

# **Efficacy of vegetated buffers for reducing waterborne pathogens**



**Rob Atwill, Ken Tate, Thomas Harter  
University of California, Davis**

**David Lewis, Neil McDougald, et al.-UC Cooperative Extension  
Maria Pereira, Lingling Hou, Betsy Haung, et al.-suffering staff**

# Reducing waterborne pathogen risks from livestock and wildlife on rangeland

---

## PROCESS

- ◆ *pathogen loading*
- ◆ *pathogen transport overland and subsurface*
- ◆ *pathogen survival & replication*

## GOAL FOR BMP

*prevalence,  
intensity,  
animal density*

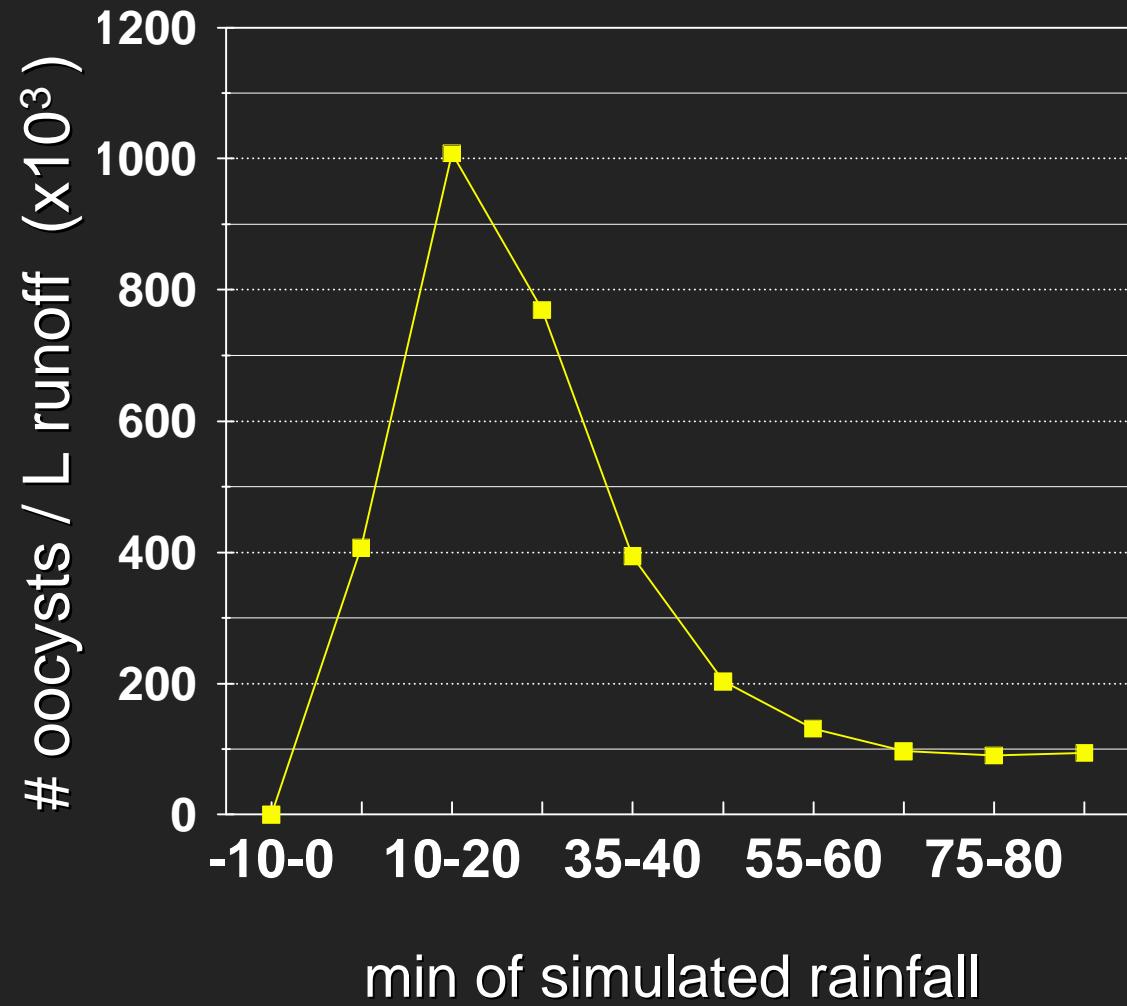
*enhance infiltration,  
attachment + straining,  
enhance retention*

*enhance rate of  
inactivation or  
predation*

## How far back to place a Fence

- ◆ Maximum pathogen load per Kg feces for key hosts
- ◆ Distance between fecal load and water
- ◆ Rate of inactivation
- ◆ Efficacy of VBS filtration as a function of buffer width, slope, RDM, ppt, bulk density, etc.
- ◆ Behavior of overland, subsurface, inter- and return flow

