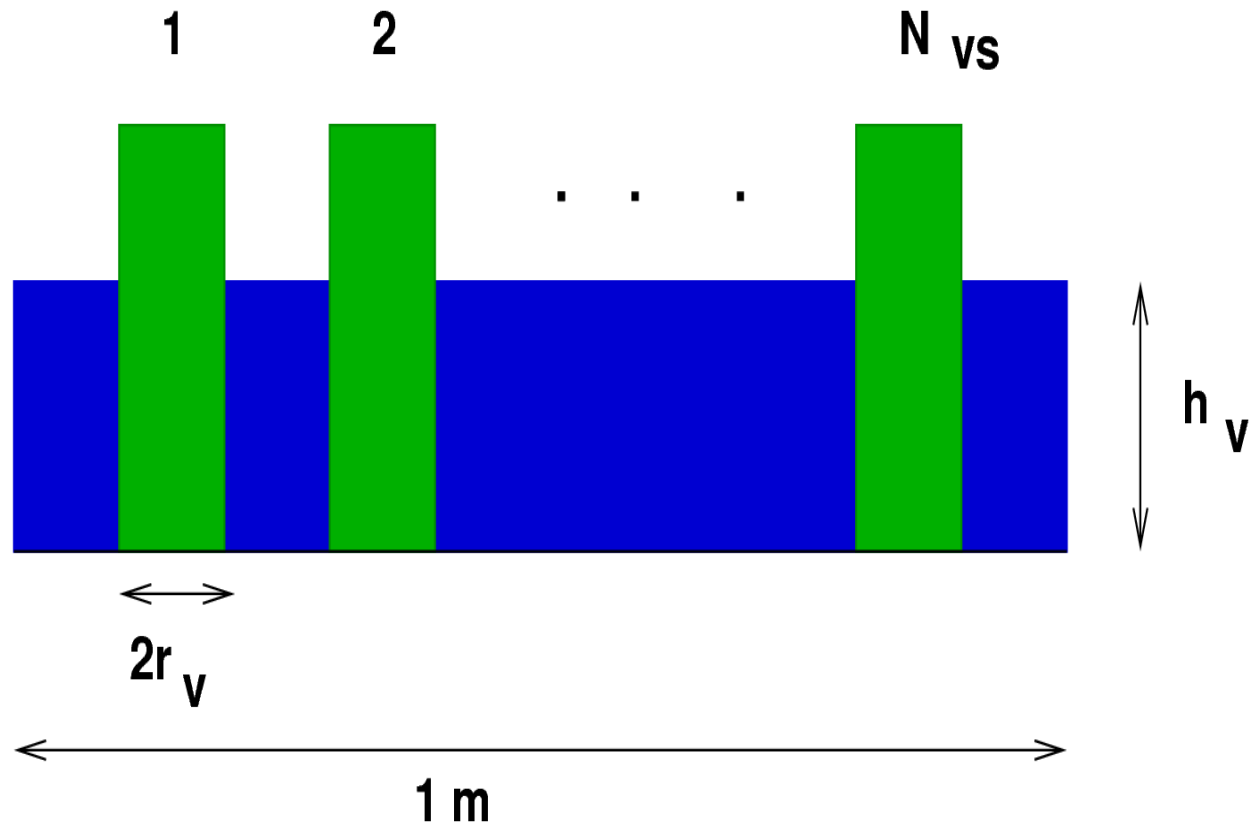
The Model



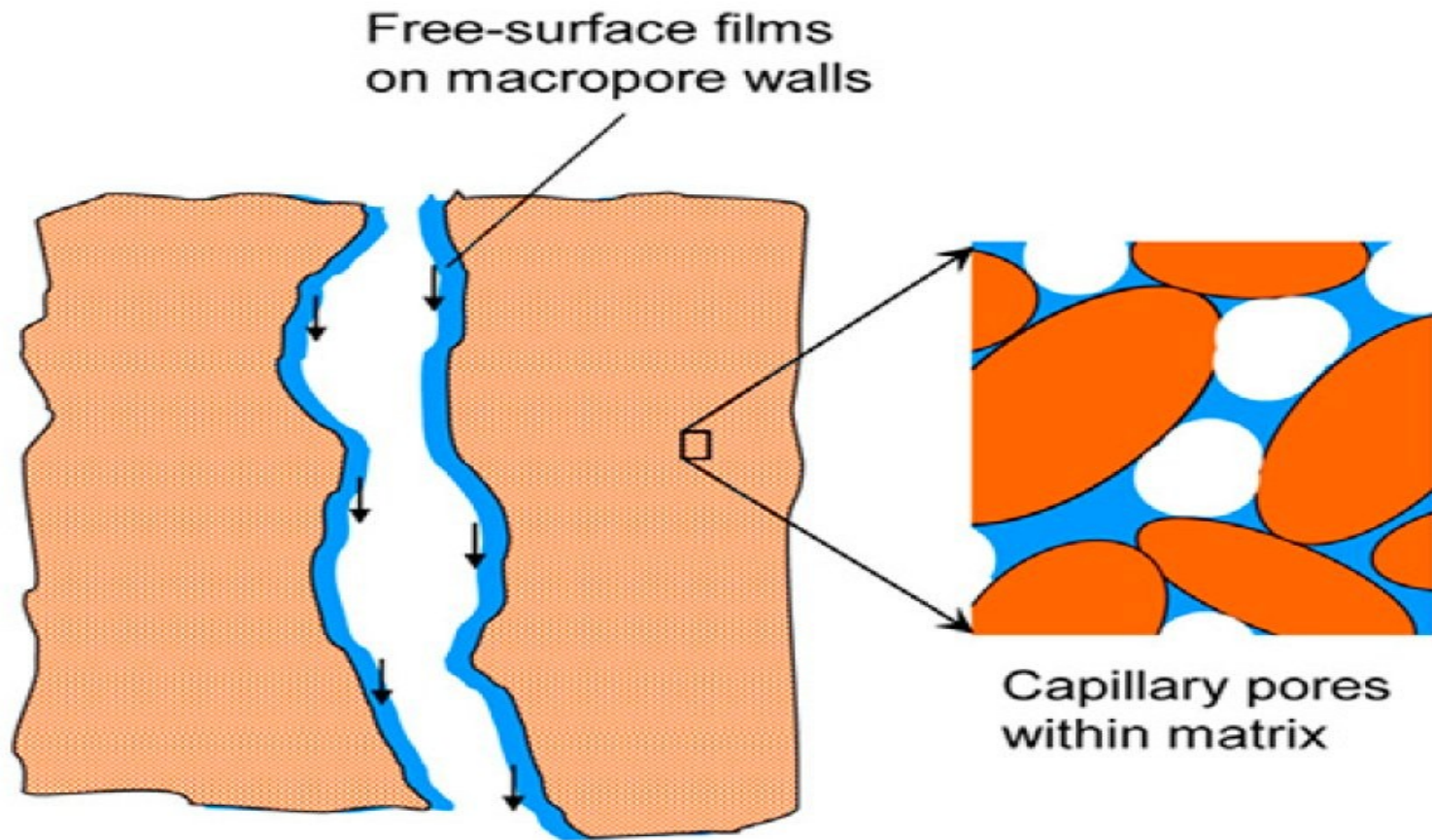
Backwater



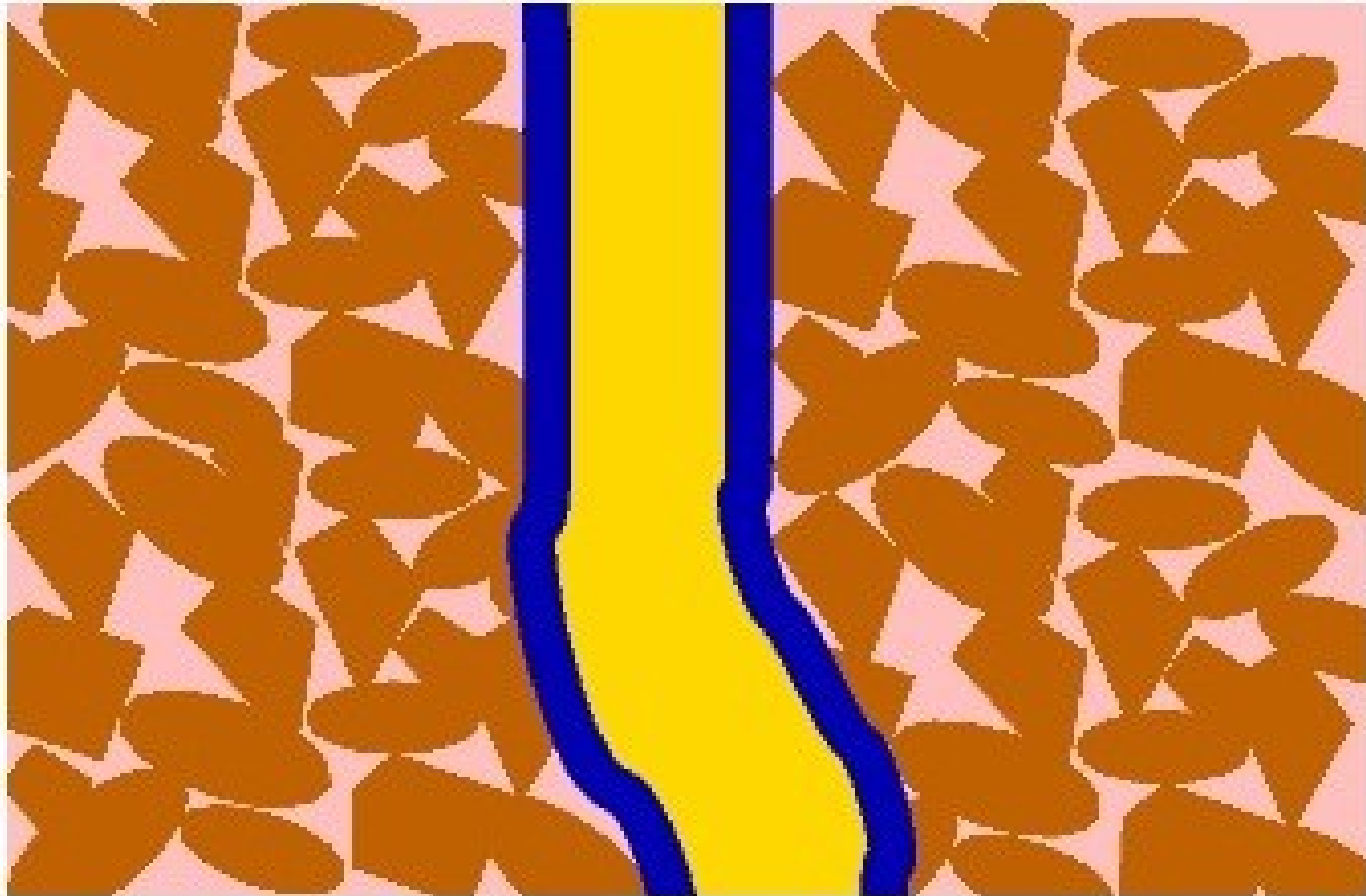
Vetiver Hedgerow



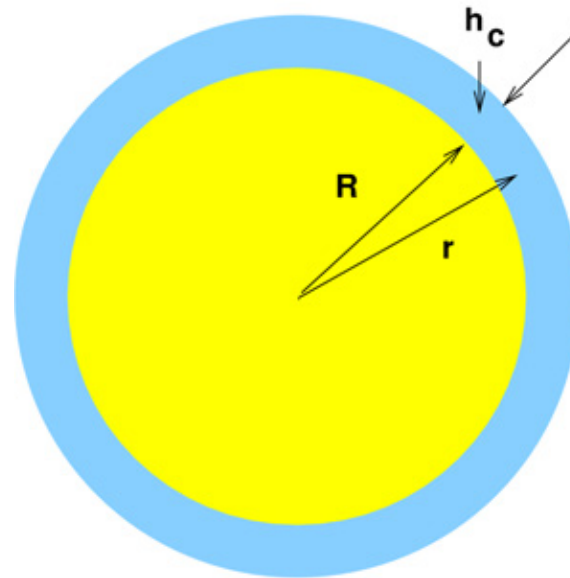
Film Flow in Macropores



Film Flow on Roots



Root Film



GWR by Vetiver Hedgerow- Netlogo



avet26 - NetLogo {/home/vinod/amodelingGWR}

