

# Regenerative Stormwater Conveyance as an Integrated Approach to Stormwater Planning

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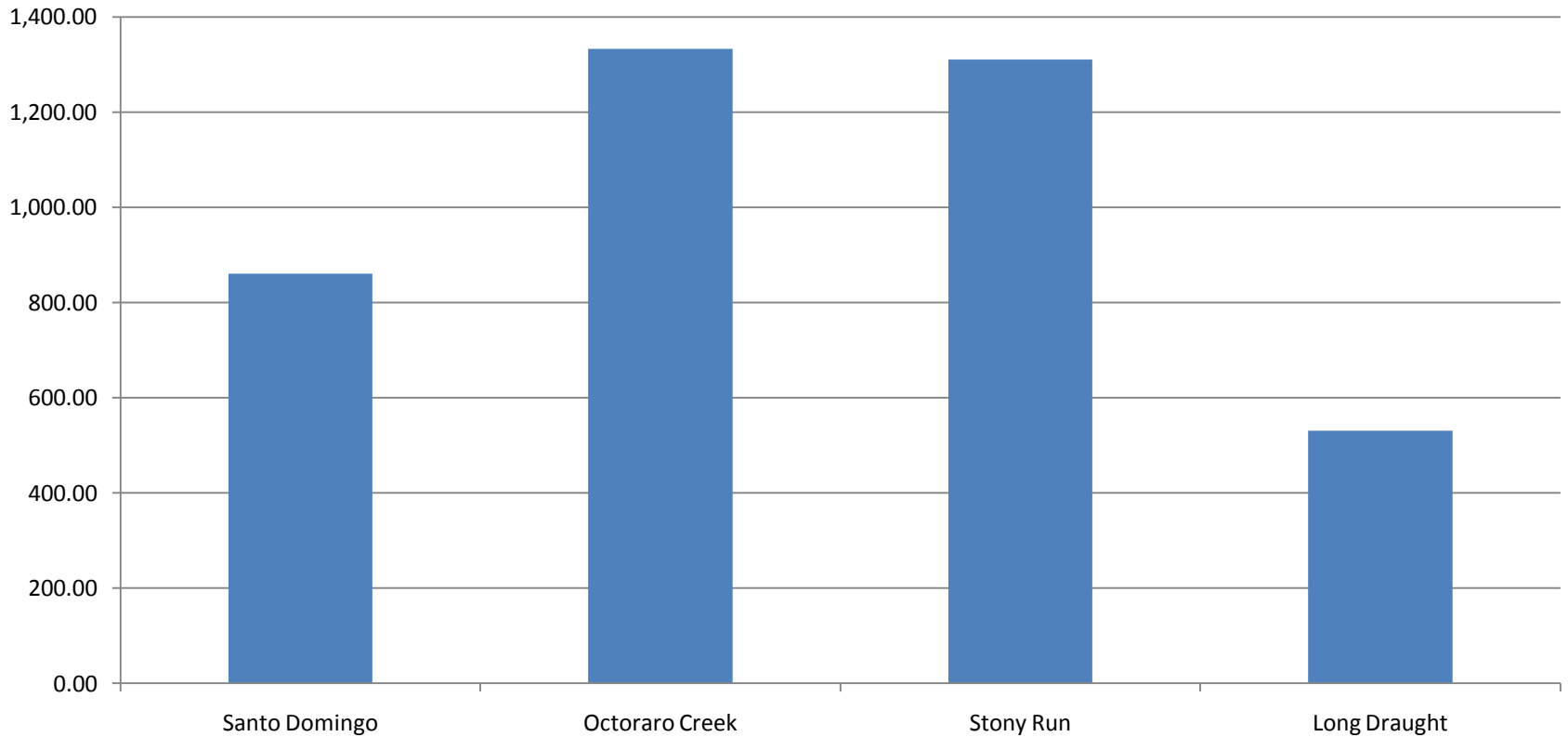