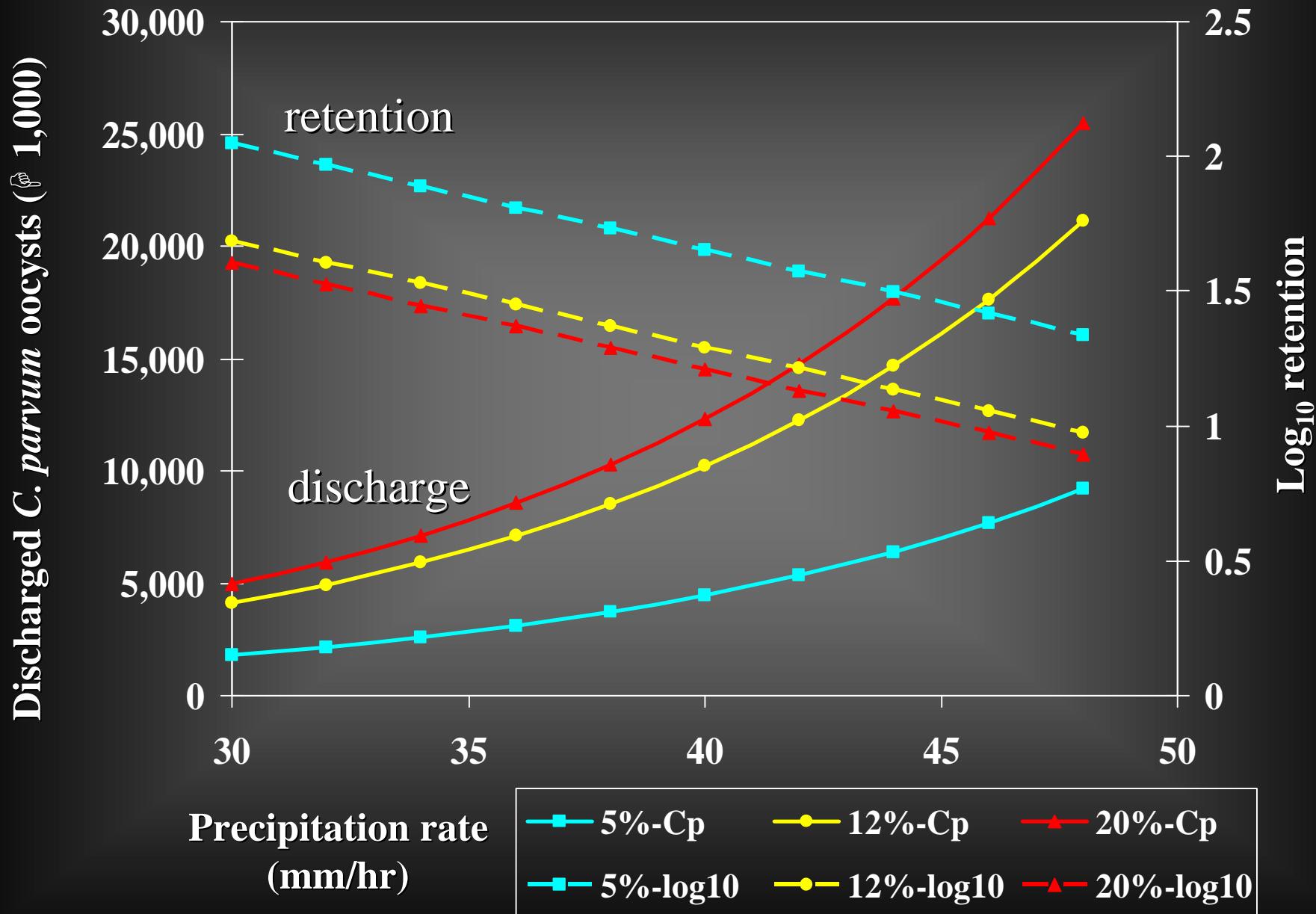
# *Cryptosporidium parvum* oocyst transport out of feces