File Edit Tools Zoom Tabs Help

Interface Information Procedures

Edit Delete Add abc Button normal speed view updates continuous Settings...

setup go go-once cleanSlate ticks: 2995 3D

vetiverpm 80 /m tickTime 4 secs Time 10
 simulateDurati... 10 mins sl... 2.86 degrees
 hinterland 100 m On surfaceRun
 rainfallInte... 15 cm/hour On debug

600000 Lv

water level
 water level (mm) vs time (mins) 0 to 12.6
 hedge- hedge+ hedge

diffusive and film flow
 flux (mm/min) vs time (mins) 0 to 12.6
 diffuse film

water at vetiver
 water level vs around vetiver 0 to 60
 waterstep ground vetiver deadLevel

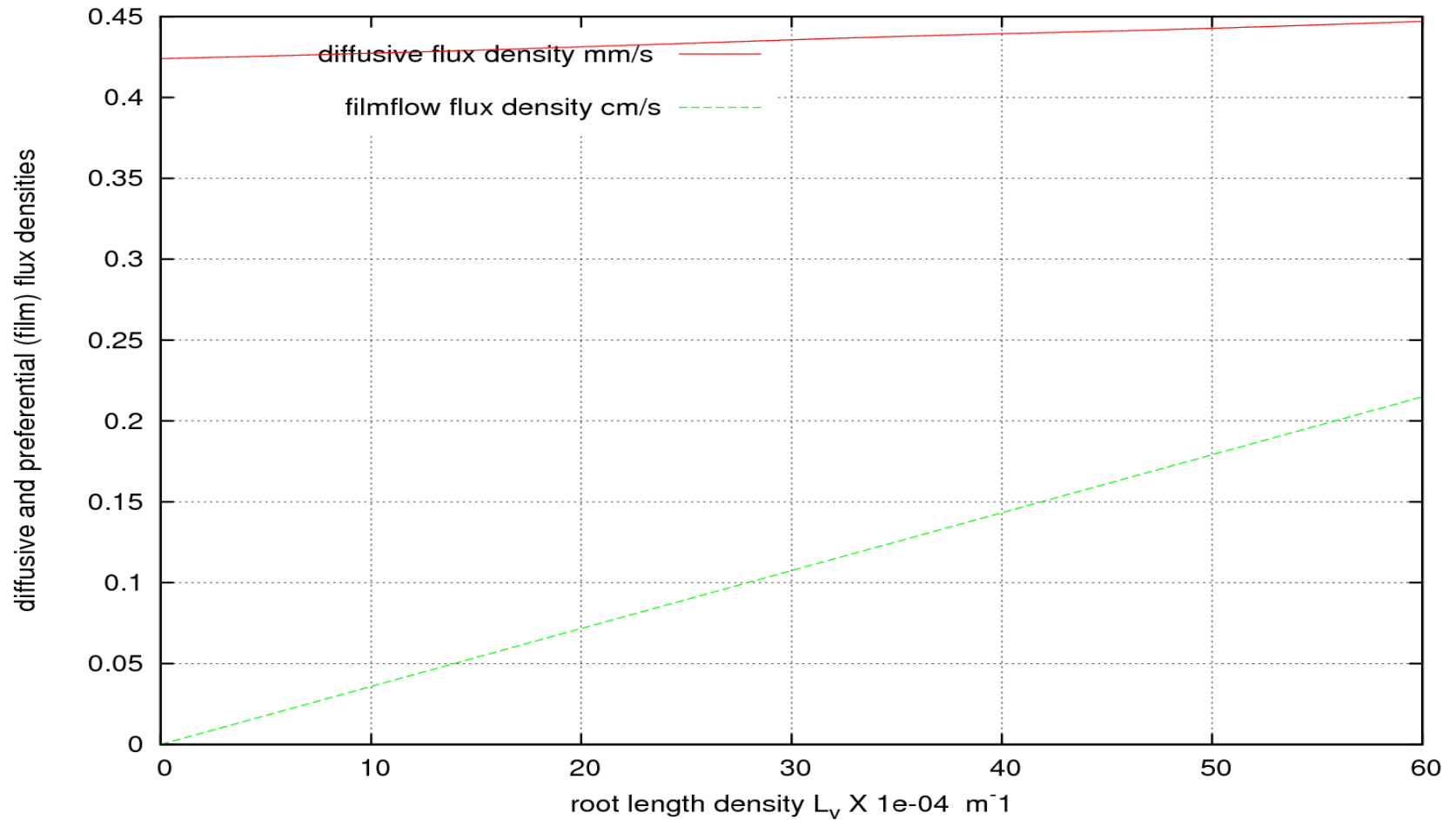
thetaDifus vs depth
 depth cm vs moisture content 0 to 0.5