# Sediment Supply

## Channel Adjustment to Stormwater Flow

Pounds sediment/ft/yr





# Baseflow Channel Design





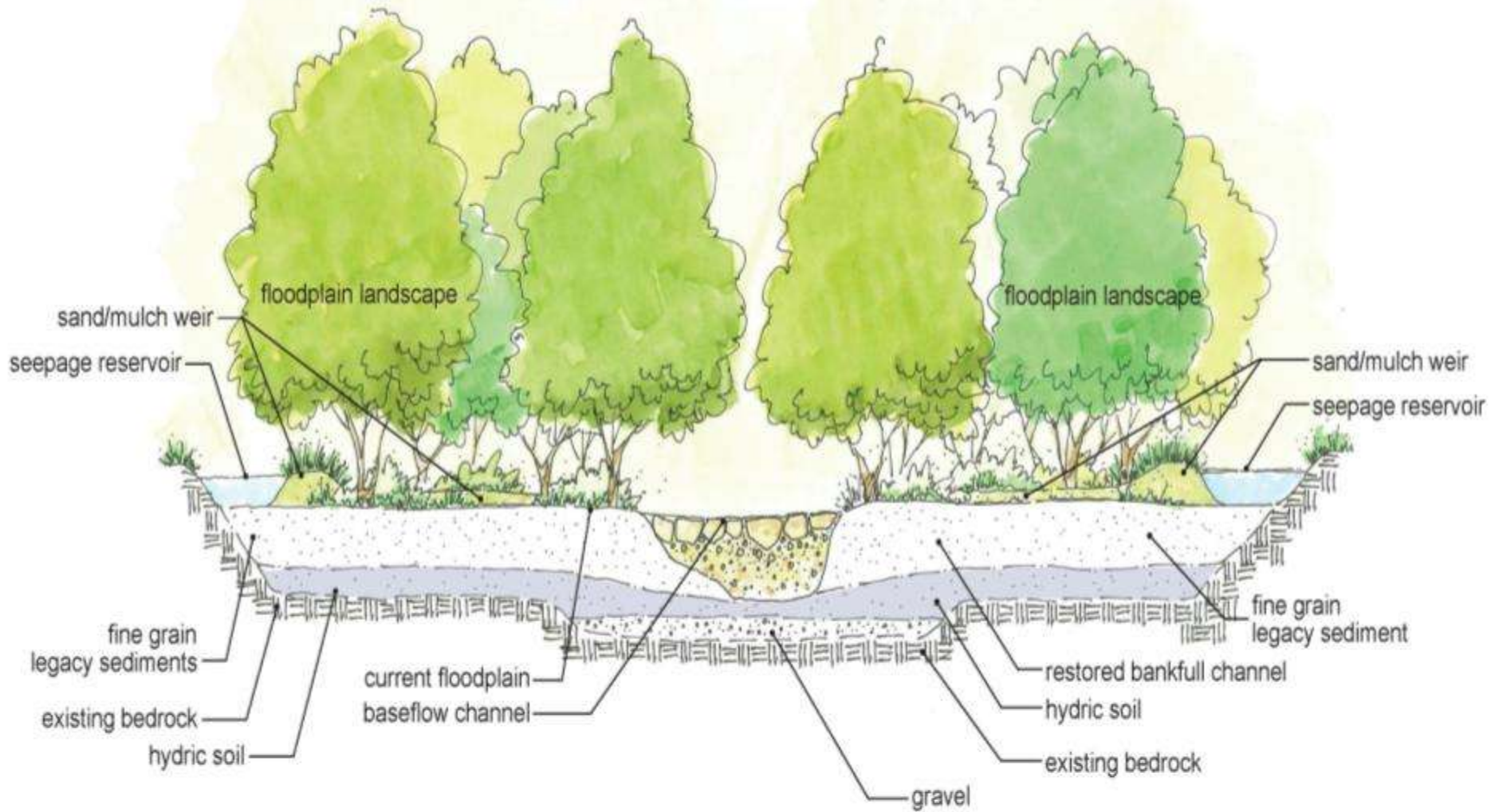
# Bankfull Channel Design

- ▶ Safe conveyance of surface water
- ▶ **Maintain sediment transport** through bankfull channel (sediment in, sediment out) without erosion or deposition
- ▶ **Floodplain access for flows greater than ~1.5 yr storm return interval**
- ▶ Presents opportunity for riparian habitat
- ▶ **Potential** to increase groundwater storage
- ▶ Presents opportunity for increased wetland distribution