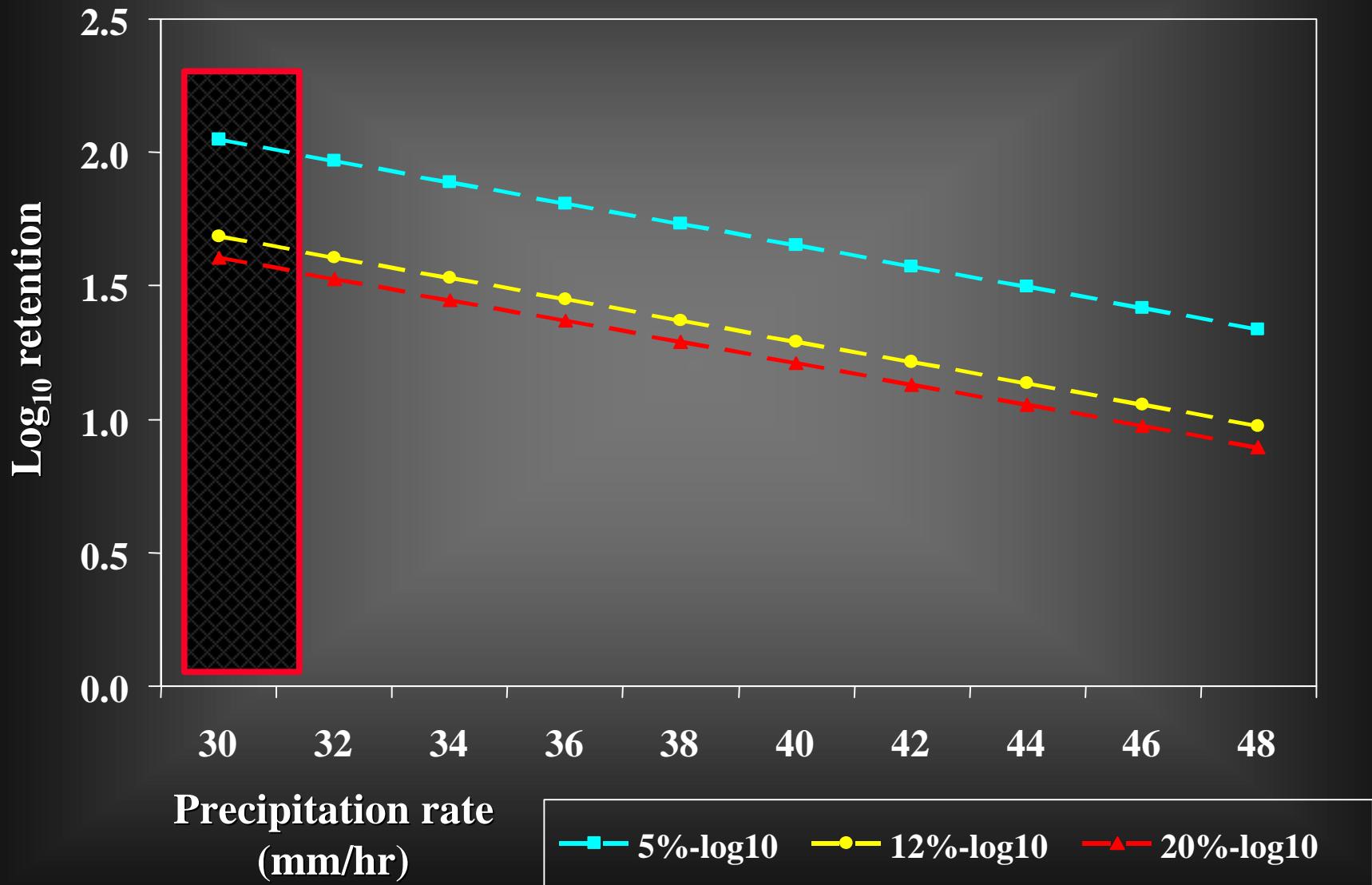
*J. Range. Manage.* 2000, 53:295-299



Load  $200 \times 10^6$  oocysts



Rainfall intensities >30 mm/hr for a 2-hr duration  
have a >25 year return interval for this region







# Predicted $\log_{10}$ reductions per meter VBS

Soil	Slope (%)	Bulk density (g/cm <sup>3</sup> )			
		0.7	1.0	1.3	1.7
capay silty clay	5	<b>2.2</b>	<b>2.0</b>	<b>1.8</b>	--
	10	<b>3.1</b>	<b>2.5</b>	<b>1.9</b>	--
	20	<b>2.7</b>	<b>2.4</b>	<b>2.1</b>	--
argonaut loam	5	--	<b>2.4</b>	<b>1.8</b>	--
	10	--	<b>2.9</b>	<b>1.9</b>	--
	20	--	<b>2.8</b>	<b>2.1</b>	--
hanford fine sandy loam	5	--	--	<b>1.7</b>	<b>1.4</b>
	10	--	--	<b>1.7</b>	<b>1.0</b>
	20	--	--	<b>1.9</b>	<b>1.4</b>