water diffused filmed
 water (cm * cm) vs time (mins) 0 to 12.6
 diffus film

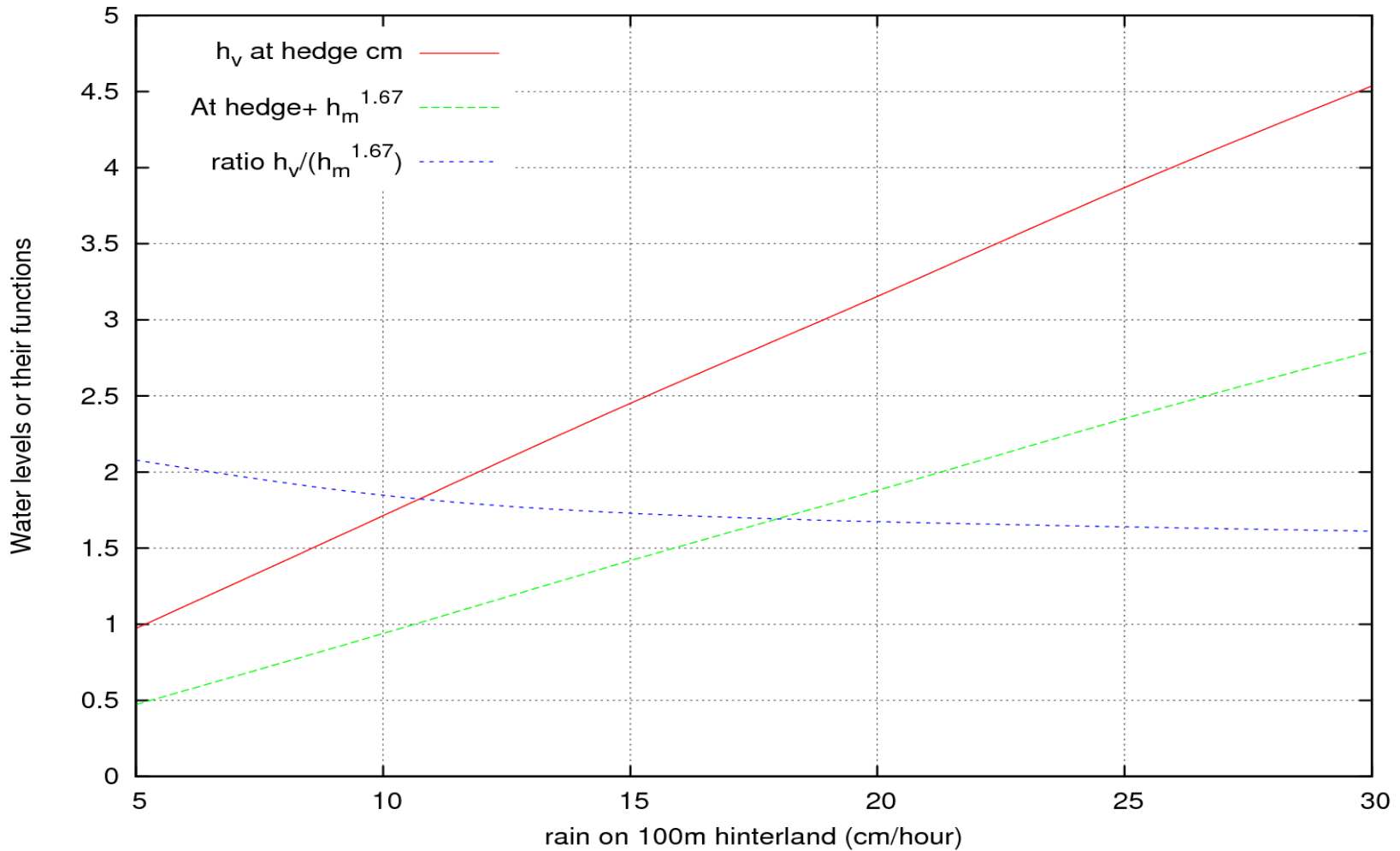
Moisture stores
 water (cm * cm) vs time (mins) 0 to 12.6
 surface soil root