# Baseflow Channel Design

- ▶ Safe conveyance of surface water
- ▶ **Interrupt sediment transport** in baseflow channel by reconnection floodplain as depositional feature
- ▶ **Frequent floodplain access by storms generating any stage increase**
- ▶ Maximizes riparian habitat
- ▶ **Always maximizes groundwater storage**
- ▶ Maximizes wetland distribution





**OPTION 3**  
 regenerative approach  
**cross section**

n.t.s.  
 01.28.2009



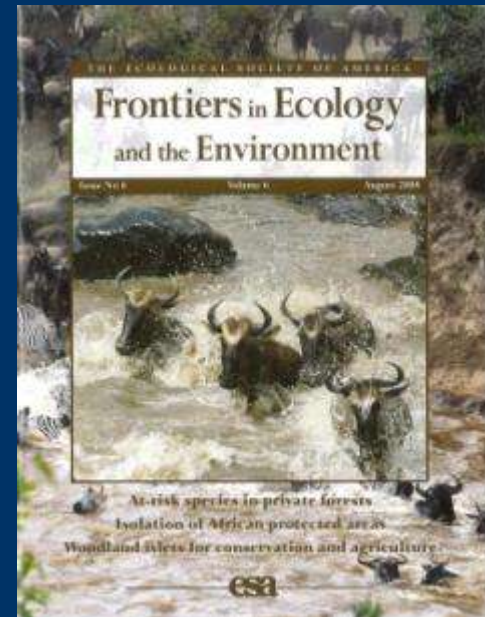


These systems are designed to mimic beaver dams



# Other Support for this Approach

- ▶ Convergent research on streams at Franklin and Marshall and University of Maryland
  - Walter and Merritts (2008) in *Science* (319) support idea that pre-colonial streams in eastern North America were small shallow flow paths frequently connected to their wetland floodplain, not bankfull channels containing range of flows moving coarse sediment (current form result of adjustment to recent land use)
  - Craig et al. (2008) in *Frontiers in Ecology* (6) document that close connection between the stream and floodplain, carbon-rich sediment, and an aggradational/depositional character contribute to effective nitrogen processing







In our study sites, for instance, the same storm event produced a peak discharge of  $276 \text{ L s}^{-1}$  for Howard's Branch, and  $1,480 \text{ L s}^{-1}$  for its corresponding control catchment (CONTROL-2) positioned near the tidal boundary (Fig. 5) despite the fact that the two catchments were equivalent in size. In addition, the recession limb of the hydrograph lasted for more than 12 hours at HBR and only half an hour at the corresponding control stream (CONTROL-2).