**Back to the field!**

**Sierra Foothill  
Research &  
Extension Center,  
University of California**

**Buffer width (m)**  
**0.1, 1.1, 2.1**

**Land slope (%)**  
**5, 20, 35**

**RDM (kg/ha)**  
**225, 560, 900, 4500**

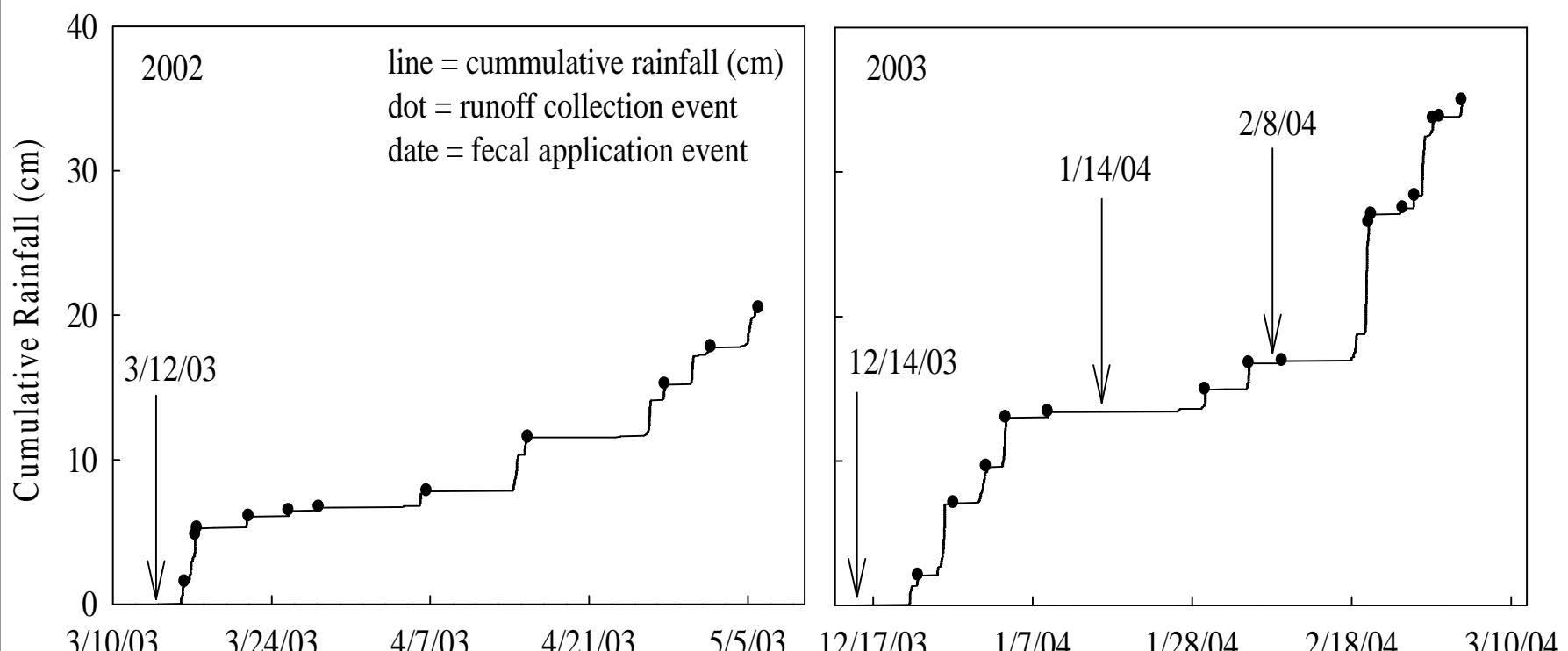
**2 rainfall seasons**





# 2002

# 2003

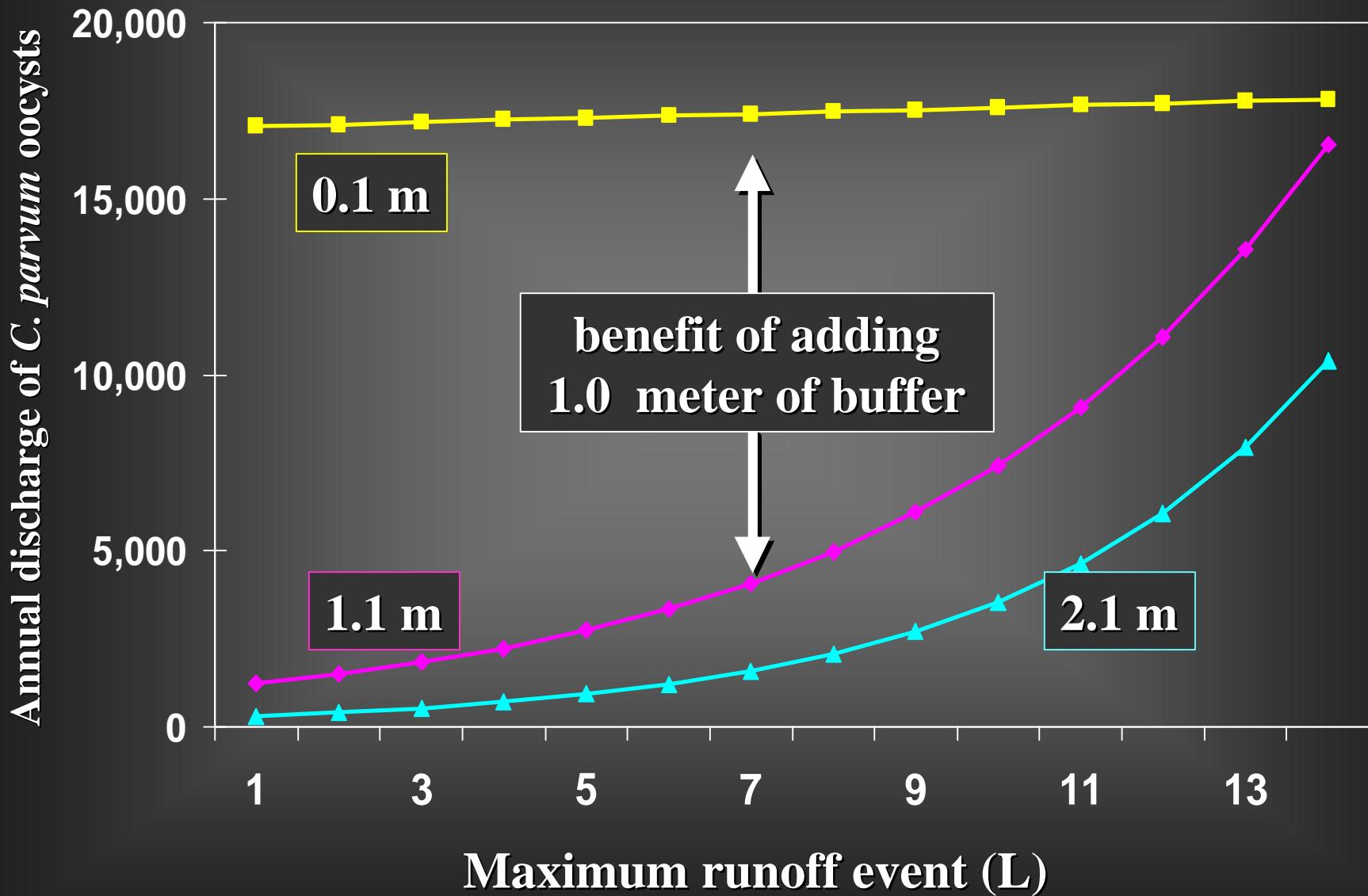