Total water flowed
 Component % vs time (mins) 0 to 12.6
 rainIn surfaceOut diffuseln filmIn

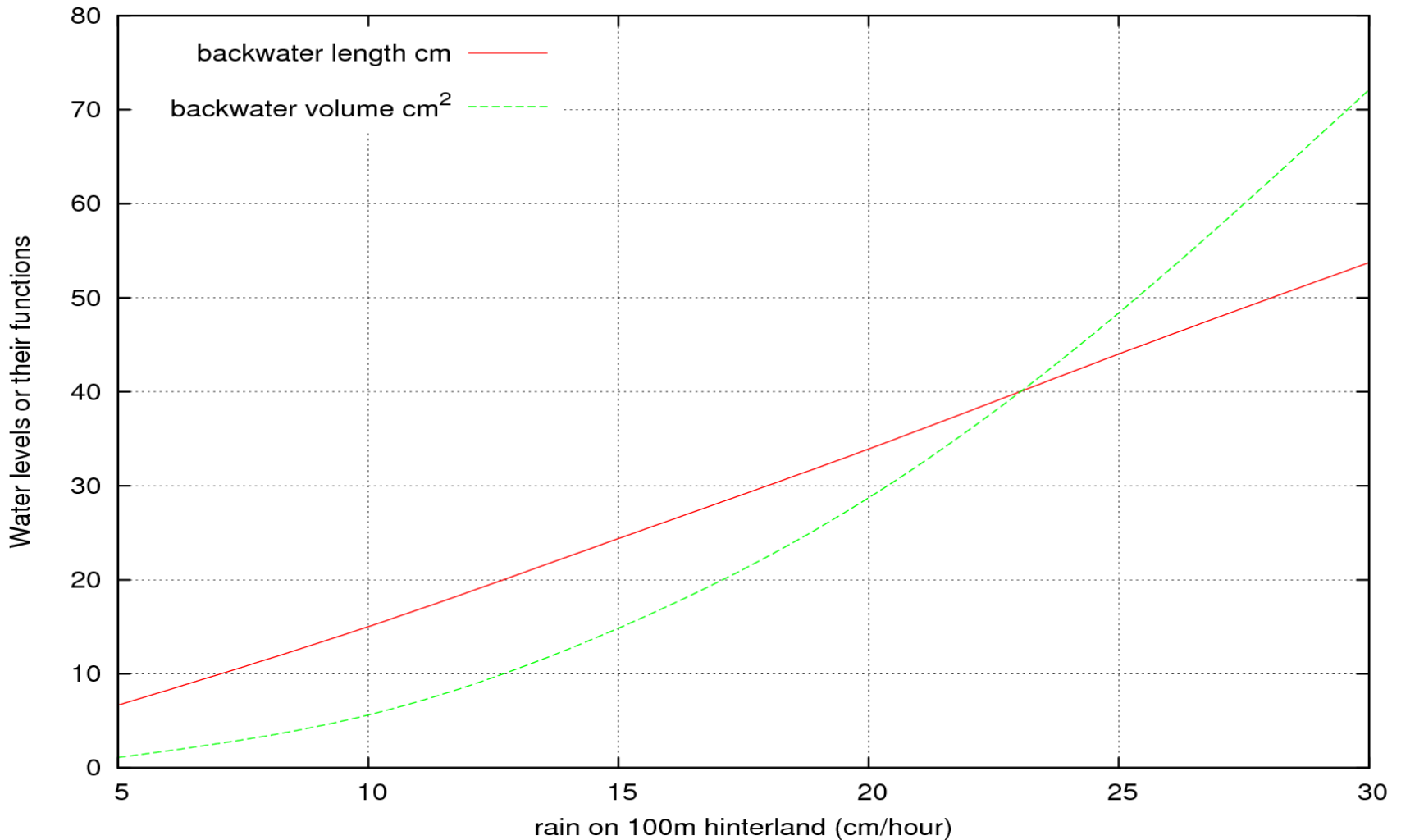
Diffusive and Preferential Flow Flux Densities