Source: Palmer and Filoso, 2009



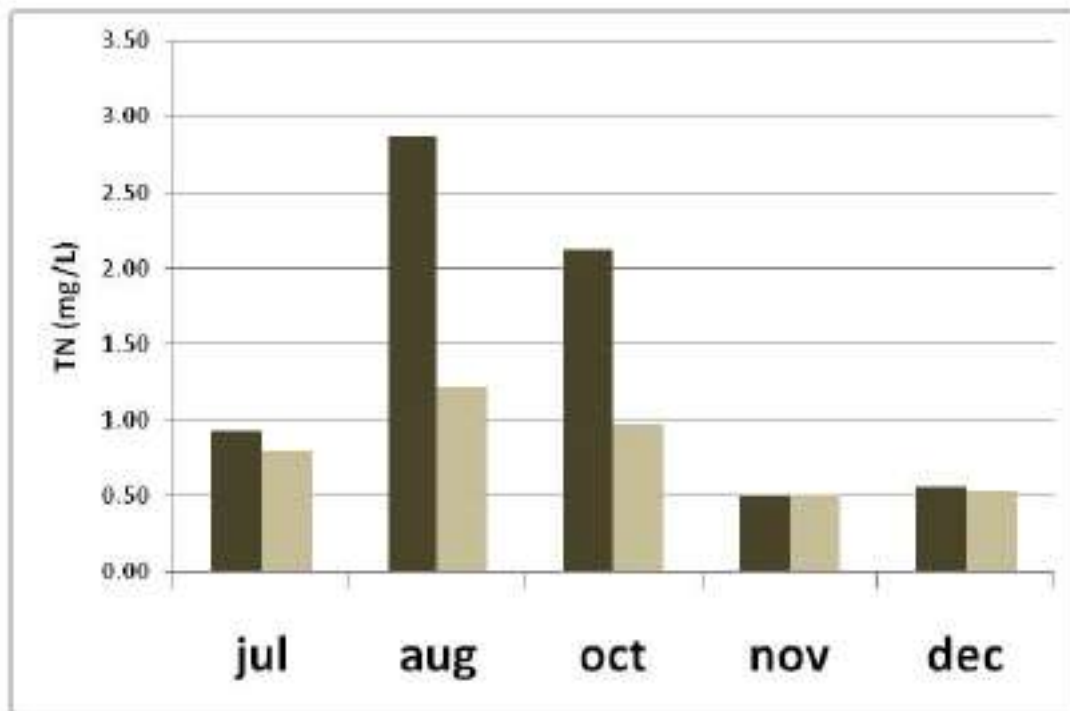


Figure 17. Discharge-weighted mean concentrations of TN in stormflow samples collected during different storms at Howard's Branch. The dark bars represent concentrations upstream of the restored reach and the light bars represent concentrations downstream.

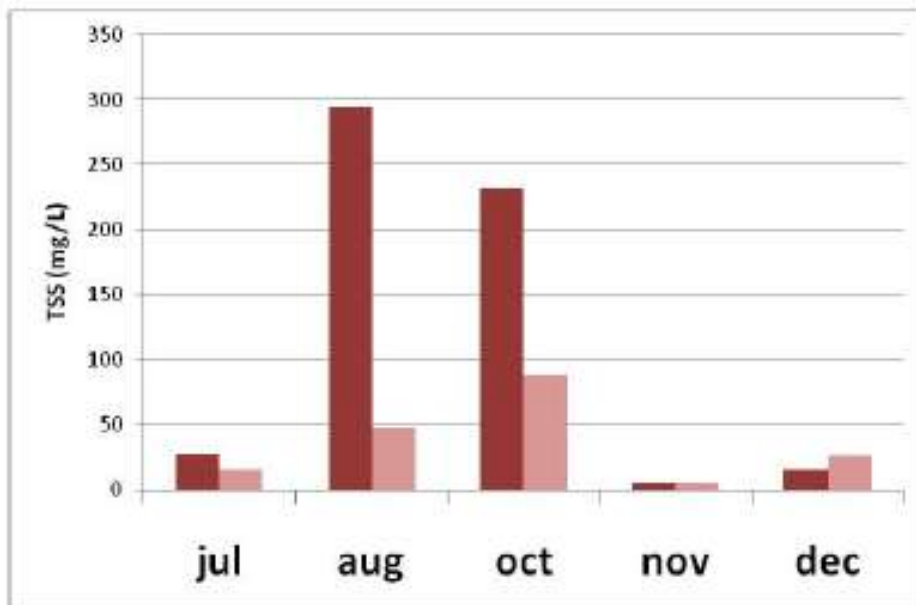


Figure 19. Discharge-weighted mean concentrations of TSS in stormflow samples collected during different storms at Howard's Branch. The dark bars represent concentrations upstream of the restored reach and the light bars represent concentrations downstream.