**2 💧  $10^8$  oocysts**

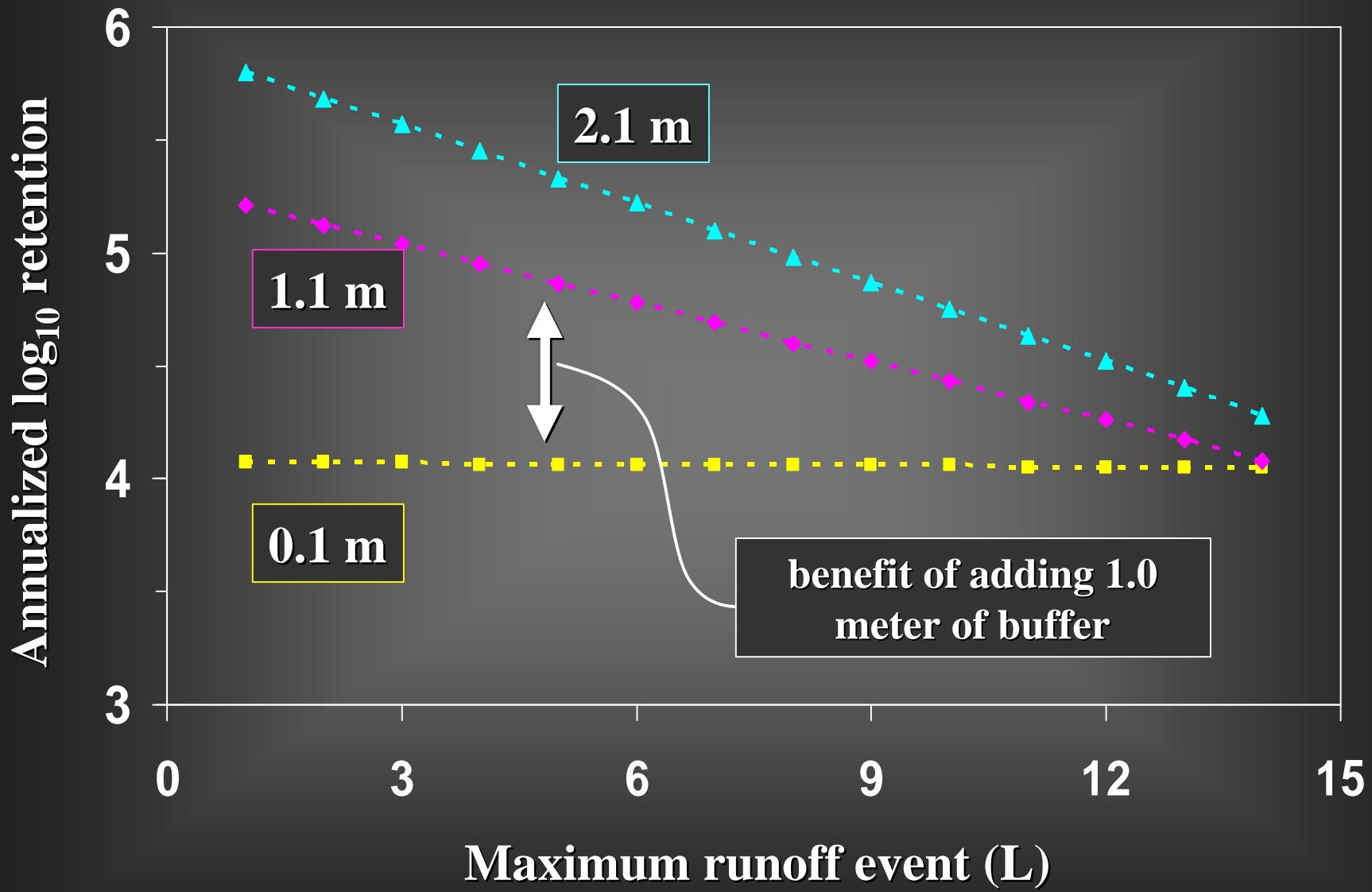
**6 💧  $10^8$  oocysts**

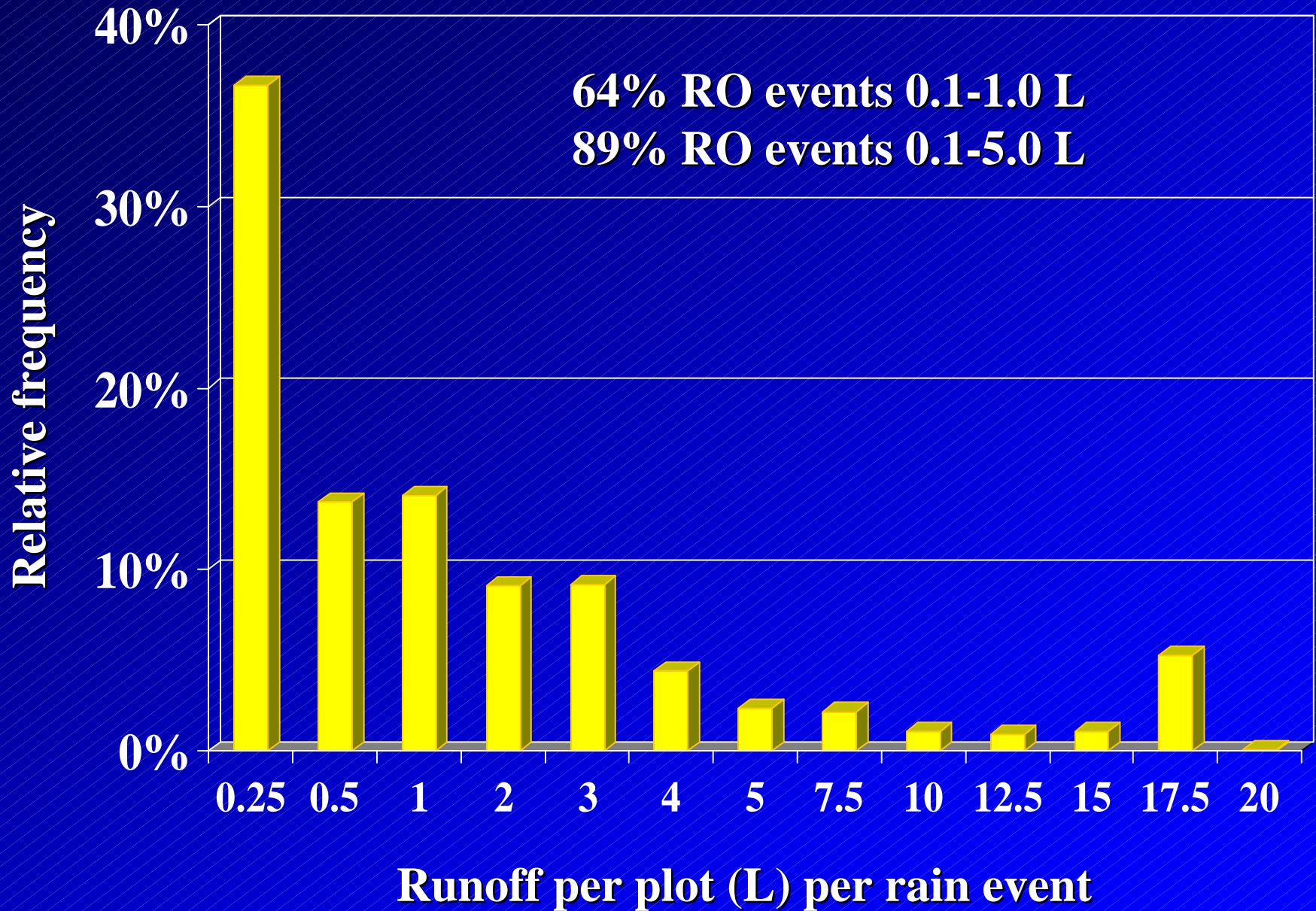
**About a quarter to half a billion oocysts**