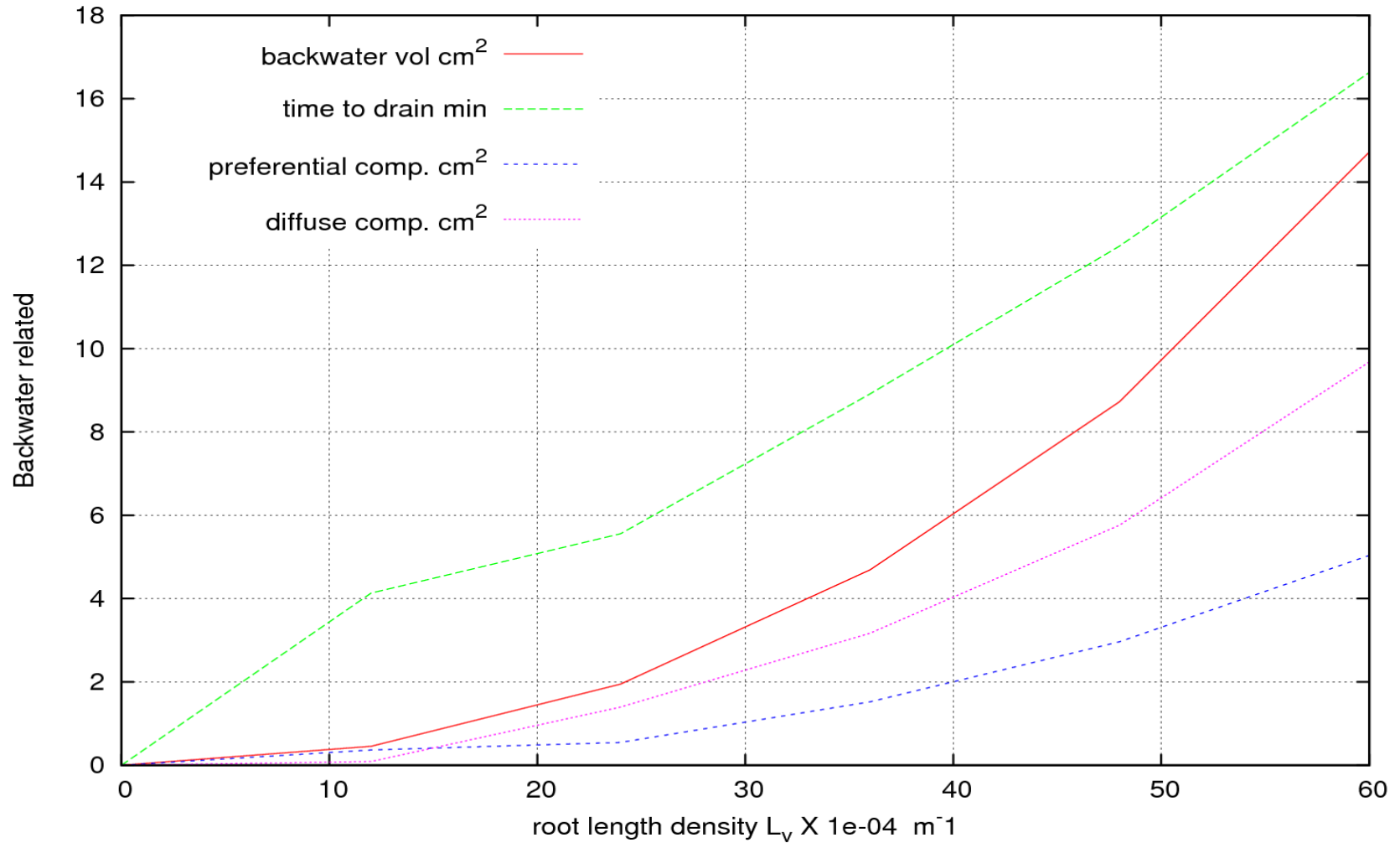
Water Levels at Hedgerow and far away



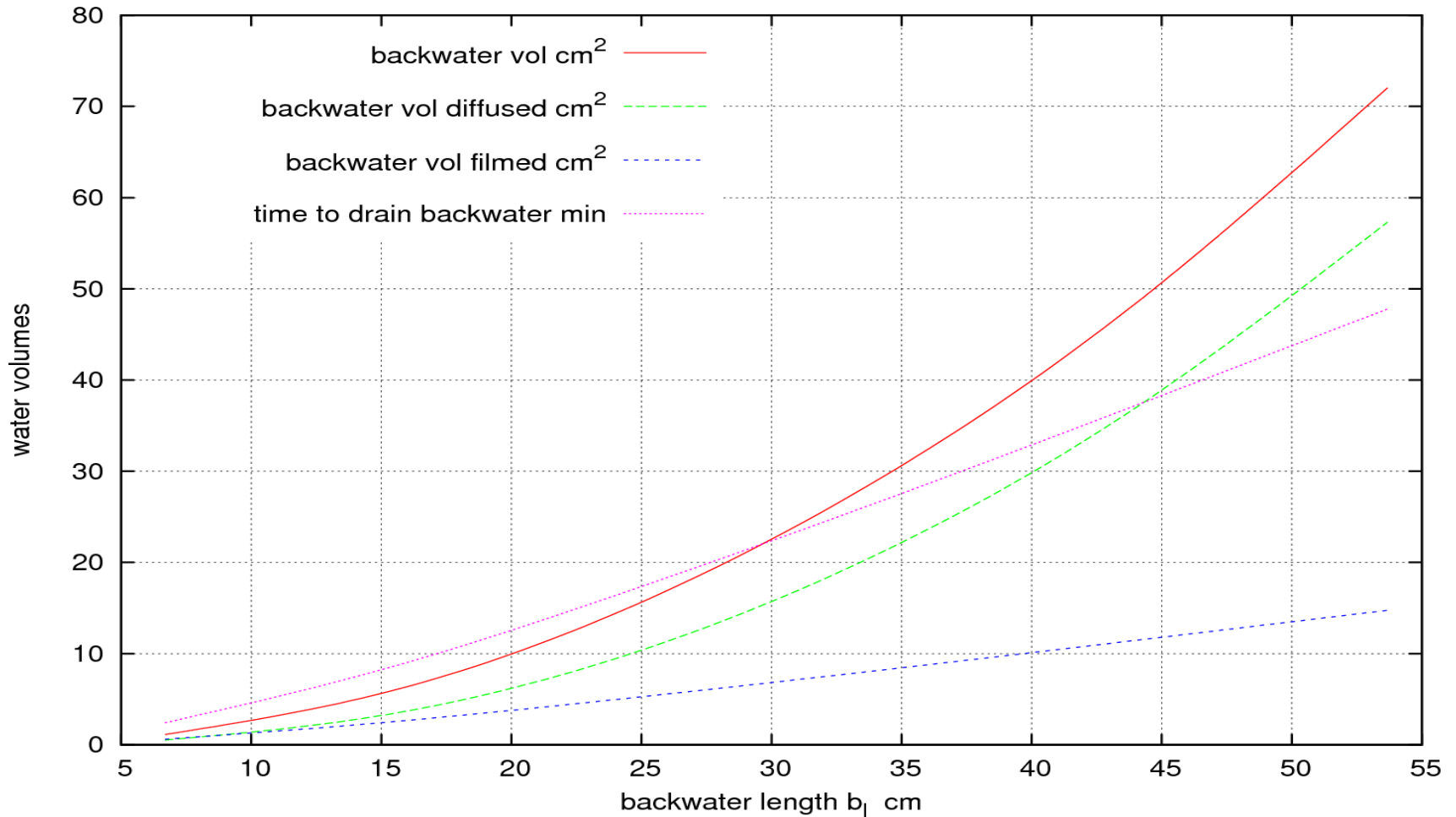