### Howard's Branch

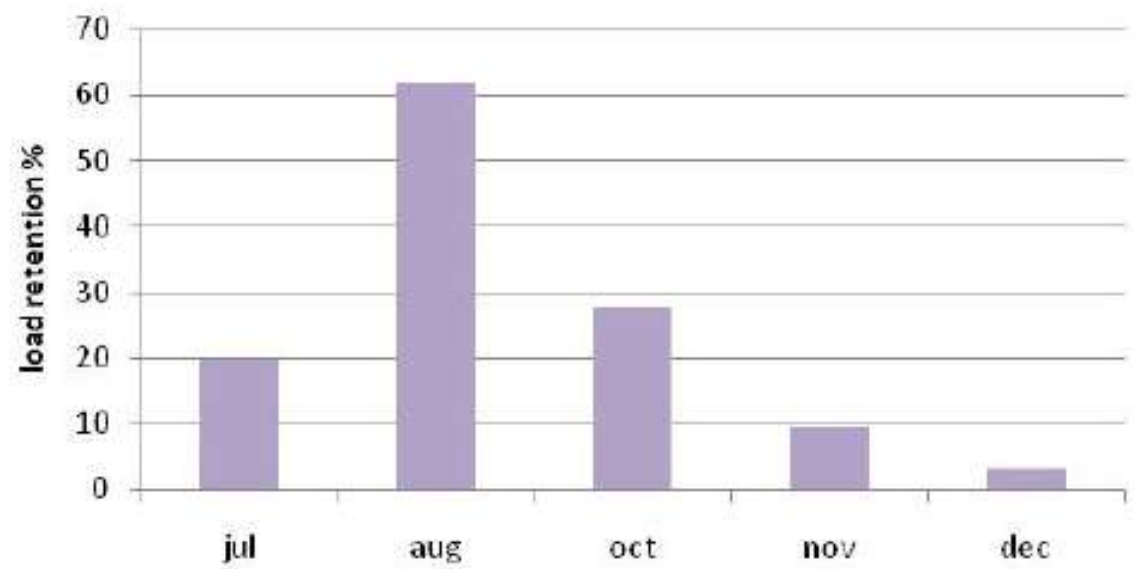


Figure 32. Percent load reduction of TN in the restored reach of Howard's Branch during five different storm events.

### Howard's Branch

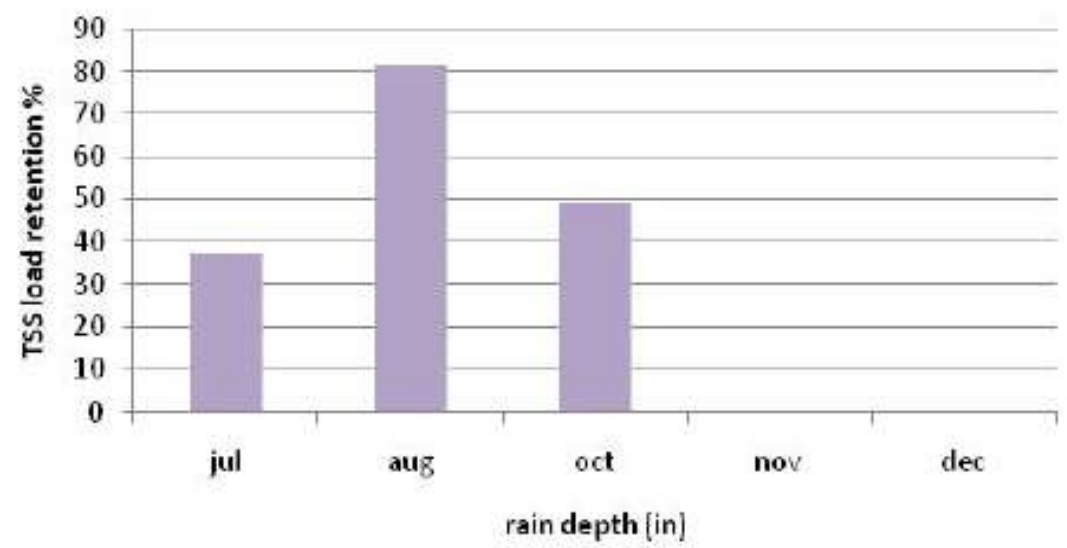


Figure 34. Percent load reduction of TSS in the restored reach of Howard's Branch during five different storm events.