# Retention of *C. parvum* oocysts by natural grassland buffers 5% land slope

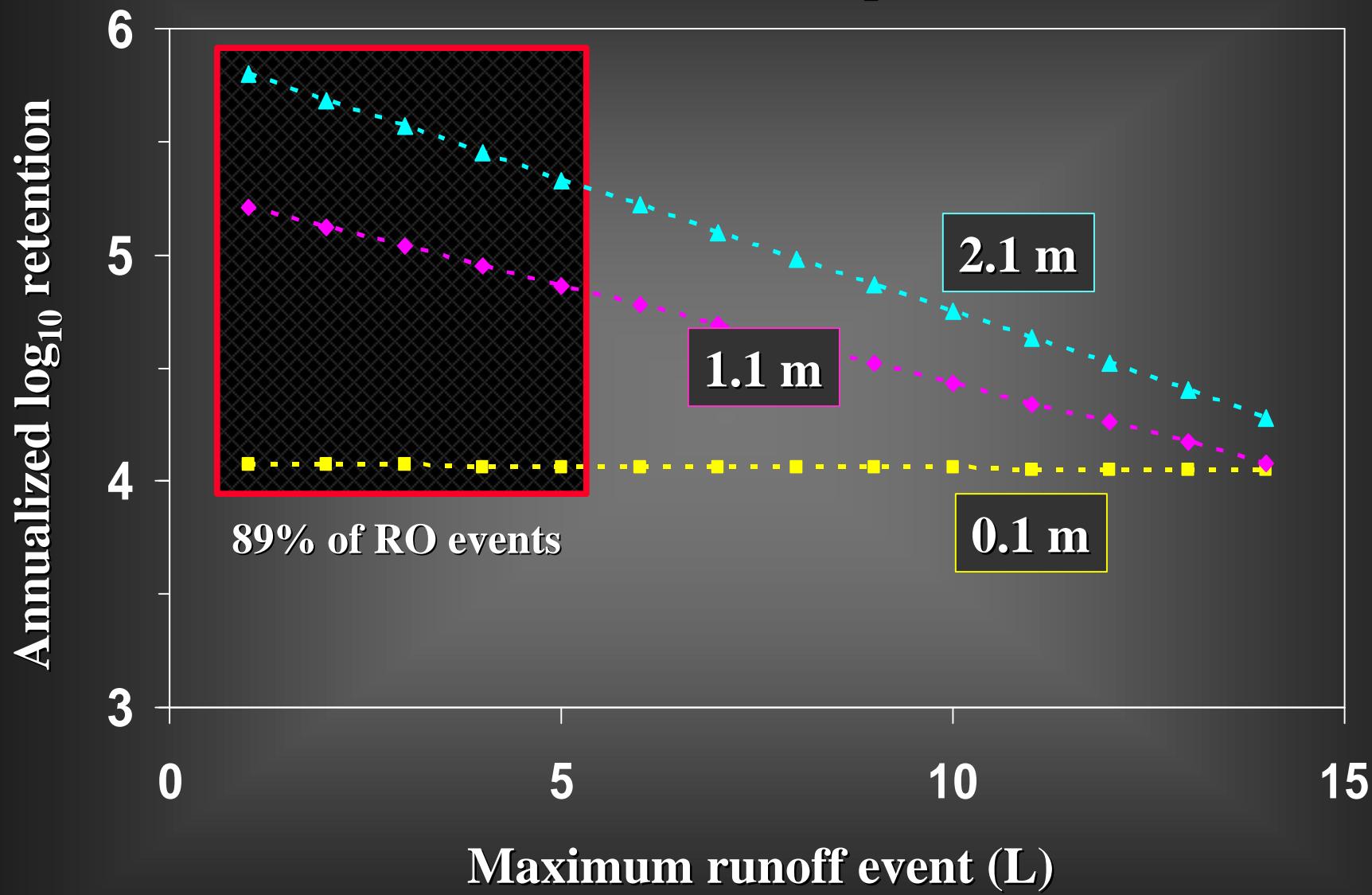


# Retention of *C. parvum* oocysts by natural grassland buffers 5% land slope

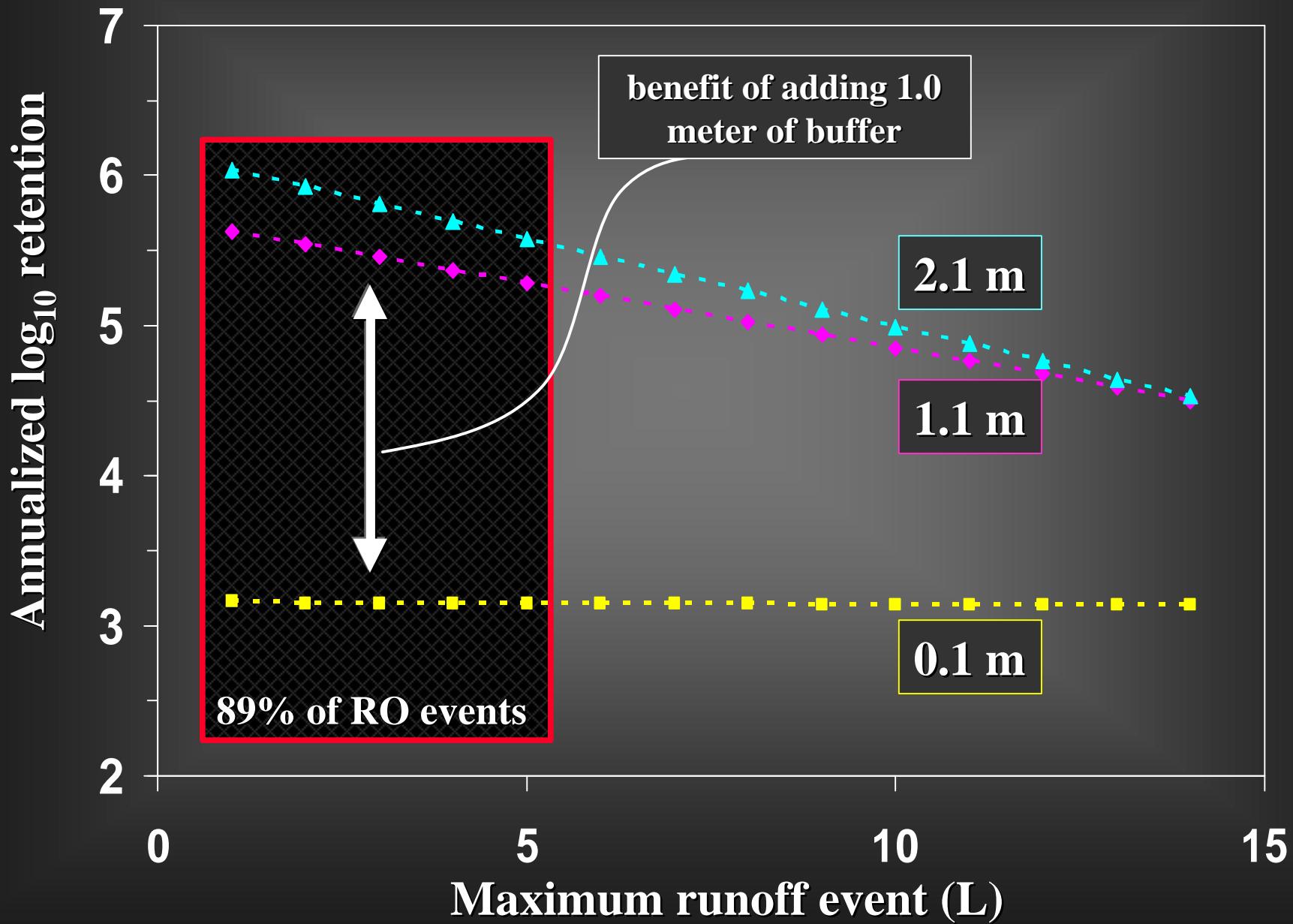




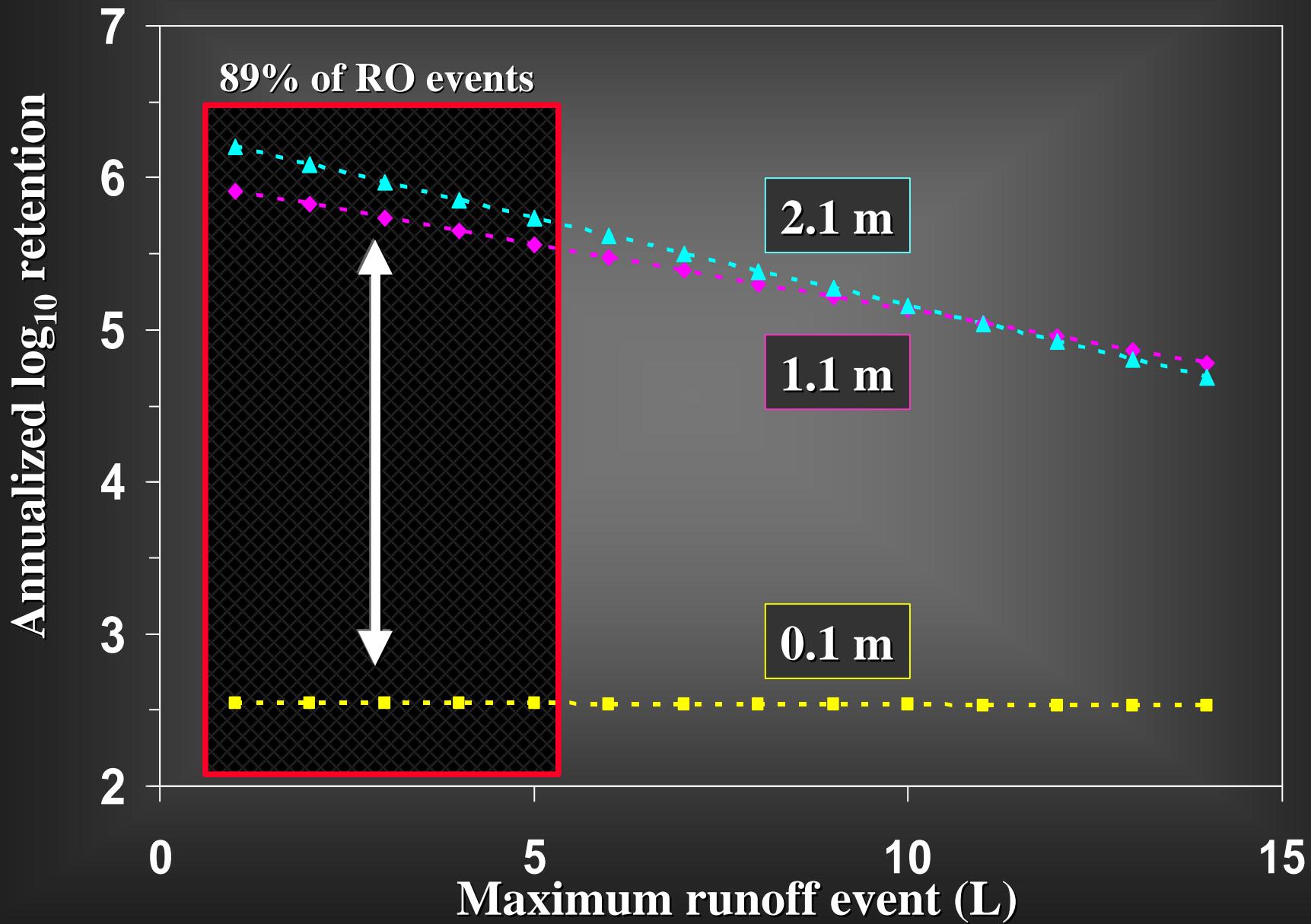
# Retention of *C. parvum* oocysts by natural grassland buffers 5% land slope



# Retention of *C. parvum* oocysts by natural grassland buffers 20% land slope



# Retention of *C. parvum* oocysts by natural grassland buffers 30% land slope



**A microbe's journey from land to water is subject to numerous attenuating and inactivating processes**