Backwater length and volume



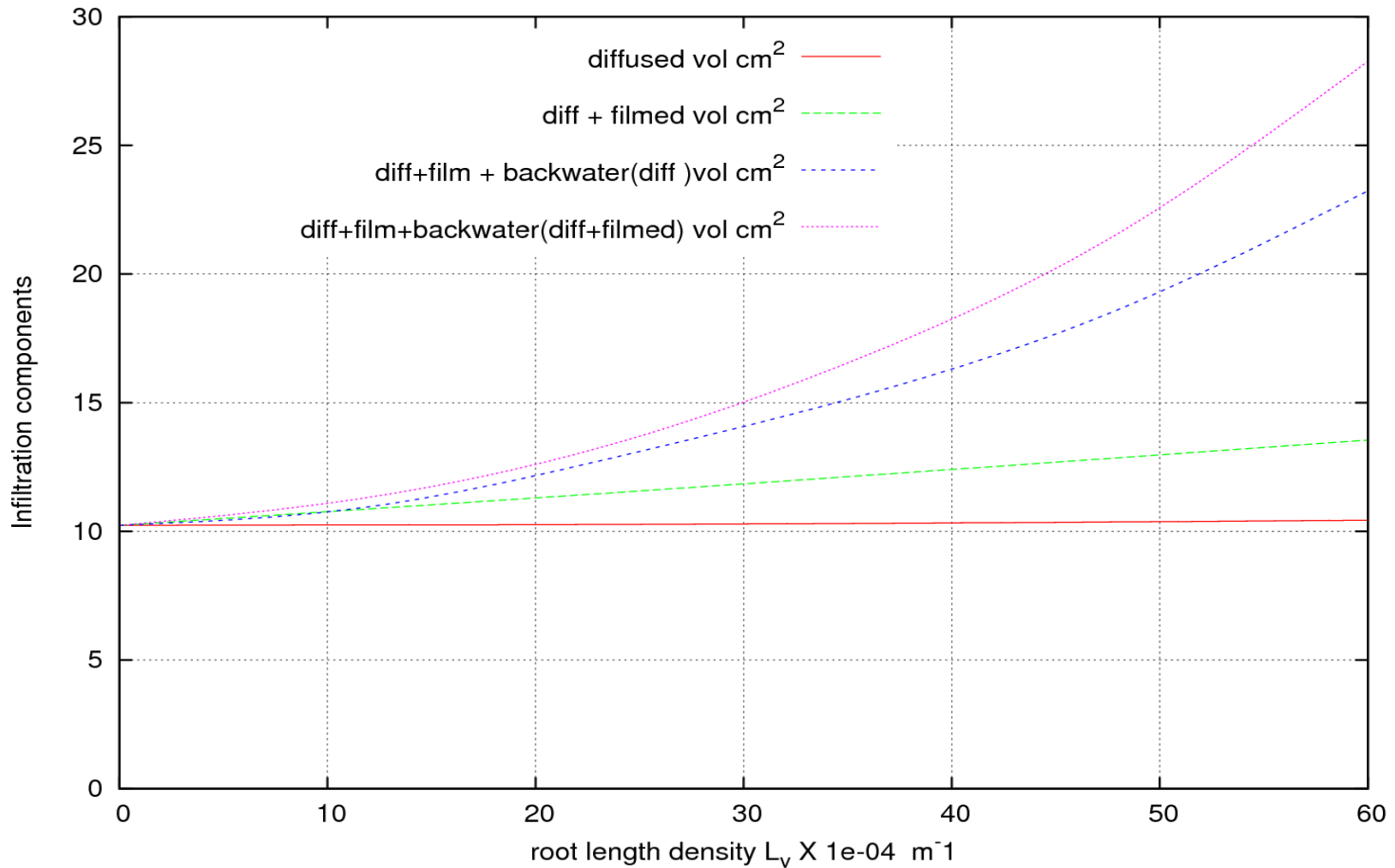
Backwater -Time to Drain and contributions by diffusion and film flow