# Regenerative Stormwater Conveyance











Sand seepage bed









**Holladay Park and Jabez Branch**



Mar 10, 2004



Maple Rd

Holladay St

175

32

Charles Hall Dr

Patuxent Fwy

3

Whisper Dr

Robert Crain Hwy

Millersville

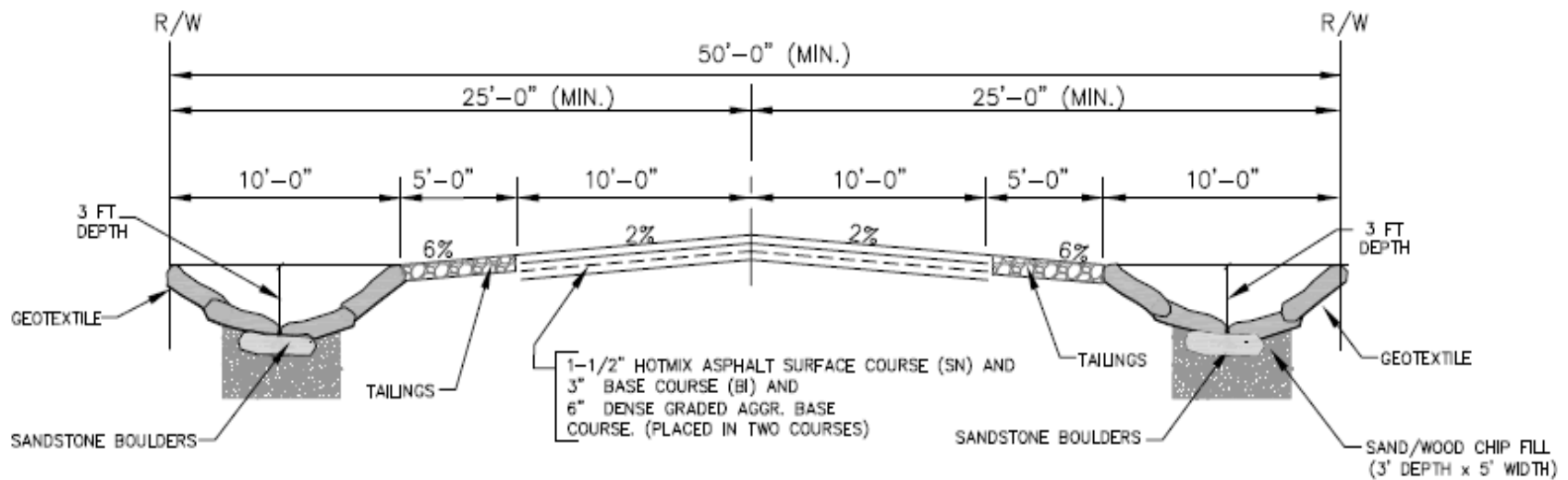
Cecil Ave

Hog F

Mill Ln



# ROAD / REGENERATIVE STORMWATER CONVEYANCE BOULDER PORTION OF WEIR CROSS SECTION

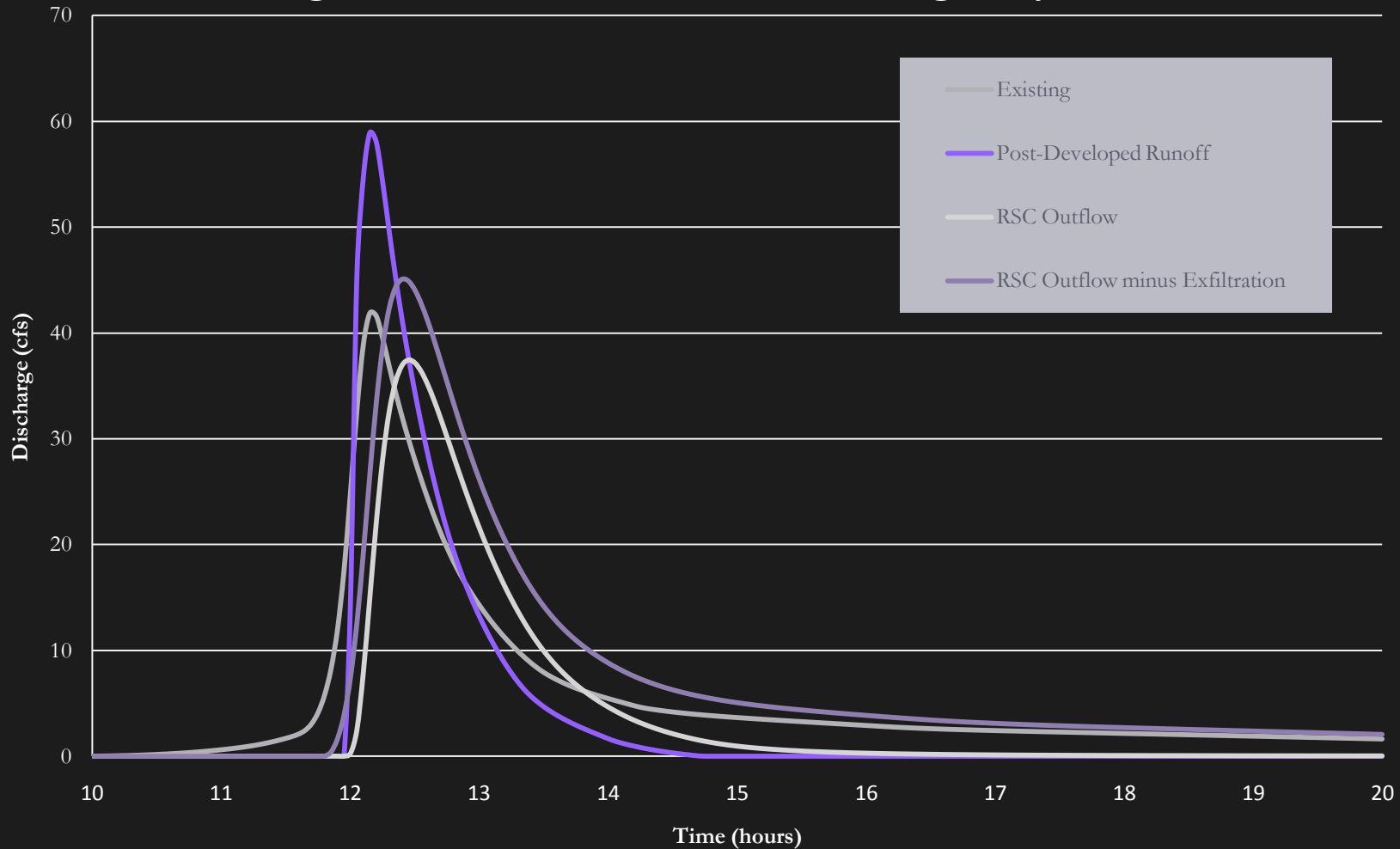








# Existing Runoff versus RSC Outflow during 100-year Event



Event	Existing	RSC Outflow	RSC Outflow Minus Exfiltration
	(cfs)	(cfs)	(cfs)
<b>1-yr</b>	0.57	0	0.35
<b>5-yr</b>	6.05	0.72	5.44
<b>10-yr</b>	11.11	5.82	10.94
<b>25-yr</b>	20.69	15.54	21.56
<b>100-yr</b>	42.14	37.44	45.14



## Holladay Park- Cost Comparison

### Phase 1-Original Design

Pipe	LF
15"	1453
18"	408
21"	48
24"	517
27"	470
30"	523
12" x14"	50
<b>Total LF</b>	<b>3469</b>

### Costs

SWM Pond	\$ 216,710.00
RCP	\$ 592,158.75
SWM Access Rd	\$ 8,900.00
Fences for SWM Pond	\$ 10,700.00
<b>Total</b>	<b>\$ 828,468.75</b>

Layout	\$44,934.00
Sediment Controls	\$21,971.00

### Current Costs

Grading/Excess	\$248,750.00
SWM Pond	\$80,131.00
Pipe	\$23,194.00
Risers/structures/headwalls	\$30,000.00
24" Pipe	\$8,420.00
Sandstone Weirs	\$14,360.00
<b>Total</b>	<b>\$404,855.00</b>



# CONCLUSIONS

- Encouraging approach to meet multiple stormwater management criteria
- Good approach for linear systems
- Stacked benefits that include:
  - groundwater recharge,
  - habitat creation,
  - water quality,
  - hydrologic modification, and
  - cost savings
- More monitoring data are needed



Questions?