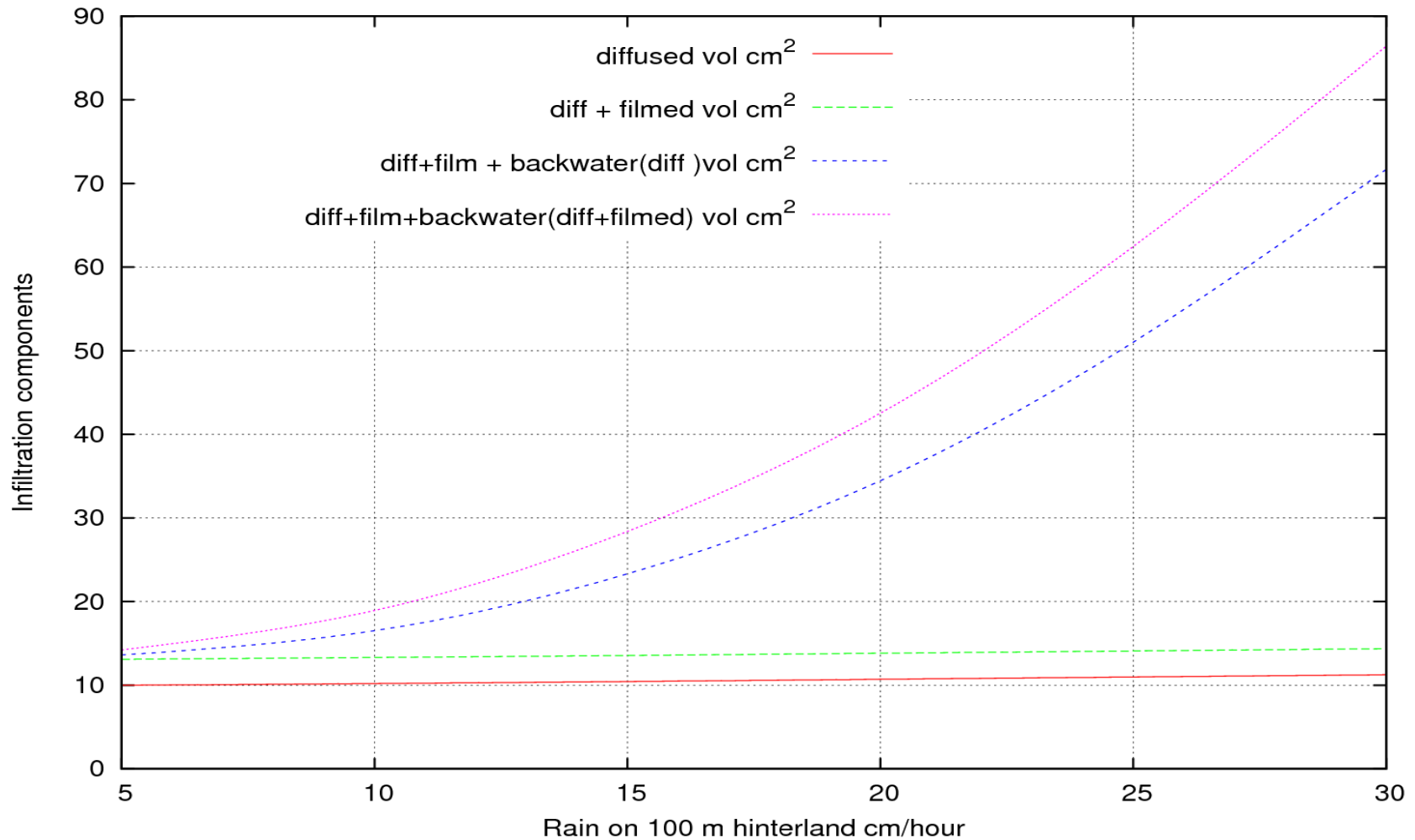
Backwater - Time to Drain and contributions by diffusion and film flow



Who contributes how much? As vetiver becomes denser.



Who contributes how much? As Rain increases.



Conclusions.



Preferential flow has 5 time capacity to increase infiltration

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Backwater volume and absorption are important when there is sufficient lull
In rain.

Thickness of hedgerow increases preferential infiltration proportionally.

Distance between hedgerows = 5 times hedgerow width

Infiltration ponds to be populated with vetiver